



Historic Preservation Tax Incentives Program

Technical Preservation Services
National Park Service

Evaluating Historic Windows for Repair or Replacement

Determinations concerning the treatment of historic windows begin 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."

Repair should be the first option considered. Repair can include renewal of finishes, material repair using epoxies, 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 practical or reasonable and replacement becomes the appropriate treatment.

The Standards also require, "The removal of historic materials or alterations of features and spaces that characterize a property shall be avoided." While 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 as described below are appropriate.

Documentation of deterioration

Determination as to when deterioration is sufficiently severe to justify replacement must be based on documentation of the condition of the windows. What constitutes effective documentation may vary with the circumstances of the project, but at minimum must include enough good quality photographs to clearly depict the full range of conditions. When a project involves a great many deteriorated windows, general quantification of the specific aspects of the deterioration may substitute for photographs and descriptions of every window. A full window survey should only be needed in limited instances.

Questions about the feasibility of repair or the quality of the repaired window can usually be best answered by doing a sample repair. The appearance, the cost of the repair, and other factors may be considered. Where particular performance levels are critical, testing of the repaired window may provide information useful in evaluating the viability of repair.

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 taken into account. 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 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 or are simple manufactured units. The more important the elevation, feature or space of which the windows are a part, the more important it is to retain the historic windows.

While factors including occupant operation, presence of hazardous materials, code requirements, or energy performance, if taken individually, are not reasons to replace windows, they 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. For example, studies have shown that the energy performance of historic windows can be significantly improved by adding storm windows and weatherstripping or by replacing the glazing or the sash.

The number of windows being replaced is a consideration that may allow for window replacement that does not depend on deterioration. It may be possible that the replacement of a few windows may have only an inconsequential effect on the character of an elevation with 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.

Some areas have code requirements in response to severe weather conditions. Mandates such as impact resistance may make it impossible for a building to have any compliant occupancy with the historic windows in place, particularly on taller buildings. In these cases, replacement of the historic windows will not be dependent on documentation of deterioration.

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Replacement Windows that Meet the Standards

The decision-making process for selecting replacement windows divides into two tracks depending on whether historic windows remain in place or no historic windows survive.

Replacement of Existing Historic Windows

When historic windows exist, they should be repaired when possible. When they are too deteriorated to repair, selection of the replacement windows must be guided by Standard 6. Design, visual qualities, and materials are specific criteria provided by the Standard that are pertinent to evaluating the match of a replacement window. Evaluating the adequacy of the match of the replacement window involves the consideration of multiple issues.

How accurate does the match need to be?

The more important a window is in defining the historic character of a building the more critical it is to have a close match for its replacement. Location is a key factor in two ways. It is usually a consideration in determining the relative importance of a building's various parts. For example, the street-facing facade is likely to be more important than an obscured rear elevation. The more important the elevation, feature or space of which the window is a part, the more important the window is likely to be, and thus, the more critical that its replacement be a very accurate match. Secondly, the location of the window can affect how much of the window's features and details are visible. This will affect the nature of an acceptable replacement. For example, windows at or near ground level present a different case from windows in the upper stories of a tall building.

Using the hierarchy of a building's features and taking into account the window's visibility, some general guidance can be drawn:

- Replacement windows on primary, street-facing or any highly visible elevations of buildings of three stories or less must match the historic windows in all their details and in material (wood for wood and metal for metal).
- Replacement windows on the primary, street-facing or any highly visible elevations that are part of the base of high-rise buildings must match the historic windows in all their details and in material (wood for wood and metal for metal). The base may vary in the number of stories, but is generally defined by massing or architectural detailing.
- Replacement windows on the primary, street-facing or highly visible elevations of tall buildings above a distinct base must match the historic windows in size, design and all details that can be perceived from ground level. Substitute materials can be considered to the extent that they do not compromise other important visual qualities.

- Replacement windows on secondary elevations that have limited visibility must match the historic windows in size, configuration and general characteristics, though finer details may not need to be duplicated and substitute materials may be considered
- Replacement windows whose interior components are a significant part of the interior historic finishes must have interior profiles and finishes that are compatible with the surrounding historic materials. However, in most cases, the match of the exterior of a replacement window will take precedence over the interior appearance.
- Replacement windows in buildings or parts of buildings that do not fit into any of the above categories must generally match the historic windows in all their details and in material (wood for wood and metal for metal). Variations in the details and the use of substitute materials can be considered in individual cases where these differences result in only minimal change to the appearance of the window and in **no** change to the historic character of the overall building.

How well does the new window need to match the old?

The evaluation of the match of a replacement window depends primarily on its visual qualities. Dimensions, profiles, finish, and placement are all perceived in relative terms. For example, an eighth of an inch variation in the size of an element that measures a few inches across may be imperceptible, yet it could be more noticeable on the appearance of an element that is only half an inch in size. The depth of a muntin or the relative complexity of a brick mold profile are more often made visually apparent through the shadows they create. Thus, while comparable drawings are the typical basis for evaluating a replacement window, a three-dimensional sample or mock-up provides the most definitive test of an effective visual match.

The way a historic window operates is an important factor in its design and appearance. A replacement window, however, need not operate in the same manner as the historic window or need not operate at all as long as the change in operation does not change the form and appearance of the window to the point that it does not match the historic window or otherwise impair the appearance and character of the building.

Factors to consider in evaluating the match of a replacement window:

- **Window unit placement** in relation to the wall plane; the degree to which the window is recessed into the wall.
 - The location of the window affects the three-dimensional appearance of the wall.
- **Window frame size and shape.** For example, with a wood window, this would include the brick mold, blind stop, and sill.
 - The specific profile of the brick mold is usually less critical than its overall complexity and general shape, such as stepped or curved.
 - Typical sight lines reduce the importance of the size and profile of the sill on windows high above ground level, especially when the windows are deeply set in the wall.
 - Though a blind stop is a small element of the overall window assembly, it is a noticeable part of the frame profile and it is an important part of the transition between wall and glass.

- Steel windows that were installed as a building's walls were constructed have so little of their outer frame exposed that any replacement window will necessitate some addition to this dimension, but it must be minimal.
- **Glass size and divisions.**
 - Muntins reproduced as simulated divided lights – consisting of a three-dimensional exterior grid, between-the-glass spacers, and an interior grid – may provide an adequate match when the dimensions and profile of the exterior grid are equivalent to the historic muntin and the grid is permanently affixed tight to the glass.
- **Sash elements width and depth.** For example with a wood window, this would include the rails, stiles and muntins; with a steel window, this would include the operator frame and muntins.
 - The depth of the sash in a double-hung window, or its thickness, affects the depth of the offset at the meeting rail of a hung window. This depth is perceived through the shadow that it creates.
 - Because of its small size, even slight differences in the dimension of a muntin will have a noticeable effect on the overall character of a window. Shape, as well as depth, is important to the visual effect of a muntin.
 - The stiles of double-hung historic windows align vertically and are the same width at the upper and lower sashes. The use of single-hung windows as replacements may alter this relationship with varying effects on the appearance of a window. In particular, when the distinction between the frame and the sash is blurred, details such as lugs may be impossible to accurately reproduce.
 - Meeting rails of historic windows were sometimes too narrow to be structurally sound. Reproducing a structurally-inadequate condition is not required.
 - The operating sash of a steel window is usually wider than the overall muntin grid of the window. In addition, the frame of the operating sash often has slight projections or overlaps that vary from the profile of the surrounding muntins. The shadow lines the muntins create add another important layer to the three-dimensional appearance of the window.
- **Materials and finish.**
 - While it may be theoretically possible to match all the significant characteristics of a historic window in a substitute material, in actuality, finish, profiles, dimensions and details are all affected by a change in material.
 - In addition to the surface characteristics, vinyl-clad or enameled aluminum-clad windows may have joints in the cladding that can make them look very different from a painted wood window.
 - Secondary window elements that do not match the finish or color of the window can also diminish the match. Examples include white vinyl tracks on dark-painted wood windows or wide, black, glazing gaskets on white aluminum windows.

- **Glass characteristics.**

- Insulated glass is generally acceptable for new windows as long as it does not compromise other important aspects of the match.
- The clarity and reflectivity of standard clear window glass are significant characteristics of most windows. Because these characteristics are often diminished for old glass, new glass equivalent to the original should be the basis for evaluating the glazing proposed for new windows. Color should only be a noticeable characteristic of the new glass where it was historically, and any coating added must not perceptibly increase the reflectivity of the glass.
- Where the glazing is predominantly obscure glass, it may be replaced with clear glass, but some evidence of the historic glazing must be retained, either in parts of windows or in selected window units.

Replacement Windows Where No Historic Windows Remain

Replacement windows for missing or non-historic windows must be compatible with the historic appearance and character of the building. Although replacement windows may be based on physical or pictorial documentation, if available, recreation of the missing historic windows is not required to meet the Standards. Replacement of missing or non-historic windows must, however, always fill the original window openings and must be compatible with the overall historic character of the building. The general type of window – industrial steel, wood double-hung, etc. – that is appropriate can usually be determined from the proportions of the openings, and the period and historic function of the building. The appearance of the replacement windows must be consistent with the general characteristics of a historic window of the type and period, but need not replicate the missing historic window. In many cases, this may be accomplished using substitute materials. There may be some additional flexibility with regard to the details of windows on secondary elevations that are not highly visible, consistent with the approach outlined for replacing existing historic windows. Replacing existing incompatible, non-historic windows with similarly incompatible new windows does not meet the Standards.

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Documentation Requirements for Proposed Window Replacement

Property owners are encouraged to repair and retain existing historic windows. Yet, there are projects where replacement of the existing windows is an appropriate treatment. In order to review proposed replacement windows for conformance with the Secretary of the Interior's Standards for Rehabilitation, the State Historic Preservation Office and the National Park need the following minimum documentation:

- Clear photographs of existing windows. When windows are boarded over, remove boards from typical windows in order to take photographs.
- Drawings showing the elevation and horizontal and vertical sections of existing historic windows. Include muntins, mullions, transoms, and other window components. For historic steel industrial windows that contain operable units, drawings must include this feature.
- Drawings showing the elevation and horizontal and vertical sections of proposed replacement windows. In the case of a hung window, provide section drawings of both the upper and lower sash, including meeting rail. For replacement steel windows, include sections of both operable and fixed units. See note below regarding manufacturers' standard cut sheets.

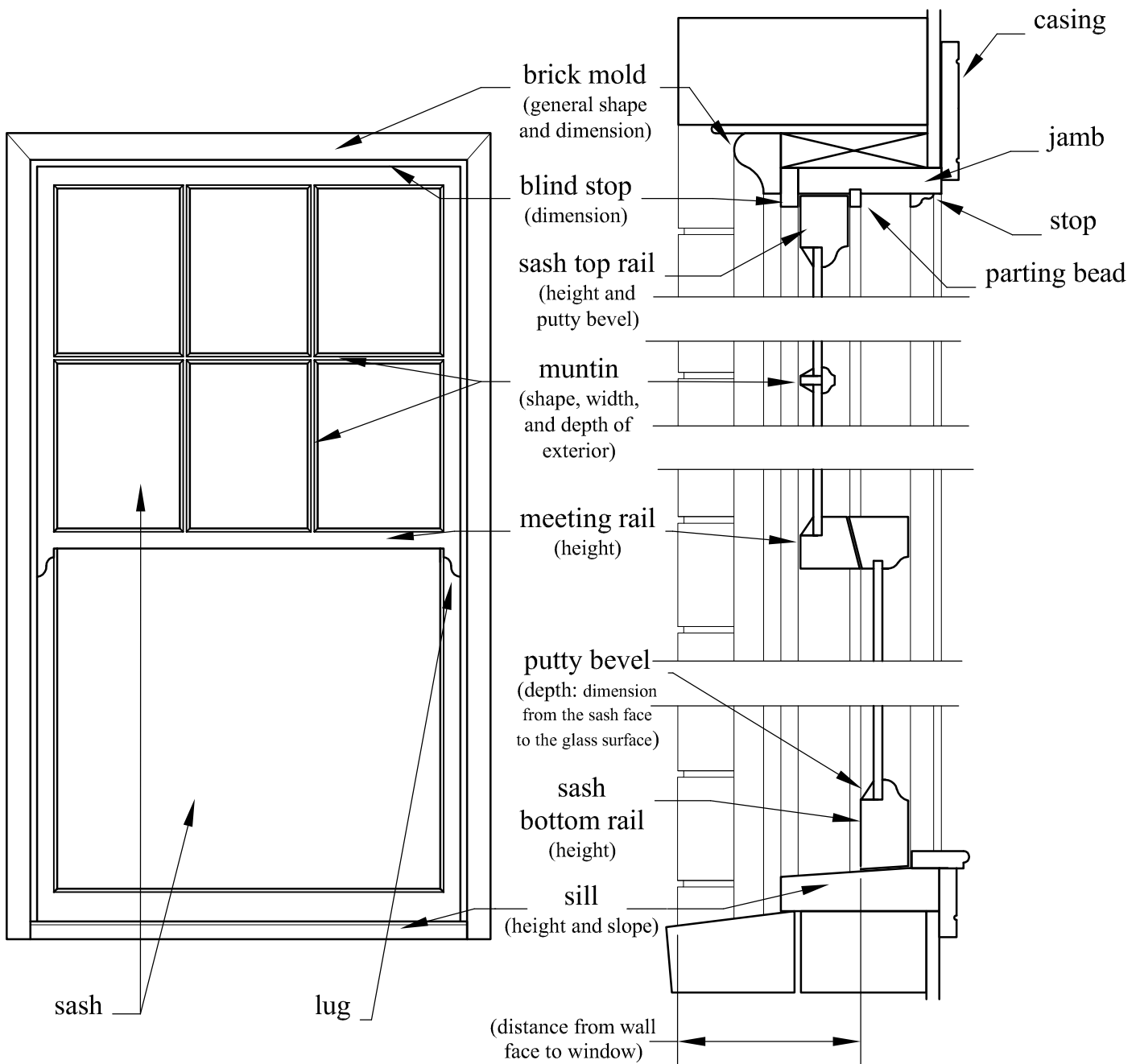
Drawings should be at the same scale and large enough to clearly show construction details. Scale should be provided, measurements noted, and materials indicated for the main components of the window. Drawings of the existing historic window should be accurate, based on field measurements. Examples of window drawings are provided on pages 2 and 3.

Replacement windows must accurately replicate the appearance of existing historic windows. Manufacturers' standard cut sheets usually are not an adequate substitute for detailed drawings since they are not drawn specifically for the proposed window replacement and do not show custom applications or installation details required for the project. In small projects where windows are being replaced and the historic or existing window is simple in design, manufacturers' standard cut sheets may be substituted for actual section drawings of the proposed window provided there is sufficient detail for review.

Window sections must show the profiles of muntins, meeting rails, sash, frames, moldings, and other features. Construction details must be apparent, including joinery. For all projects, the window's relationship to the existing wall plane must also be provided for both the existing historic windows, when present, and the proposed replacement window.

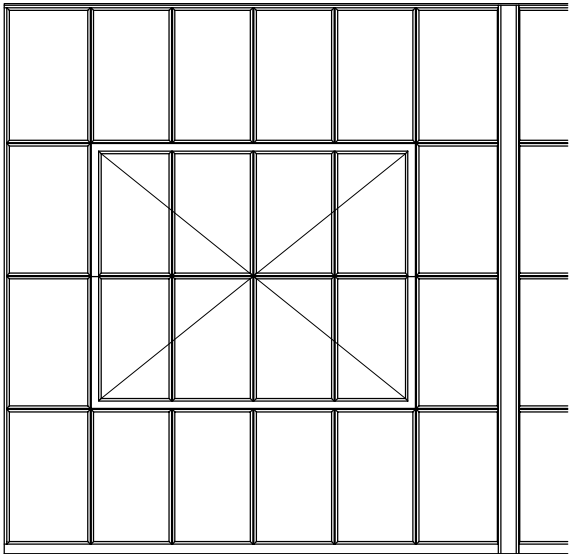
Wood Windows

The drawings below show the details required to document existing historic windows and any replacement windows. The specific information needed about each element is noted in parentheses. Note that the section drawing on the right shows the relationship of the window sash to the exterior wall plane.



Industrial Steel Windows

These drawings show the details required to document existing historic windows and any replacement windows. The specific information needed about each element is noted in parentheses. For replacement windows, be sure to show not only the typical muntin dimensions, but also any variations within the unit, such as wider pieces that support the operable sash.



Elevation

perimeter frame
(width)

top frame of
operating sash
(profile and width)

muntin
(shape, width, and
depth of exterior)

bottom frame of
operating sash
(profile and width)

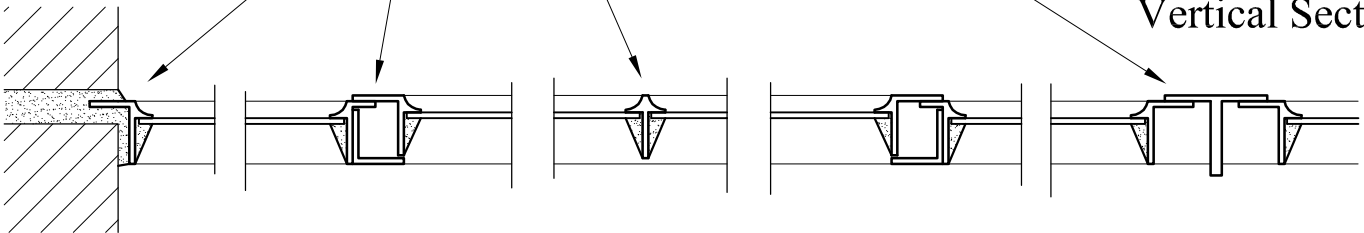
(distance from wall
face to window)

mullion
(profile & width)

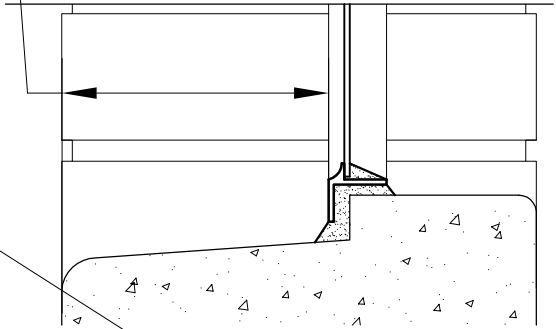
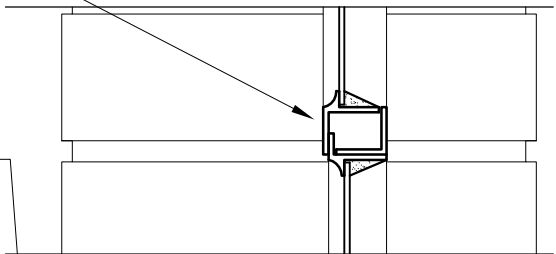
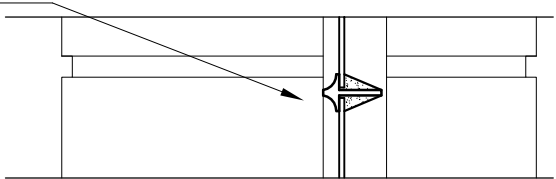
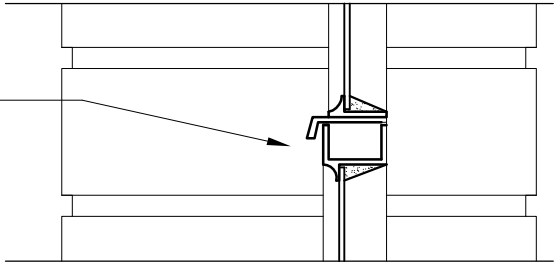
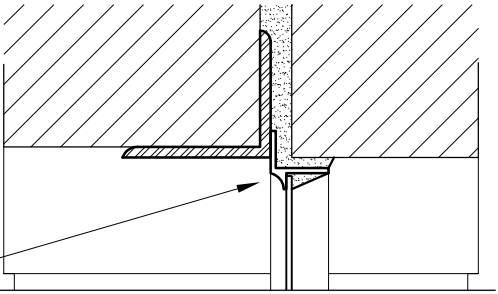
muntin
(shape, width, and depth of exterior)

operating sash & frame
(profile and width)

perimeter frame
(width)



Horizontal Section



Vertical Section