

A WINDOW OF OPPORTUNITY

How to Evaluate Historic Windows and Determine the Appropriate Restoration and Retrofit Treatment

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SANDVICK ARCHITECTS,
INC.



Presentation Overview

- A. Importance of Historic Windows - Why Restore?
- B. Common types of historic windows
- C. Guideline Resources - National Technical Preservation Services Resources
- D. Evaluating historic window condition and repair classifications
- E. Common issues and considerations related to window restoration and retrofit approach
- F. Considerations for large scale projects
- G. Metal window restoration techniques
- H. Wood window restoration techniques
- I. Questions and answers

Importance of Historic Windows

- Key character defining elements, often time both exterior and interior



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Importance of Historic Windows

- "Eyes of the Building" - Walls and roof define form and mass while openings often a key part of defining the expression of the building.



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Importance of Historic Windows

- Window details, style, plane of the glass, ornamentation, repetition all contribute to the sytlitic expression and the relief of the façade,contributing to the shade and shadow lines that often define a buildings façade.



Importance of Historic Windows

Evident for ornamental windows - Also true for warehouse and factory windows



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Importance of Historic Windows

- Optimized daylighting and ventilation – Now considered a "Green" approach.



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Importance of Historic Windows

- Secretary of the Interior Standards indicates that character defining original historic fabric should be retained, repaired and restored.



Overview of Window History in America

- Earliest windows were wood casement
- By early 1800's single and double hung came into popular use
- Ganged double hung and triple hung, counterbalanced very large wood windows innovated for use in industrial buildings - maximize daylighting and ventilation.
- Late 1800's, early 1900's - widespread adoption of fire codes in major cities.
- Metal double hung windows (fabricated to mimic wood window appearance) emerge where buildings are in close proximity to each other.
- Late 1800's Early 1900's - Fire resistant construction takes hold - Steel casement, double hung windows emerge in city high rise buildings, especially upper floor windows.
- Early 1900's - 1940's Steel industrial sash eventually replaced ganged wood windows in manufacturing and warehouse structures - Very strong - maximized daylight openings - made window walls possible.
- Post WWII - aluminum frame windows gain popularity - lower price perceived increased longevity.
- Late 20th century - Insulated glass, thermal break technology, vinyl and fiberglass windows

Potential Benefits of Restored Window over Replacement

- Old growth wood - wood windows fabricated prior to 1920 are likely made from old growth wood - dense, strong, dimensionally stable and inherently rot resistant wood.
- Thermal performance – A well restored wood window that is properly weather stripped and combined with a storm window can perform just as well as a new window, potentially better in some applications.
- Historic windows were designed to be maintained and repaired. New windows often required total replacement of a sash or frame member if damaged or deteriorated.
- Longevity - Average life of an average replacement window is 15-20 before a failure occurs. The life of a properly restored window with exterior storm can be 50 years with proper maintenance.



Guideline Resources - National Technical Preservation Services Resources

- Secretary of the Interior Standards - Guidelines for Rehabilitating Historic Buildings
- Preservation Brief # 9 - The repair of Historic Wooden Windows
- Preservation Brief # 13 - The Repair and Thermal Upgrading of Historic Metal Windows
- Preservation Brief #33 – The Preservation and Repair of Historic Stained and Leaded Glass
- Preservation Tech Notes #1-22

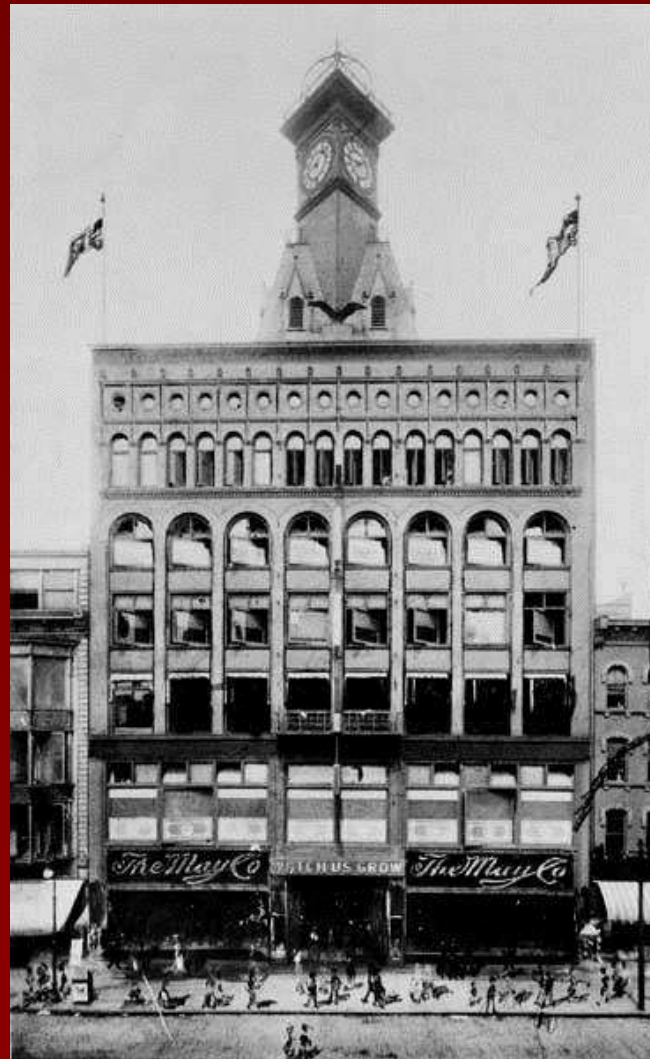


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Common Types of Historic Windows



INDUSTRIAL STEEL SASH



PIVOT WINDOWS



CASEMENT WINDOWS



HUNG WINDOWS



HOPPER/AWNING
WINDOWS (PROJECT
IN & PROJECT OUT)

Project Evaluation

Physical Evaluation - Evaluate windows and record conditions to establish a comprehensive overview of types of windows, materials, and condition classification. Can often establish patterns, identify issues necessary to determine the appropriate restoration plan.

- Window location- Orientation and exposure often contributes to condition
- Paint Condition
- Frame and sill Condition
- Sash condition (rails, stiles and muntins)
- Condition of joinery
- Existence and condition of weatherstripping - Not unusual for some historic window systems to have no weatherstripping
- Hardware condition
- Glazing type and condition - Glass, glazing beads, and glazing compound.
- Overall condition of window

Project Evaluation – H.J. Heinz Complex



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Project Evaluation – H.J. Heinz Complex



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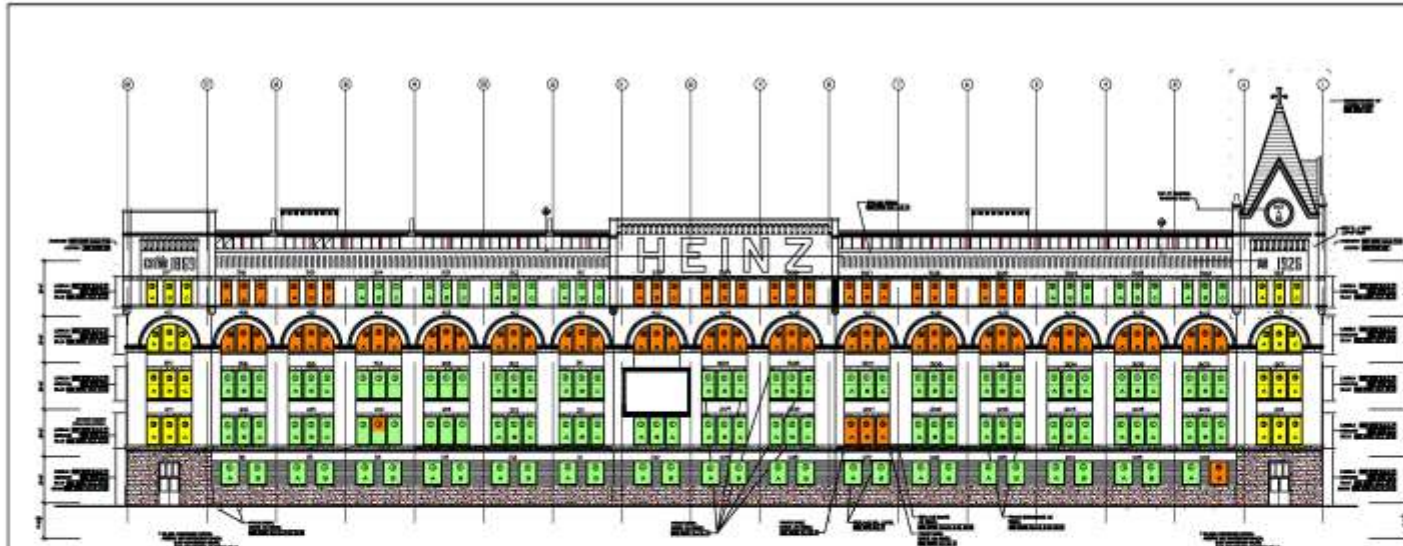
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NORTH ELEVATION

WINDOW TREATMENT TYPES
 232 TOTAL WINDOW OPENINGS

1. ENTIRELY MISSING WINDOWS
 73 or 32% of total

2. METAL FRAME WINDOWS
 24 existing 3 over 3

3. WOOD FRAME WINDOWS
 135 existing 1 over 1

4. METAL FRAME WINDOW REPLACEMENT WINDOWS
 New 24x36 metal frame windows with 3 over 3 panes. The existing windows are to be replaced with new windows. The existing windows are to be replaced with new windows. The existing windows are to be replaced with new windows.

5. NEW WOOD FRAME WINDOW REPLACEMENT WINDOWS
 New 24x36 wood frame windows with 1 over 1 panes. The existing windows are to be replaced with new windows. The existing windows are to be replaced with new windows. The existing windows are to be replaced with new windows.

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WOOD FRAME WINDOWS
 135 existing 1 over 1

NOT TO SCALE

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EXISTING WINDOW SURVEY AND
 PROPOSED WINDOW TREATMENT TYPES

H.J. HEINZ LOFTS
 CEREAL BUILDING

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Project Evaluation – Repair Classifications

Repair Class I: Routine Maintenance

- Paint exhibits peeling – no major buildup of paint
- Weatherstripping is present but needs replacement
- Some glazing may be broken or missing or inappropriately replaced
- Putty replacement
- Hardware repair or replacement needed
- Window may not be fully operational – weight ropes broken, hinges damaged – repair may require removal of sash.
- All wood parts are intact and do not exhibit much open graining or feathering
- All metal parts are intact and do not exhibit any major corrosion (light surface rust may be present)

Project Evaluation – Repair Classification 1



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Project Evaluation – Repair Classification 1



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Project Evaluation – H.J. Heinz Complex

Repair Class II: Stabilization

- Paint exhibits peeling
- Weatherstripping is compromised or missing
- Glazing may be broken or missing or inappropriately replaced
- Advanced level of putty replacement
- Hardware repair or replacement needed
- Window not be fully operational – weight ropes broken, hinges damaged – repair requires removal of sash.
- Wood parts exhibit some opening graining, feathering, or joint separation and require epoxy consolidation and or rejoining work at joints
- Metal parts may exhibit localized corrosion through metal – holes in hollow section window, depressions in solid section windows

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Repair Class III: Splices and Parts Replacement

- Paint may be missing entirely
- Weatherstripping usually missing
- Glazing broken or missing or inappropriately replaced
- Glazing putty may be missing
- Hardware repair or replacement needed
- Window is not fully operational – weight ropes broken, hinges damaged – repair will require removal of sash.
- Wood parts exhibit opening graining, feathering, and joint separation and require epoxy consolidation and or rejoining work at joints
- Advanced deterioration – wide open graining, feathering of wood, or complete deterioration of member. Part replacement & rebuilding required.
- Metal parts exhibit advanced corrosion – sections may be missing and joints may be separated or compromised.

Project Evaluation – Repair Category 3



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Project Evaluation – Repair Category 3



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Project Evaluation – Beyond Repair



•Note: Some severe deterioration may not be obvious. Wood can age, dry rot, loose moisture content and look intact but upon probing, be found to lack structural integrity. Touch, and probe window wood, attempt to operate a few to really get an idea of potential hidden problems.

Project Evaluation



•NEVER EVALUATE A WINDOW FROM ONLY THE INTERIOR!!

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Common Issues And Considerations Related To Determining Window Restoration And Retrofit Approach

- 1. Window character hierarchy** - is there a combination of highly decorative windows with simpler windows at higher elevations?
- 2. Results of window evaluation and condition survey** - is there a clear pattern and approach that presents itself?
- 3. Size of the project** - Smaller scale window restoration project vs. large scale projects
- 4. Complexity of restoration project** - Combination of restoration and replacement?
- 5. Requirements of end users and governing agencies that are partners in the project**
 - Hotels
 - HUD Requirements
- 6. Operability & code considerations**
 - Ventilation requirements - fresh air and smoke control
 - End user concern - Insurance concerns - Fix in shut position or install limiters
- 7. Proximity to floor and doors** - tempered glass glazing

Common Issues And Considerations Related To Determining Window Restoration And Retrofit Approach

- 8. Thermal upgrade** - what opportunities or limitations does the existing window present due to its existing configuration? What will the impact be on the historic window?

Glazing pocket size - Sash thickness

Mult pane windows - much more difficult to prepare to receive insulated glass if rabbet depth is not adequate.

- 9. Window size –**

Weight of new glass and pane - can sash frame handle the weight

Size of new insulated pane - insulated pane thickness and glass thickness is dictated by glass size - can large sash handle the thickness?

Weight pocket size and counterbalance

- 10. Weather stripping existence and upgrade** - Is one of the most important considerations for both thermal and acoustical upgrade

Common Issues And Considerations Related To Determining Window Restoration And Retrofit Approach

11. Window operation - are windows required to be operable? –

Interior and exterior storms

12. Acoustical upgrade - Is there a requirement or a common sense need to improve the building enclosure acoustics?

Building change in use or newly introduced noise source

13. Hazardous materials treatment approach –

Lead paint treatment approach

Glazing compound removal - asbestos content

14. Building Codes –

Design Pressures

Glazing materials

Special Considerations For Large Scale Projects

1. Project Budget –

A well restored window cost generally as much to replace with a heavy commercial or architectural grade new window

2. Number, type, and complexity of windows to be restored

Are there hundreds, or thousands of windows to restore?

Is it an extensive scope, with multiple types of windows?

Though mockups look good - Quality often suffers in large scale projects

3. Condition of windows to be restored - can they be restored on site?

4. Complexity of window treatment scope -

Highly decorative windows –

Retrofit with insulated glass or other upgrade treatment?

5. Schedule

Special Considerations For Large Scale Projects

- 6. Selecting a qualified professional window restoration Contractor for a large project**
 - A. High quality window restoration is a crafted skill
 - B. Labor and skill intensive
 - C. Must know historic windows and their anatomy
 - D. Must master restoration and retrofit technologies
 - E. Frame repair - Same source repair responsibility is important - the sash and the frame work as a system.

Special Considerations For Large Scale Projects

6. Selecting a qualified professional window restoration Contractor for a large project (continued)

F. Must have sufficient skilled labor personnel and supervisory and management staff and facilities to handle large production projects.

- Inventory windows
- Key sash to openings -
- Sash often have adjusted over time to their specific opening
- There can subtle dimension differences from opening to opening
- Manage and phase window restoration operations & coordinate with general contractor

Special Considerations For Large Scale Projects

***CHOOSE CAREFULLY - THE WRONG CONTRACTOR
CAN AT BEST PROVIDE A SUBSTANDARD
RESTORATION PRODUCT RESULTING IN ADDITIONAL
TIME AND
MONEY TO CORRECT, AND AT WORST CAUSE
THE COMPLETE LOSS OF HISTORIC FABRIC***



***HERE A CASE STUDY THAT SHOW'S WHAT CAN AND
DID GO WRONG . . .***

Special Considerations For Large Scale Projects



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Special Considerations For Large Scale Projects



MOCK-UP, MOCK-UP, MOCK-UP!!!

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Special Considerations For Large Scale Projects



MOCK-UP, MOCK-UP, MOCK-UP!!!

Window Restoration Techniques – Hung Windows Paint and Glazing Compound Removal

Paint and Glazing Compound Removal –

- Lead paint most likely present - Removal method should be lead safe
- Heat gun not recommended - can vaporize lead damage sash - especially very dry wood
- Infrared heat box - lower heat does not vaporize lead - also loosens glazing putty
- Steam boxes & steam strippers- Lead safe - Dense woods tolerate moisture better than softer wood windows
- Peel Away products - Good for frame work - can be very messy – requires thorough neutralization

Window Restoration Techniques – Hung Windows Paint and Glazing Compound Removal

Paint and Glazing Compound Removal –

LOOSENED PAINT AND GLAZING COMPOUND



**INFRARED
STRIPPER**

STEAM BOXES

STEAM HOSE

Window Restoration Techniques – Hung Windows Paint and Glazing Compound Removal



FIELD STRIPPING OF FRAMES

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Window Restoration Techniques – Hung Windows Sash and Frame Repair

FRAME AND SASH REPAIR –

- Remove badly rotted wood portions or entire elements
- Fungicide application - Fungus can linger and continue to work on wood – must arrest growth
- Epoxy consolidation and patching - satisfactory for repairs of trim, and members that still hold some structural integrity
- Joinery repair - mortise and tenon repair of stiles, rails and muntins

Metal angles are not a long term solution

Epoxy consolidation should not replace proper joinery repair

- New wood splices with new mortise and tenon features
- Sill repair/replacement - Common location for advanced deterioration

Epoxy consolidation - marine grade can be effective

Replacement with new rot resistant species of wood

Window Restoration Techniques – Hung Windows Sash and Frame Repair

FRAME AND SASH REPAIR –

- Stop repair and replacement –
Common for the parting stop to be rotted, damaged or dry and warped
- Mullion repair for ganged windows -
Important structural element for window system - need to insure anchorage and structural repair in addition to cosmetic repair.
- Molding repair-
Common for the bottoms of moldings to be rotted

Window Restoration Techniques – Hung Windows Sash and Frame Repair



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Window Restoration Techniques – Hung Windows Sash and Frame Repair



Window Restoration Techniques – Hung Windows Sash and Frame Repair



Window Restoration Techniques – Hung Windows Sash and Frame Repair



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Window Restoration Techniques – Hung Windows Sash and Frame Repair

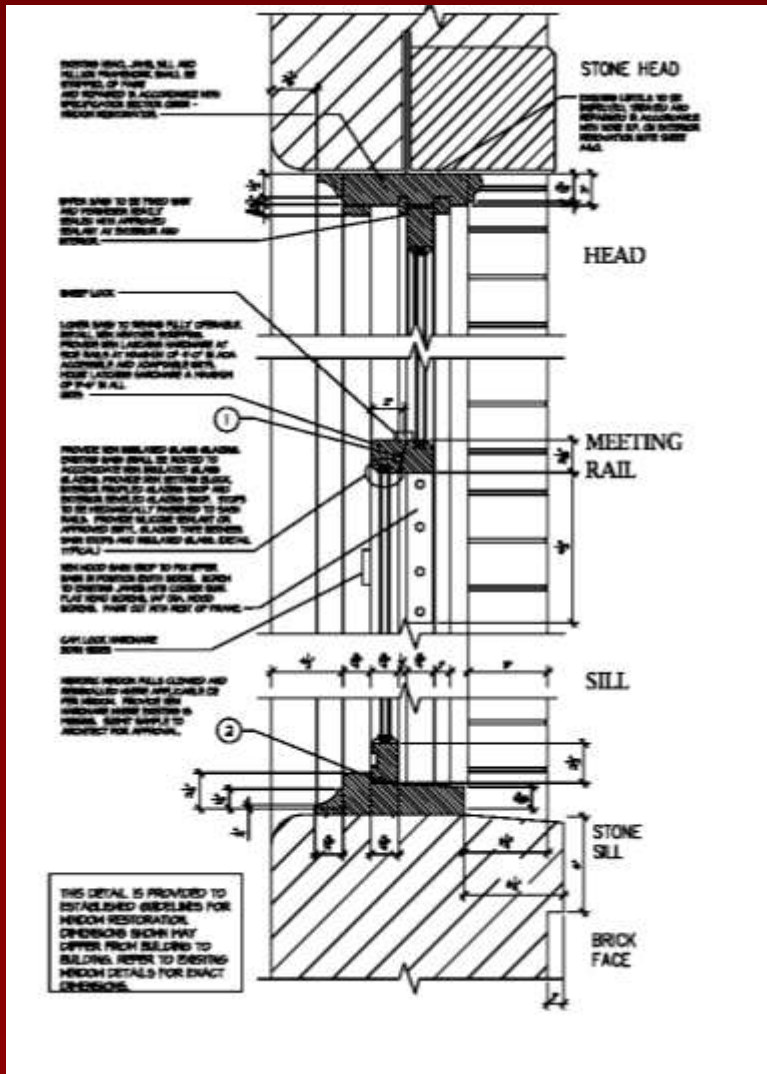
Glazing and thermal upgrade approaches

- Traditional single pane glazing - rim rabbet with thin bed of glazing putty, press glass into putty, install glazing points, then putty glaze and tool to bevel.
- Retrofitting with insulated glass -
 - Route sash if needed to accommodate glazing depth
 - Meeting rails may require routing to remove glazing slot
 - Install insulated glass in approved silicone glazing sealant that is compatible with insulated glass seal (no glazing putty)
 - Narrow sightline desiccant spacer
 - Do not use glazing points
 - Install new continuous pressure beveled glazing stop with new sealant bead
 - Insulated glass with transparent low E coatings such as Solarban 60 on the third surface. Reflectivity within acceptable limits.

Glazing compounds have been re formulated to address federal regulations
- take longer to cure/skim over - may need to wait 21 days before painting.

Window Restoration Techniques – Hung Windows

Thermal and Acoustic Treatment

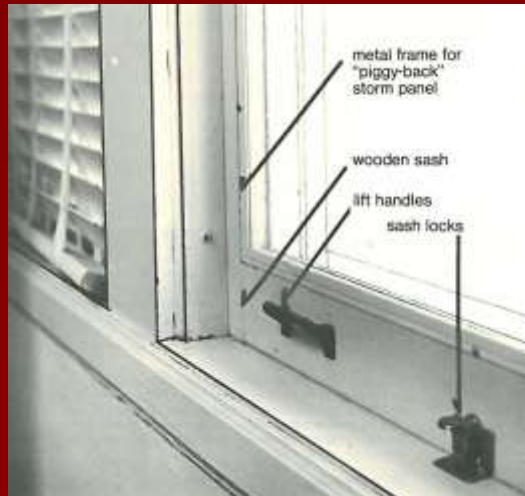
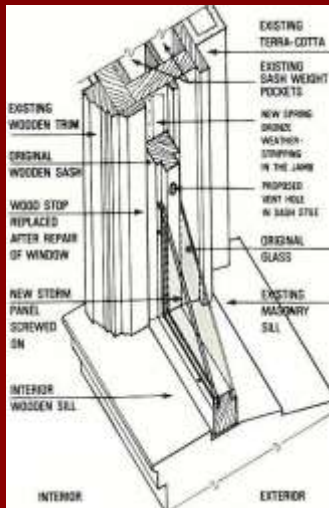
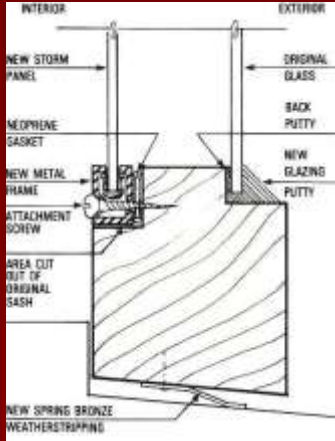


Window Restoration Techniques – Hung Windows

Thermal and Acoustic Treatment

Glazing and thermal upgrade approaches

- Piggy back panel – can work for single light windows -
- Interior and exterior storm windows



Window Restoration Techniques – Hung Windows

Thermal and Acoustic Treatment

Counter weight rebalancing:

If glazing thickness or type (single to insulated glass) is changed then the counterweights will need to be replaced or added onto.

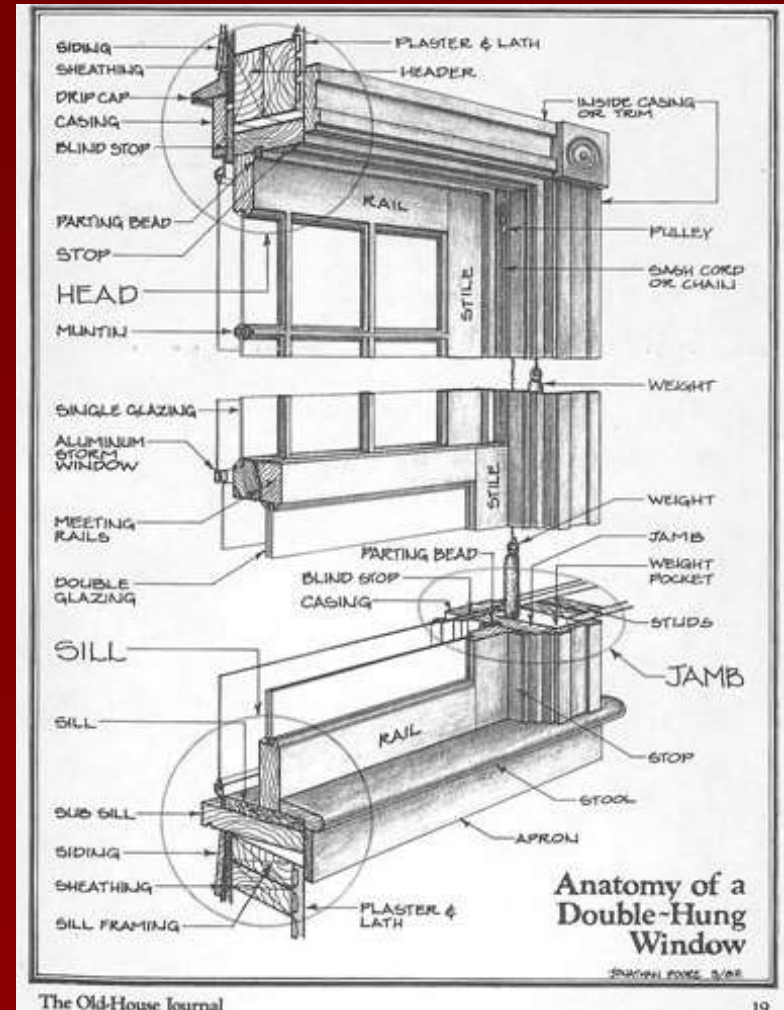
Chains and ropes –

Chains can be cleaned and reused if in good condition. It is recommended that all ropes be replaced with good sash cord.



Hardware -

Retention of historic hardware if available is recommended. Strip paint and reinstall. Replication hardware is available for most common ordinary window types.

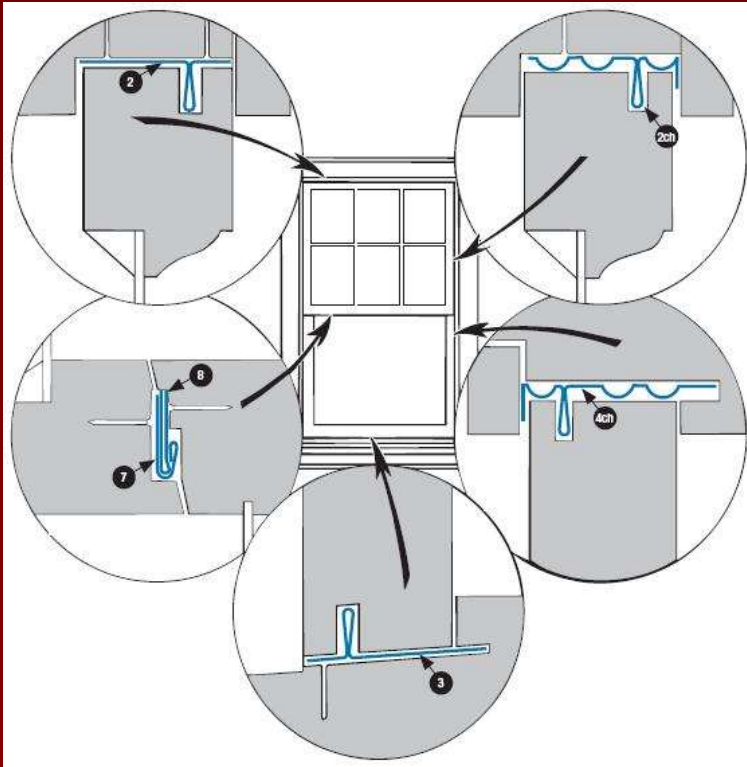


Window Restoration Techniques – Hung Windows Installation Scopes

Weather Stripping –

- Key to overall thermal and acoustical improvement.
- Trial and error especially for windows that originally did not have weather stripping. It usually takes several mockups to determine what will work for most conditions.
- Some historic windows never had weatherstripping - industrial, factory, warehouse. These will require a little extra work to achieve a successful product.
- Zinc or bronze curb weather stripping very common and still made (Zero International). May not address acoustical issues.
- Combinations of high quality, good memory, compression weatherstripping with pile weatherstripping can be used to address various and sometimes imperfect conditions. Need to be careful not to compromise operation force.

Window Restoration Techniques – Hung Windows Installation Scopes



Window Restoration Techniques

Metal Window Restoration Techniques -Steel Industrial Sash

Remove from opening -

Quite often embedded in masonry jambs and concrete head and sill.

Paint removal -

Media blasting in a controlled environment needed to control lead and potential asbestos from remaining glazing compound

Prime coat -

Prime with high quality primer immediately after blasting - blasted steel will flash rust quickly.

Replace corroded elements -

Sill elements are often corroded - weld in new steel elements matching the existing profile. Weld broken connections at muntins.

Finish prime and paint -

Prime new elements with rust arresting industrial grade primer and coat entire window with industrial grade finish system- minimum 3 coats for finish system

Window Restoration Techniques

Metal Window Restoration Techniques -Steel Industrial Sash

Glazing and thermal upgrade approaches

- Traditional single pane glazing - rim glass with thin bed of glazing putty, press glass into putty, install glazing clips, then putty glaze and tool to bevel. Glass should not touch metal frame.
- Retrofitting with insulated glass - Can usually accommodate 1/2" insulated glass.
 - Back bed glass with silicone glazing sealant. Set insulated pane in sash and press to shims - do not allow glass to touch metal.
 - Glaze interior with silicone sealant and tool to a beveled condition.
 - Do not use glazing clips - will crack insulated glass.
 - Insulated glass with transparent low E coatings such as Solarban 60 on the third surface – Reflectivity within acceptable limits.

Window Restoration Techniques

Metal Window Restoration Techniques -Steel Industrial Sash



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THANK YOU!!

QUESTIONS ?