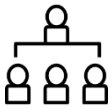
Historic Preservation Commission

Regular Meeting
City Council Chambers – City Center South
1001 11th Avenue – Greeley, Colorado
March 7, 2022 – 4:00 p.m.



Regular meetings of the Historic Preservation Commission are held **in person** on the 1st and 3rd Mondays of each month in the City Council Chambers, 1001 11th Avenue, Greeley, Colorado.

Members of the public may attend and provide comment during public hearings.

Written comments may be submitted by US mail or dropped off at the Planning office located at 1100 10th Street, Greeley, CO 80631 or emailed to cd_admin_team@greeleygov.com. All written comments must be received by 10:00 a.m. on the date of the meeting.

Meeting agendas and minutes are available on the City's meeting portal at Greeley-co.municodemeetings.com/

IMPORTANT – PLEASE NOTE

This meeting is scheduled as an **in-person session only**. If COVID, weather, or other conditions beyond the control of the City dictate, the meeting will be conducted virtually and notice will be posted on the City's MuniCode meeting portal by 10:00 a.m. on the date of the meeting (https://greeley-co.municodemeetings.com/).

In the event it becomes necessary for a meeting to be held virtually, use the link below to join the meeting. Virtual meetings are also livestreamed on YouTube at https://www.youtube.com/CityofGreeley.

For more information about this meeting or to request reasonable accommodations, contact the administrative team at 970-350-9780 or by email at cd_admin_team@greeleygov.com.

Historic Preservation Commission

March 7, 2022 at 4:00 PM
1001 11th Avenue, City Center South, Greeley, CO 80631

Agenda

1. Call to Order
2. Roll Call
3. Approval of the Agenda
4. Approval of Minutes dated February 14, 2022
5. Resolution Commending Laura Sattler for Service on Historic Preservation Commission
6. Report from Historic Greeley Inc.
7. A public hearing to consider a Certificate of Approval for exterior alterations at 825 12th Street, a contributing property in the Monroe Avenue Historic District
8. Commission Member Reports
9. CPI Saving Places Conference Reports
10. Staff Report
11. Adjournment

Historic Preservation Public Hearing Procedure

Public Hearing to…

1. Chair introduce public hearing item
2. Historic Preservation Staff report
3. Applicant Presentation
4. Commission questions
5. Chair opens public hearing
6. Chair closes public hearing
7. Applicant rebuttal
8. Commission discussion and vote

City of Greeley, Colorado
HISTORIC PRESRVATION COMMISSION PROCEEDINGS
Special Meeting

February 14, 2021

1. Call to Order

2. Roll Call

Chair Brunswig called the meeting to order at 4:00 p.m.

The hearing clerk called the roll.

PRESENT
Chair Bob Brunswig
Commissioner Doran Azari
Commissioner Christen DePetro
Commissioner Sean Jaehn
Commissioner Jacob Melish
Commissioner Dan Podell

One vacancy exists.

3. Approval of Agenda

Elizabeth Kellums indicated that there were no additions or corrections to the agenda and it was approved as presented.

4. Approval of January 31, 2022 Special Meeting Minutes

Commissioner Podell noted one correction to the minutes. Commissioner Azari moved to approve the minutes of the special meeting dated January 31, 2022 as corrected. Commissioner Podell seconded the motion. Motion carried 6-0. One vacancy exists.

5. Report from Historic Greeley Inc.

Rebecca Brunswig, 1700 Montview Boulevard, addressed the Commission on behalf of Historic Greeley Inc. and highlighted several events that have recently taken place at the Southard-Gillespie house. She asked about future plans for the Plumb Farm. Ms. Kellums was unaware of any plans and offered to check with staff and report back.

6. **A public hearing to consider a Certificate of Approval for exterior alterations at 825 12th Street, a contributing property in the Monroe Avenue Historic District (HPDR2022-0001)**

Ms. Kellums advised that the applicant had requested to withdraw the application and stated that staff would be working with the applicant on a different course of action and return to the Commission at a future date.

7. **A public hearing to consider a Certificate of Approval for a glass wall and door at 826 9th Street, a contributing property in the Downtown Greeley Historic District (HPDR2022-0002)**

Chair Brunswig asked whether any commissioner had a conflict of interest. There being none, Ms. Kellums addressed the Commission and described the application for exterior renovations at 826 9th Street, a contributing property in the Downtown Greeley Historic District. She presented a map showing the location of the property. Ms. Kellums advised that the proposed project is to enclose the recessed entrance with a glass wall and door that would fill in the arched opening. She presented photographs of the existing opening and a mock-up of the proposed changes. Ms. Kellums advised that the exterior is not original or a historic storefront and that the proposed changes would not affect any historic fabric, design features or building integrity.

Ms. Kellums reported that over the years, the recessed area has become a place for people to camp out and sleep. She added that some of the activities of those hanging out in the alcove have presented potential health and safety concerns for building tenants and described things such as an individual setting a small fire, urination in the alcove, and a gentleman brandishing a knife. Ms. Kellums described the proposed window frame materials and stated that they would closely match the existing frames.

Staff reviewed the application in accordance with the criteria and standards of Development Code Section 24-1003(j), a, b, c, e, f and h, and determined that the proposed project would have a neutral effect on the character of the property and relationship to other buildings. She added that the proposed changes would have a positive effect on the Historic District and the building as they would provide additional protection to the structure. Ms. Kellums advised that the Building Code requires the door to swing outward; however, there is an option that it could swing inward if it is kept open when the building is occupied. She described the mechanism to keep the door locked in an open position on those occasions.

Ms. Kellums noted that the proposed project also complies with the Secretary of Interior's Standards as it would have a minimal impact on the building features and details and a positive impact on the protection, enhancement, perpetuation and use of the building. She added that the proposed project also complies with the District Designation Plan for storefronts and that the alteration does not detract from the character of the building. Staff recommended approval.

Commissioner Podell noted that the lights appear to go all the way to grade and asked whether it was structurally safe to have glass come to the ground. Ms. Kellums advised that Building Inspection would review as part of the permitting and inspection process. Upon question by Commissioner Podell, Ms. Kellums advised that the door will open inward and locked in an open position when the building is occupied. She added that the door will be as flush with the front of the building as possible.

Upon question by Commissioner Azari, Ms. Kellums stated that what is being proposed has not received final approval by Building Inspection, adding that the Chief Building Official provided an opinion that if the door is locked in an open position allowing egress, it should not create a problem. She added that the applicant has not yet applied for a building permit. She added that the Commission could allow her permission to approve any minor changes or, alternatively, the applicant could return at a future time and seek approval of the Commission. Ms. Kellums did not believe there were any issues since the proposed change will not impact the architectural integrity or historic fabric of the building.

Bill Andrews, 2503 29th Avenue, addressed the Commission on behalf of the building owner, First Church of Christ, Scientist. Mr. Andrews described several of the problems that have arisen due to people sleeping, urinating, and lighting fires in the entryway. He added that groups of people have camped in the alcove and that the upstairs tenants are concerned for their safety and the safety of staff and clients. He described an incident where a gentleman had a knife and staff was afraid to leave the offices. Mr. Andrews also expressed concerns about sanitation and safety of the building tenants. Mr. Andrews reported that the alcove will be recessed a few inches to install the door frame. Upon question by Commissioner Podell, Mr. Andrews advised that new signage will be placed on the glass which will be a safety glass.

Chair Brunswig opened the public hearing at 4:30 p.m. There being no citizen input, the public hearing was closed at 4:30 p.m.

Commissioner DePetro moved that, based on the application received and the preceding analysis, the Commission find that the proposed glass wall and door at 826 9th Street meets the requirements of Section 24-1003(j) of the Greeley Municipal Code. Based on these findings, the Commission approves the Certificate of Approval with the condition that all required permits be obtained prior to commencement of work. Commissioner Podell seconded the motion. Motion carried 6-0. One vacancy exists.

8. Appointment of Historic Preservation Low Interest Loan Committee

Ms. Kellums addressed the Commission and described the financial incentive available for owners of historic properties. She provided a description of Low Interest Loan Committee and its required members who would serve for a specific time and evaluate applications for a low interest loan. Ms. Kellums reported that staff recently received a loan application and that it would be necessary to approve appointees to the Low Interest Loan Committee.

Commissioner Azari moved to approve the recommended appointees to serve on the Historic Preservation Low Interest Loan Committee for three-year terms or the duration of the term on the Historic Preservation Commission or employment with the City or term on the City Council, as applicable, and whichever is shorter. Commissioner Podell seconded the motion. Motion carried 6-0. One vacancy exists.

9. Commission Member Reports

Commissioner Azari shared some of the takeaways from the CPI Saving Places conference that he attended, both in person and virtually. He described ongoing research around the nation to identify and preserve communities that have been ignored in the area of preservation, including Native American, Latinx, and African American communities. Commissioner Azari noted that research is important not only for documentation of history, but for its moral and ethical implications and how they affect us today. Presenters at the conference reported that very few preservation efforts are being made in disadvantaged communities, adding that use of older buildings is often more efficient than demolition in many instances. Commissioner Azari reported that national resources are being impacted by climate change and age, and that efforts are being taken to examine the effects of climate change and the need to identify infrastructure that is deteriorating due to climate change, age, and neglect. He expressed thanks for the opportunity to attend the conference and receive information that would be beneficial to Greeley residents.

Chair Brunswig noted that he would report on the sessions he attended at the next meeting. He referenced the 2021 Greeley Historic Resources Survey Plan and the recommendations to advance historic preservation in Greeley. Chair Brunswig asked commissioners to review the plan and focus on a couple of areas, including the goals and objectives and immediate recommended actions. He noted sections on the Sunrise Community and Cranford neighborhood that Greeley should address over the next few years.

Ms. Kellums asked the commissioners to be thinking about Historic Preservation Month and described some of the events and activities done in previous years.

10. Staff Report

Ms. Kellums advised that she had attended several sessions at the CPI Saving Places conference and enjoyed a session presented by the keynote speaker about slave houses. She added that she would provide a full report at a future meeting. Chair Brunswig agreed that the conference was well done and very informative.

11. Adjournment

With no further business before the Commission, Chair Brunswig adjourned the meeting at 4:58 p.m.

_____

Bob Brunswig, Chair

_____

Elizabeth Kellums, Secretary

CITY OF GREELEY HISTORIC PRESERVATION COMMISSION
RESOLUTION NO. 1
SERIES 2022

A RESOLUTION COMMENDING LAURA SATTLER FOR HER SERVICE ON THE CITY OF GREELEY HISTORIC PRESERVATION COMMISSION.

WHEREAS, Laura Sattler has served the City of Greeley through her membership as a commissioner of the City of Greeley Historic Preservation Commission from December 2019 to December 2021; and

WHEREAS, Ms. Sattler showed an active interest in every topic of discussion, bringing to such discussions a valuable perspective as a Greeley resident and property owner; and

WHEREAS, during her tenure, Ms. Sattler expended many hours in the consideration of historic property designation applications and certificate of approval applications, state historic preservation income tax credit applications, and policy discussions; and

WHEREAS, during this time, Ms. Sattler supported various historic preservation events, including walking tours, History Brown Bags, and Historic Preservation Month events;

NOW, THEREFORE, BE IT RESOLVED that the City of Greeley Historic Preservation Commission members and the Community Development staff express their sincere appreciation for, recognition of, and contributions made by Laura Sattler in service to the City of Greeley**.**

Signed and approved this 7th day of March 2022.

_____
Bob Brunswig, Chair

_____
Christen DePetro, Vice-Chair

_____
Doran Azari

_____
Sean Jaehn

_____
Jacob Melish

_____
Dan Podell

ATTEST:

_____
Betsy Kellums
Secretary, Historic Preservation Commission

Historic Preservation Commission Agenda Summary

March 7, 2022

Key Staff Contact: Elizabeth Kellums, Planner III, 970-350-9222

Title:
A public hearing to consider a Certificate of Approval for exterior alterations at 825 12th Street, a contributing property in the Monroe Avenue Historic District

Summary:
Property owner requests approval for exterior alterations, including window replacement, masonry painting, new stucco, porch masonry repair and new awnings and light fixtures. The Historic Preservation Commission reviews the project for compliance with the Greeley Municipal Code requirements.

Recommended Action:

Attachments:
Staff Report
Attachment A – Application Narrative
Attachment B – Photographs
Attachment C – Window Brochure
Attachment D – Site Map
Attachment E – Preservation Brief 9
Attachment F – Preservation Brief 2

HISTORIC PRESERVATION COMMISSION SUMMARY

ITEM: Certificate of Approval for Major Alteration

CASE NUMBER: HPDR2022-0001

PROJECT: Exterior Alterations

LOCATION: 825 12th Street, Arthur Strong House

APPLICANT: Walter Scruggs, representative of property owner Blue Oak Properties LLC

CASE HISTORIC PRESERVATIONIST: Elizabeth Kellums, Planner III – Historic Preservation

HISTORIC PRESERVATION COMMISSION HEARING DATE: March 7, 2022

HISTORIC PRESERVATION COMMISSION FUNCTION:

Review the proposal for compliance with Criteria and Standards for altering designated properties or contributing properties in an historic district in Section 24-1003j of the City of Greeley Municipal Code, and approve or deny the request.

PROJECT OVERVIEW AND BACKGROUND:

Proposed Project

On January 7, 2022, Walter Scruggs, representative of property owner Blue Oak Properties LLC, submitted an application for a Certificate of Approval for exterior alterations at 825 12th Street to the Historic Preservation Office. Staff determined the application to be complete on January 10, 2022. At the January 31st Historic Preservation Commission meeting, the Commission continued the hearing to February 14th for Staff to work with the applicant to determine the best course of action. On February 8th, the applicant withdrew the application and then requested to re-submit the application on February 17, 2022. Prior to initial application, the applicant completed most of the work but stopped upon receiving notice that it required Historic Preservation Commission approval. Staff indicated that the existing vinyl windows do not meet the standards and guidelines, and the applicant revised the application for the windows. The applicant requests approval for completed work, including the following:

Completed:

- completed window replacement on the east, north and west sides and the first story of the south side on the house, and on the north non-historic addition;
- added new stucco on the addition to the north;
- completed masonry repair on front porch;
- painted masonry.

Future work to include:

- replacement of the 5 vinyl windows on the second story on the south side and the corner vinyl window on the west side that connects to the corner window on the south side with wood windows more closely matching the original wood windows;
- addition of metal awnings and exterior light fixtures.

Please see the Application and Narrative for a Certificate of Approval (Attachment A), Photographs (Attachment B), Window Product Information (Attachment C), Existing Site Map (Attachment D), Preservation Brief #9 Repairing Historic Windows (Attachment E), and Preservation Brief #2 Repointing Mortar Joints in Historic Masonry Buildings (Attachment F).

Existing Conditions

This Foursquare residence is a rectangular-shaped, two story, painted brick structure with a composition shingle, hipped roof. Roof features include hipped front and side dormers, wide overhanging eaves and decorative brackets. It has a stone foundation and brick and stone exterior with added wood panel siding enclosing the front porch. The main facade is broken into three bays and contains off-centered entrances. The new doors are paneled fiberglass with multiple lights. The one-story, enclosed porch has stone column bases. The porch was enclosed and covered with stucco at an unknown date. The new vinyl windows are one-over-one single hung sash. Before replacement, windows were wood frame, double hung and one-light picture windows, including a bay window on the second story with decorative leaded glass in the upper sash of the middle window of the bay window. The two brick chimneys are located on the north end of the west elevation and near the east end of the north elevation.

Obvious alterations completed at an unknown date, prior to the current owner, include a one-story, flat roof wooden back porch with wooden porch railing on top. The front porch has also been enclosed and the wall covered with stucco. A mid-story, enclosed entrance with a stairway replaced a bay window at an unknown date. Finally, there is an extensive one-story concrete addition on the rear (north elevation). The integrity of the house has been significantly compromised, and retains minimal historic materials. Historic brick walls on the main house have been stuccoed in portions and painted where brick was still uncovered. The house still retains the wide overhanging eaves, the dormer, and the stone pier porch supports on the front porch.

Background

The Arthur Strong House at 825 12th Street is a contributing property in the Monroe Avenue Historic District, designated by the Historic Preservation Commission in 1999, effective in 2000. Because the period of significance for the historic district ends in 1926, and the addition was constructed after 1926 at an unknown date but likely by the late 1960s, the addition is considered a non-historic addition. A 1967 wiring permit for additions supports a possible late 1960s construction date for the addition. The property is subject to review by the Historic Preservation Commission for major alterations and is subject to the District Designation Plan for the Monroe Avenue Historic District.

SITE DATA:

Legal Description:	GR 5271 W70' L6 BLK84, City of Greeley, County of Weld, State of Colorado
Neighborhood:	Monroe Avenue Historic District
Designation:	Contributing property in the Monroe Avenue Historic District
Year Property Built:	ca. 1903
Architectural Style/Type:	American Foursquare Type
Zoning:	Commercial – High Intensity (C-H)
Dates of Significant Renovations:	Several significant alterations, including a one-story addition on the north that connects the house to a carriage house at the north end of the property, enclosure of the porch, removal of a bay window on the west facade and replacement with an exterior entrance and staircase, a one-story enclosed room addition with a baluster rail on the roof on the north façade, all completed at unknown dates, prior to designation of the historic district in 1999/2000. No documentation for those alterations has been found.

Housing Code Enforcement Master File Control Card for 825 12th St; Owner: Marie Amendola; total occupancy: 12; Number of dwelling units: 10. Date of initial inspection: 3/17/1975; re-inspection to be upon rehab by GUR.

Housing Code Enforcement Master File Control Card for 825 12th St; Owner: Marie Amendola; total occupancy: 14; Number of dwelling units: 12. Date of initial inspection: 1/29/1975; reinspection to be upon rehab by GUR.

Permit #681127; Wiring permit for Additions and Alterations; Owner: Fred J. Schmidt; Date: 5/28/1967.

Source: Building Permit File for 825 12th Street

KEY ISSUES AND ANALYSIS:
The proposed work is evaluated according to the relevant criteria for alteration of designated properties, defined in Section 24-1003j, as follows in the staff analysis. Only the applicable criteria and standards are listed.

City of Greeley Code, Section 24-1003j Criteria and Standards

1. Alterations. Criteria and standards for alterations to a designated property or a property in a historic district are as follows:

(a) The effect of the alteration or construction upon the general historical or architectural character of the designated property.

(c) The effects of the proposed work in creating, changing or destroying the exterior architectural features and details of the structure upon which the work shall be done.

(e) The effect of the proposed work upon the protection, enhancement, perpetuation and use of the landmark or landmark district.

(f) Compliance with the current Secretary of the Interior's Standards for the Rehabilitation of Historic Properties, as defined in 24-1003.m.

(h) Other requirements for alterations of a designated property or contributing property in a district as are required by the procedures and bylaws established by the Commission.

Secretary of the Interior's Standards for Rehabilitation

(2) The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features, spaces and spatial relationships that characterize a property will be avoided.

(5) Distinctive materials, features, finishes and construction techniques or examples of craftsmanship that characterize a property will be preserved.

(6) Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture and, where possible, materials. Replacement of missing features will be substantiated by documentary and physical evidence.

(7) Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.

(9) New additions, exterior alterations or related new construction will not destroy historic materials, features and spatial relationships that characterize the property. The

new work will be differentiated from the old and will be compatible with the historic materials, features, size, scale and proportion, and massing to protect the integrity of the property and its environment.

(10) New additions and adjacent or related new construction will be undertaken in such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

Applicable Guidelines from the District Designation Plan for the Monroe Avenue Historic District)

Preservation of Original Features
Original materials and features, as well as the distinctive form, scale, and siting of a structure, contribute to its character and should be respected and preserved whenever feasible. The distinguishing qualities and characteristics of the structure and its site should be preserved using the simplest means possible. It is important that the property retain a high percentage of original features to retain its integrity. This is especially true for individually designated properties.

5. Preserve existing original site features or original building materials and features.
   a. Preserve original wall and roof materials.
   b. Preserve original doors, windows, porches, and other architectural features.
   c. Preserve original site features such as set-back, steps, walls, fences, landscaping, and walkways.
   d. Avoid removing or altering original materials and features.
   e. If weatherization is necessary to maintain energy efficiency, do not remove original doors or windows. Select storm windows and doors that do not diminish the integrity of the original doors and windows.

6. Repair deteriorated historic features to the extent possible, and replace only those elements that cannot be repaired.
   a. Patch, piece-in, splice, consolidate, or otherwise upgrade the existing material, using recognized preservation methods whenever possible, rather than remove the element.
   b. If disassembly of an original element is necessary for its repair or restoration, use methods that minimize damage to the original materials and replace the disassembled components in their original configuration.

Windows
Windows, the elements that surround them, and their relationship to one another are among the most important character-defining elements of a historic structure. The basic elements of windows are their operation, proportions, number of divisions, and the dimensions of the frame. Historic windows should be preserved wherever feasible; this is especially important for individually designated properties.

11. *Preserve the functional and decorative features of original windows.*
    a. *Features important to the character of windows include frames, sash, muntins, mullions, glazing, sills, heads, jambs, moldings, operation, and groupings of windows.*
    b. *Stained and leaded glass are often found in windows and doors of historic buildings and houses, and special care should be taken to preserve and protect these windows.*
    c. *Typically, houses feature a front window or grouping of windows. The proportions, type, relationship, decorative glass, and surrounding detail should be preserved.*
    d. *Repair frames and sash by patching, splicing or reinforcing, rather than replacing.*
    e. *If replacement of any original window is necessary, match it as closely as possible.*
    f. *Metal, vinyl, or fiberglass awnings, hoods, or shutters that are not historically accurate should not be used.*

12. *Retain the position, type, number and groupings of windows, especially on significant facades.*

13. *Maintain original window proportions.*
    a. *Preserve the vertical emphasis typical of historic windows.*
    b. *Do not reduce an original opening to accommodate a smaller window. Likewise, do not enlarge an opening to accommodate a larger window. If enlargement is necessary for emergency egress, do so on a minor elevation (rear or side).*

14. *Use materials that appear similar to the original when replacement is necessary. Replacing a wood window with another wood window is preferred; however other materials may be considered if the operation, dimension, profile and finish are similar.*

15. *Consider storm windows as an alternative to window replacement.*
    a. *Install storm windows on the interior whenever feasible.*
    b. *Match the sash of the original windows, if storm windows are installed on the exterior.*
    c. *Metal storm windows may be appropriate if the frames match the proportions and profile of the original windows and if the frames are anodized or painted so that raw metal is not visible.*

General Exterior

Original materials should be repaired rather than replaced. Wood is a common material for historic buildings in Greeley; however, stone, brick, concrete, and other materials were also used. Greater flexibility in materials may be considered for additions and new construction within the Monroe Avenue Historic District.

18. Use materials that appear similar in character to those used historically, if replacement is necessary.

a. Materials similar to those employed historically are preferred.

b. Substitute materials may be used for replacing individual building elements, but not the primary building material.

c. Application of sidings such as vinyl, aluminum, and plastic may not be used.

19. Preserve the appearance of original materials.

a. Avoid covering original materials with new materials. If such covering is necessary, install in such a way as to avoid damaging original materials when the covering is removed.

b. Aluminum or vinyl siding may not be used. Such materials can cause the original siding to deteriorate more rapidly.

c. Original materials should not be covered with stucco, permastone, or other masonry-like materials.

Masonry

Masonry is a common material for historic buildings in Greeley. Houses may be constructed of brick with wood detail and trim, while commercial and institutional buildings are constructed of either brick or stone with stone, terra cotta, or other trim. The character of a historic masonry wall is a combination of the material itself, the size and proportion of the modular units, the finish of the material, the pattern with which the material may be laid, and the character of the mortar that binds the units together. All of these features should be preserved when feasible. Ancillary buildings and site features constructed of masonry should be treated in the same way.

24. Preserve the original masonry when feasible.

a. Avoid painting masonry, unless this is needed to provide a weather-protective coating to soft material. Painting changes the character of the building. If painting is necessary, select a color as close to the original masonry as possible.

b. Paint may be removed from masonry if the procedure will not damage the original finish. Repainting in the original color of the masonry is an alternative to stripping the paint.

c. If masonry has a stucco finish, removing the covering may be difficult, since original brick finishes were sometimes chipped to provide a connection for the stucco application. If removing stucco is to be considered, first remove the material from a test patch to determine the condition of the underlying masonry.

d. Covering masonry with other materials is inappropriate.

25. Preserve original mortar characteristics, including composition, profile, and color.

In most cases, matching the composition of the original mortar mix may be essential to the presentation of the masonry itself. In order to avoid deterioration of the masonry, the mortar must be softer or more permeable than the masonry units. Matching the original mortar will also prevent moisture from being trapped inside the walls.

Replacement or Substitution of Original Features

In the event replacement is necessary, the new feature should match the original in size, shape, color, texture, and other visual qualities. Original features often include siding porches, wood frame windows, decorative detailing, etc.

45. Replace missing original features with accurate replications where feasible.

- *a. Replace only those portions that are beyond repair.*
- *b. Use the same kind of material as the original when feasible. A substitute material is acceptable if the form and design of the substitute itself conveys the visual appearance of the original material. For example, a metal windows frame may be considered if it accurately conveys the dimension and profile of the original wood window.*
- *c. A high percentage of the materials and features of the property must be original in order to retain historic integrity. While no exact percentage should be used, the building must be able to convey a sense of its period of significance.*

New Alterations and Additions

When planning new alterations and additions, consider the effect on significant historic materials and features of the property. Loss of historic building fabric should be minimized. The addition should not affect the ability to perceive the historic character of the building, especially from public ways, such as streets, alleys, and parks. Contemporary interpretation of the original structure is an appropriate alternative to a more replicative design. It needs to be compatible with the overall architecture but simplified in style and detailing and must appear newer.

48. Minimize negative effects upon original materials and features when planning additions and alterations to a historic building.
Avoid obscuring or removing significant features to accommodate new additions and alterations.

49. Minimize negative technical effects upon original features.

- *a. Consider the technical impacts of new construction on a historic structure. For example a construction process may cause vibration that results in cracks in a historic masonry wall.*
- *b. New alterations should be accomplished in such a way that they can be removed without destroying original materials or features.*

Staff Analysis:

The proposed project complies with the applicable criteria and standards for the following reasons:

Window Replacement

The proposed replacement of the new vinyl windows on the second story of the south elevation with wood windows would have a positive impact on the general historical and architectural character of the property and the designated historic district, as it would replace non-historic vinyl windows with historically appropriate wood windows. The windows on the front of the house are the most significant. Windows on the sides, rear, and non-historic addition are not as significant as the front windows, so replacing them with vinyl would have less of an impact on the property and district. The replacement windows have wider profiles, a glossy and smooth texture and framing, and significantly alter the character of the house. Originally, the house windows were wood with narrower frames and a slightly different sash configuration on some of the windows. One window on the front bay window had leaded glass in the smaller upper sash that was replaced and now has a significantly different profile and finish. Many of the original windows had smaller upper sashes and larger lower sashes. The current replacement windows do not have the same visual impact on the house as the previous windows, which appear to be the historic windows. The proposed wood replacement windows for the six second story windows on the south and southwest corner would have the smaller upper sash and larger lower sash, similar to the configuration of the original windows, thereby having a positive impact on the historical and architectural character and features of the house. Replacement of those six windows with wood windows would also add to the ability of the house to contribute to the district.

Windows are one of the most significant features on a historic building. Replacement of wood windows with vinyl windows had an adverse effect on the integrity of the house and of the district, so replacing the front second story vinyl windows with wood would have a positive impact on the district. Replacement of the front second story vinyl windows with wood windows with profiles closer to the original windows meets the Secretary of the Interior's Standards for Rehabilitation. Removal of historic materials is to be avoided and historic materials are to be preserved. Standard #6 specifically states, "(6) Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture and, where possible, materials. Replacement of missing features will be substantiated by documentary and physical evidence." Finally, the replacement of the front vinyl windows with wood windows meets the District Designation Plan design guidelines (DDP), since the wood replacement windows would be similar to the original windows in material, design, profile and finish. The project did maintain the position and groupings of windows on the primary façade, meeting that portion of window guidelines also.

Masonry Painting

Painting of unpainted masonry had an adverse effect on the historic and architectural character of the house, as well as on the texture and materials of the house. Paint acts as a sealant on masonry. When moisture is sealed behind the paint, it can damage the brick, causing it to spall or cause other problems, potentially leading to structural problems. For these reasons, the painting

of the unpainted brick had an adverse effect on the property due to the negative impact of paint sealing the brick, trapping moisture in the building and potentially causing damage. It also adversely affects the exterior finish of the brick, which also does not meet the Secretary of the Interior's Standards. The DDP recommends not painting masonry unless the paint is needed to provide weather protective coating for a soft material. The applicant did not provide documentation that the brick was soft and needed the paint as a protective covering. Removal of paint from masonry can significantly damage the masonry. For these reasons, the masonry painting does not meet the criteria and standards, including the DDP. Because of the potential for damaging the masonry from removing paint, which might not successfully remove all paint, the painted masonry should be closely monitored and maintained.

Stucco

On the non-historic north addition, new stucco was installed over existing stucco. The new stucco changed the profile and appearance of the addition, since the addition is non-historic, the alteration had a minor impact on the property. It did not impact the protection, enhancement, perpetuation and use of the property. Since the addition is non-historic, the alteration did not impact historic features or materials and had a neutral effect on the property and district.

Porch Masonry Repair

Several masonry piers on the front porch required repointing, which involves removal of a portion of the existing mortar and application of new mortar that matches the original mortar. According to the applicant, the mortar composition matches the original, and the color matches the original. Repointing, if done inappropriately, can damage the masonry and have a major impact on the historic and architectural character of a building and its features, particularly when completed on significant facades or over large portions of a masonry building. Since the mortar matches the original, it will have a positive impact on the character of the building, as well as on the protection, enhancement, perpetuation and use of the building. The appearance of the mortar on the corner of the porch has much larger joints and does not match the original mortar joints in dimension. However, those stones were pulling away from the house, and the additional mortar will help strengthen the pier. For these reasons, the porch masonry repair meets the requirements in the Greeley Municipal Code and the DDP.

Awnings and Light Fixtures

Installation of awnings and light fixtures are minor alterations, but are included as they are part of the overall project for which the applicant seeks approval. The installation of awnings over the doors and the installation of new exterior light fixtures next to the doors on the one-story rear addition would have a minor impact on the historical and architectural character of the house. They would have a neutral effect on the protection, enhancement, perpetuation and use of the property and would be easily removed. They meet criteria and standards in Section 24-1003j (1) a, c, e and f, but the DDP does indicate that metal awnings that are not historically accurate should not be used. For this reason, staff recommends the applicant seek other awning options and request approval from staff for awnings that meet the DDP. Staff recommends approval of the proposed light fixtures, as they are compatible with the structure, mimicking early 20th century light fixtures, and they meet the standards and guidelines in the Greeley Municipal Code and the DDP, which indicates that light fixtures should be in character with the structure.

While the house has been significantly altered in the past, these additional alterations further erode the overall integrity of the house and the district. The house would still be considered to be contributing, however, any future alterations should be carefully considered for any impact on the integrity of the house and district. Further alterations in the future could potentially prevent the house from conveying significance and contributing to the historic district.

In summary, for these reasons, the proposed window replacement, masonry painting, stucco, masonry repointing, and light fixtures meet the criteria and standards in Section 24-1003(j) of the Greeley Municipal Code, including the Secretary of the Interior's Standards and the District Designation Plan for the Monroe Avenue Historic District. The proposed metal awnings do not meet the District Designation Plan, which indicates metal awnings that are not historically accurate should not be used.

Section 24-1003(j) (1) Criteria and Standards Addressed: a, c, e, f, and h (Secretary's Stds #2, 5, 6, 7, 9 and 10) and the Monroe Avenue Historic District Designation Plan

NOTICE:
Greeley Municipal Code Section 24-1003(f) specifies public notification requirements for Certificate of Approval applications, specifically posting a sign at the property, readily visible by adjacent property owners and from the public right-of-way, no less than 14 days prior to the public hearing. Staff posted notice at this property on February 17, 2022 and emailed a letter of notification with the date, time and location of the public hearing on February 18, 2022.

STAFF RECOMMENDATION:
Approval of the window replacement, masonry painting, stucco replacement, masonry porch repair/repointing and light fixtures. Staff recommends the applicant work with Staff to identify historically accurate awnings for Staff review, as awnings are a minor alteration.

RECOMMENDED MOTION:
A motion that, based on the application received and the preceding analysis, the Commission finds that the proposed window replacement, including replacement of 6 second story vinyl windows on the south and southwest with wood and replacement of remaining windows with vinyl, masonry painting, stucco replacement, porch repair/repointing and proposed light fixtures at the Arthur Strong House at 825 12th Street meet (1) Criteria and Standards a, c, e, f, and h of Section 24-1003(j)(1) of the Greeley Municipal Code, and therefore approves the request for a Certificate of Approval, conditional upon the applicant obtaining all required permits and obtaining Staff approval for awnings that meet the District Designation Plan.

ATTACHMENTS:
Attachment A – Application & Narrative for Certificate of Approval
Attachment B – Photographs
Attachment C – Window Product Information

Attachment D – Existing Site Map
Attachment E – Preservation Brief #9 Repairing Historic Windows
Attachment F – Preservation Brief #2 Repointing Mortar Joints in Historic Masonry Buildings

City of Greeley Community Development Department, Historic Preservation Office, 1100 10th Street, Greeley, CO 80631 970.350.9222
www.greeleygov.com/hp

APPLICATION FORM FOR CERTIFICATE OF APPROVAL

MAJOR ALTERATIONS

The City of Greeley's Historic Preservation Code, Section 24-1003 of the Municipal Code, requires that no exterior major alteration is permitted of any designated historic property or property within a designated historic district without a Certificate of Approval issued by the Historic Preservation Commission. **Please complete pages 5, 7, and 8 and add additional sheets as necessary.**

PROPERTY OWNER(S)

Name: Blue Oak Properties, LLC
Address: 3400 W. 16th Street, Bldg 1, Suite 1-B
Phone: 707-480-6800
Cell phone:
Email: scruggs77@gmail.com

APPLICANT (if different From property owner)

Name:
Address:
Phone:
Cell phone:
Email:

HISTORIC PROPERTY

Name: 825 12th Street
Address: 825 12th Sreet
Historic District (if applicable): Monroe Avenue Historic District
Legal Description:

Certification: I certify that the information and exhibits herewith submitted are true and correct to the best of my knowledge.

Applicant (Print): Walter Scruggs Telephone: 707-480-6680

Signature: Walter Scruggs Date: 1/6/2022

Property owner's signature required. If applicant is other than property owner, property owner approves of the applicant's proposed project.

Owner (Print): Walter Scruggs Telephone: 707-480-6680

Signature: Walter Scruggs Date: 1/6/2022

THIS PAGE LEFT INTENTIONALLY BLANK

MAJOR ALTERATIONS CERTIFICATE OF APPROVAL SUBMITTAL CHECKLIST

Include all pertinent information identified on the following page(s), as well as special information requested by Historic Preservation Staff. Add additional sheets for narrative/information as necessary. Additional copies may be requested by Staff, if required for use by persons or groups providing advisory assistance. Submit this application and all required attachments through the City of Greeley website project module of eTRAKiT:

http://greeleygov.com/services/etrakit

The need for additional documents, as listed below, will be determined in a consultation with Historic Preservation Staff and may include:

ALTERATIONS

☐ **Pre-application Conference (in person or phone) (not required)** _____ **Date**

☒ **Application Form signed by applicant and owner (if different)**

☐ **For projects involving architectural drawings, one set 11"x17" (and larger if requested) scaled project drawing(s), including name, date, project address, north arrow, graphic scale, date of drawings, and name, address & phone of owner and designer (if drawings are needed); or**

☒ **Mock-Up of signs or awnings, as needed**

☒ **Product literature, if applicable, such as for window, roof projects, etc.**

☐ **If the proposal is for replacement of historic material, such as windows or siding, provide estimates from qualified contractors for repair and restoration and for replacement.**

☒ **Digital photos accurately representing existing materials, colors, and textures of each side of the building, site or structure to be affected. Date the photographs. Provide information about the view (such as view looking to the north), name of the photographer and about the subject of the photo.**

☒ **<u>Narrative of the proposed project (please type or print legibly on a separate page) Please include responses to the following:</u>**

a. **What is the proposed project? Include detailed information about materials, design, measurements, location on the building or property.**

b. **Time constraints on the project/Project urgency?**

c. Identify which design guidelines relate to the project. Explain how the proposed project meets the guidelines. Provide justification if the proposed project does not meet the guidelines.

Guidelines are available for download on the City's historic preservation website,
http://greeleygov.com/services/historic-preservation/documents
General guidelines are relevant for individually designated properties. District guidelines are also available for properties located with Greeley Historic Register designated districts.

Contact the Historic Preservation Office at 970.350.9222 or elizabeth.kellums@greeleygov.com for more information or for assistance.

Attention: Elizabeth Kellums; Historic Preservation, City of Greeley

Subject: 825 12th Street – Project Narrative (Re: Page 7-8 of COA Application Form)

Date: 1-6-2022

A. What is the proposed project? Included detailed information about materials, design, measurements, location on the building or property.

   This project aims to restore and repair this property while updating exterior colors of the building(s) to create cohesion and curb-appeal. Please see below 'Scope of Work' outlined for our contractors.

   - Soffit & Trim clean-up and repair due to dry rot damage (50% DONE)
   - Access areas repaired/replaced (DONE)
   - Rear laundry room on Unit #4 converted into stucco framing and concrete stairs (PLANNED)
   - Historic corbel detail to remain and be painted (DONE)
   - Fix tuck points at brick and paint (brick is discolored beyond cleaning efforts) (DONE)
   - Clean up stucco around roof drainage vents of building addition (1-story units behind original structure) (DONE)
   - Replace the fascia (rotten and deteriorating) (PLANNED; FASCIA REMOVED)
   - Repair access vents (PLANNED)
   - Replace exterior lighting (PLANNED)
   - Replace exterior unit numbers (PLANNED)
   - Replace broken and deteriorated dryer vents with higher quality, painted specification (PLANNED)
   - Exterior stucco and trim paint (75% DONE)
   - Black metal awnings added over entry doors to provide a necessary cover from the elements and add a much needed design feature. (PLANNED; ALREADY BUILT)

B. Time constraints on the project / Project urgency?
   - This property was purchased on 12/30/2020. By Summer, we learned that the exterior of this building had significant age and maintenance related issues that made conditions difficult for residents occupying this building. We, the owner, have worked diligently to create this scope of work and vision for the building that we believe will improve the quality of life for our tenants and to highlight this property in the Monroe Avenue Historic District while keeping the integrity of historic features that it possesses. Due to the amount of planning and work that has gone into this, we are eager to finalize these updates and have a turn-key property as soon as possible.

C. Identify which design guidelines relate to the project. Explain how the proposed project meets the guidelines. Provide justification if the proposed project does not meet the guidelines.
   - Doors & Entrances
     - The original entrance to the front structure on the property has been left in place. We intend to refinish it and restore its character. All other doors that were on the

property when the purchase was made were not original. They have been replaced with a new door that has a historic flair.
    - Black metal awnings to be added over entrances on the L shaped building.
- Windows (DONE)
    - The windows on the property were broken and contained wood rot beyond repair. Heat and cooling functions were wasted with the poor insulation they provided. Residents could not easily access fresh air because windows did not function properly. Greeley Glass has replaced these windows with white vinyl Alside Fairfield 80 Low E windows. These new windows blend in with our new paint color scheme, as the previous windows did.
- General Exterior (75% DONE)
    - The existing decorative sandstone has been repaired to the greatest extent possible. It remains exposed in its original state in our new, proposed design. The existing brick was discolored in many places beyond cleanability, so we opted to paint it. All existing trim work and decorative corbels remain, painted a new color. The existing L shaped building behind the main house was a deteriorated and aged stucco finish when the property was purchased. We have updated the stucco color.
- Paint Colors (DONE)
    - A muted paint color palate was chosen along with an accent color to highlight the historic corbel details of the building. The existing decorative sandstone was left as-is and ties in nicely with the new colors.
- Masonry (DONE)
    - Existing decorative sandstone has been repaired to the greatest extent possible and left exposed. The existing brick was discolored in many places beyond cleanability, so we opted to paint it a neutral color.

From: scruggs777@gmail.com
To: Betsy Kellums
Subject: [EXTERNAL] Re: windows
Date: Tuesday, January 11, 2022 6:29:58 PM
Attachments: Alside Fairfield 80 Low E Brochure.pdf

Hi Betsy,

These windows were disposed of when taken out. I discussed this with Phill @ Greeley Glass. He also clarified the windows that were removed. The front building that is 4 units had old wood windows that were original. They were single pane and very dilapidated. The L shaped building in back had single pane aluminum frame windows from the 40's to 50's. As you might imagine, none of them functioned well or were thermally efficient.

I attached an overview of the Alside Fairfield 80's Low E window. These are the windows that I put in my own home and rental properties. They are very nice, low sound penetration and great thermal protection.

I will be there on the 31st along with our design professional.

Walter Scruggs
707-480-6800

On Tue, Jan 11, 2022 at 8:03 AM Betsy Kellums <Elizabeth.Kellums@greeleygov.com> wrote:

> Hi Walter,
>
> Do you still have the windows that were removed from 825 12th Street?
>
> City of Greeley Colorado
>
> **Elizabeth Kellums**
>
> Planner III – Historic Preservation
>
> Community Development |Planning
>
> 1100 10th Street

Greeley, CO 80631

970-350-9222 | elizabeth.kellums@greeleygov.com

http://greeleygov.com/

---

825 12TH STREET EXTERIOR SCOPE, COLORS & SPECIFICATIONS

- Soffit and trim clean-up and repair
- Access areas repaired/replaced
- Rear laundry room on Unit #4 converted into stucco framing and concrete stairs (or at least new wood ones)
- Keep Corbel detail except for one deteriorated one - paint accent color per specs
- Fixing tuck points on all brick and stone up building
- Unit #4 private laundry converted into stucco
- Dig out dirt on backside of building so new stucco goes all of the way down
- Paint Brick - fix tuck points first
- Cleanup stucco around roof drainage vents
- New fascia
- Access vents
- New exterior lighting installed
- Exterior numbers - need to use the standoff spec in our package
- Dryer vents - metal (new spec included, paint black)
- Exterior stucco and trim paint

- White Gutters
- Black Railing
- Black Metal Awning

Trim & Fascia
Simply White OC-117
BEN EXTERIOR 'Soft Gloss' SHEEN

Stucco
Revere Pewter HC-172
BEN EXTERIOR 'Low Lustre' SHEEN

Doors & Corbels
Nimbus Gray 2131-50
BEN EXTERIOR 'Soft Gloss' SHEEN

All Brick
Cromwell Gray HC-103
BEN EXTERIOR 'Soft Gloss' SHEEN

BLACK METAL AWNING
4"-5" ABOVE DOORS

Internet #303974716 Model #30716 Store SKU #1003111453

Best Seller

Everbilt

5 in. Elevated Black Number 1

★★★★½ (451) Questions & Answers (53)

Hover Image to Zoom

Share Print

$8.88

- Non-reflective smooth black finish
- Metal construction for superior durability and long lifespan
- Weather resistant and easy to install with fasteners included
- See More Details

Greeley Store

✔ 11 in stock Aisle 24, Bay 005 Text to Me

Finish: **Black**

Black | Satin Nickel

Character: **Number 1**

Number 0 | **Number 1** | Number 2 | Number 3 | Number 4 | Number 5 | Number 6 | Number 7 | Number 8 | Number 9

How to Get It Delivering to: **80631** | Change

Store Pickup	Ship to Home	Scheduled Delivery
Pickup Today	Get it by Thu, Aug 19	As soon as Today
FREE	FREE	$35.00

11 in stock at **Greeley**
Curbside pickup available.
Check Nearby Stores

- 1 +

Add to Cart

— or —

Buy now with PayPal

34

Internet #300120037 Model #KB 06304-DEL Store SKU #1002067336

776

Home Decorators Collection

Mauvo Canyon Collection Black Outdoor Seeded Glass Dusk to Dawn Wall Lantern Sconce

★★★★☆ (538) Questions & Answers (111)

UNIT ENTRY LIGHTING

Hover Image to Zoom

Share Print

$79.97

- 11 in. Outdoor Wall Lantern that complements exterior décor
- Black Finish with Seedy Glass and Dusk to Dawn feature
- Integrated LED produces 517 Lumens and 100-watt equivalence
- View More Details

Greeley Store

✔ 1 in stock Aisle BW, Bay 033 Text to Me

Actual Color Temperature (K): **3125**

3123 **3125**

How to Get It Delivering to: **80631** | Change

Store Pickup	Ship to Home	Scheduled Delivery
Available	Get it by Tue, Nov 9	As soon as Tomorrow
FREE	FREE	$8.99

1 in stock at **Greeley**
Check Nearby Stores

⚠ This item may not be available for pickup until **tomorrow.**

PRO REFERRAL **Get Referred To A Local Pro** What to Expect

☐ Add Pro Referral

Protect This Item Learn more
Select a Home Depot Protection Plan by Allstate for:

○ 2 Year / **$12.00**

◉ No thanks

Acclaim Lighting (Brand Rating: 4.3/5)

Flood Lights 2-Light Matte Black Motion Activated Outdoor LED Light Fixture

★★★★☆ (7) Questions & Answers (9)

GENERAL EXTERIOR LIGHTING

Hover Image to Zoom

Share Print

$136.00

Save up to $100 on your qualifying purchase.
Apply for a Home Depot Consumer Card

- Durable cast aluminum fixture with a sturdy tempered glass lens
- Cree LED provides 3000K medium white light for up to 50,000 hours
- Features a photocell and adjustable heads for efficiency
- See More Details

How to Get It — Delivering to: 80631 | Change

Ship to Store	Ship to Home	Scheduled Delivery
Pickup Aug 17 - Aug 18	Get it by Tue, Aug 17	Not available for this item
FREE	FREE	

We'll send up to 21 to Greeley for free pickup
Curbside pickup available.
Change Store

Protect This Item Learn more
Select a Home Depot Protection Plan by Allstate for:

- ○ 2 Year / $18.00
- ◉ No thanks

- 1 +

Add to Cart

— or —

Buy now with PayPal

Schlage

Century Matte Black Entry Door Handle with Latitude Door Handle

★★★★★ (168) Questions & Answers (18)

FRONT DOOR

Hover Image to Zoom

Share Print

$113.33

Save up to $100 on your qualifying purchase.
Apply for a Home Depot Consumer Card

- Unkeyed handle pairs well with a deadbolt for complete entry set
- Self-aligning screw holes make installation easy & hassle-free
- Limited lifetime warranty on the mechanics and finish
- View More Details

Finish: **Matte Black**

How to Get It Delivering to: **80631** | Change

Ship to Store	Ship to Home	Scheduled Delivery
Pickup Nov 11 - Nov 15	Get it by Tue, Nov 9	Not available for this item
FREE	FREE	

We'll send up to **572** to **Greeley** for free pickup
Change Store

PRO REFERRAL **Get Referred To A Local Pro** What to Expect

Add Pro Referral

37

- 1 + Add to Cart

Internet #310640472 Model #F51A G LAT 622 Store SKU #1004712809

Schlage

Latitude Matte Black Keyed Entry Door Handle

★★★★½ (18) Questions & Answers (1)

BACK DOOR

Hover Image to Zoom

Share Print

$59.97

- Keyed knob best used for exterior doors with security needs
- Self-aligning screw holes make installation easy & hassle-free
- Limited lifetime warranty on the mechanics and finish
- View More Details

Finish: **black**

~~Matte Black~~ ~~Satin Nickel~~ **black**

How to Get It Delivering to: **80631** | Change

Ship to Store
Pickup
Nov 11 - Nov 15
FREE

Ship to Home
Get it by
Tue, Nov 9
FREE

Scheduled Delivery
Not available for this item

We'll send up to **29** to **Greeley** for free pickup
Change Store

Get Referred To A Local Pro What to Expect

Add Pro Referral

- 1 + Add to Cart

Schlage
Century Matte Black Single Cylinder Deadbolt
★★★★★ (120) Questions & Answers (18)

FRONT AND BACK DOOR

Hover Image to Zoom

Share Print

$35.74

- Operates with key outside, thumb turn inside
- All-metal chassis for added strength and durability
- Limited lifetime warranty on the mechanics and finish
- View More Details

Finish: **Matte Black**

How to Get It — Delivering to: **80631** | Change

Ship to Store	Ship to Home	Scheduled Delivery
Pickup Nov 11 - Nov 15	Get it by Tue, Nov 9	As soon as Today
FREE	FREE	$8.99

We'll send up to **118** to **Greeley** for free pickup
Change Store

PRO REFERRAL **Get Referred To A Local Pro** What to Expect

Add Pro Referral

39

- 1 + Add to Cart

Internet #204487446 Model #GK3190 Store SKU #1000021886 Store SO SKU #806449

Feather River Doors

36 in. x 80 in. 6 Lite Clear Craftsman Unfinished Smooth Left-Hand Inswing Fiberglass Prehung Front Door

★★★★☆ (199) Questions & Answers (106)

BACK DOORS

Hover Image to Zoom

Share Print

$298.00

Save up to $100 on your qualifying purchase.
Apply for a Home Depot Consumer Card

- Craftsman style resembles real wood with fiberglass durability
- ENERGY STAR qualified for superior insulation properties
- Available in 2 sizes with right- or left-handed swing
- See More Details

Greeley Store

✔ 1 in stock Aisle 38, Bay 003 Text to Me

Common Door Size (WxH) in.: **36 x 80**

32 x 80 | **36 x 80**

Door Handing: **Left-Hand/Inswing**

Left-Hand/Inswing | Right-Hand/Inswing

How to Get It Delivering to: **80631** | Change

Store Pickup	Ship to Home	Scheduled Delivery
Pickup **Today** **FREE**	Not available for this item	As soon as **Tomorrow** **$79.00**

1 in stock at **Greeley**
Curbside pickup available.
Check Nearby Stores

- 1 + Add to Cart

— or —

Buy now with PayPal

Everbilt

4 in. Heavy Duty Exhaust/Intake Hood in White

PAINT BLACK

★★★★½ (20) Questions & Answers (2)

Hover Image to Zoom

Share Print

$27.98

How to Get It — Delivering to: 80631 | Change

Store Pickup	Ship to Home	Scheduled Delivery
Pickup Today FREE	Not available for this item	As soon as Today $8.99

3 in stock at Greeley
Check Nearby Stores

- 1 + Add to Cart

825 12TH STREET - PRE-RENOVATION PHOTOS, JULY 2021

825 12TH STREET - RENOVATION PHOTOS, DECEMBER 2021

From: scruggs777@gmail.com
To: Betsy Kellums
Cc: Bryony Huber; Phill Crust
Subject: [EXTERNAL] Re: 3rd attempt email response - vinyl brochure.
Date: Wednesday, February 23, 2022 4:52:33 PM

Hi Betsy,

We are fine with the wood windows. Yes, Bry and I will be there in-person on March 7.

Walter Scruggs
707-480-6800

On Wed, Feb 23, 2022 at 4:48 PM Betsy Kellums <Elizabeth.Kellums@greeleygov.com> wrote:

> To be upfront, I really am not sure that the new vinyl windows would be a significant enough difference to be something that would be supportable. I will recommend approval using the wood, but you are welcome to provide arguments to convince the Commission to allow you to use the vinyl by showing how they meet the Standards and Guidelines.
>
> Walter – are you planning to attend the Historic Preservation Commission meeting at 4 p.m. on March 7th? It will be in-person at the City Council Chambers, 1001 11th Avenue, the City Center South Building. Someone authorized to speak on behalf of the applicant needs to be in attendance or we will likely have to continue it. Phill – you are welcome to attend as well, and we would appreciate your insight if the Commission has questions about the windows, but you are not required to attend of course.
>
> City of Greeley Colorado
>
> **Elizabeth Kellums**
>
> Planner III – Historic Preservation
>
> Community Development | Planning
>
> 1100 10th Street

Greeley, CO 80631

970-350-9222 | elizabeth.kellums@greeleygov.com

http://greeleygov.com/

From: Phill Crust <greeleyglassllc@gmail.com>
Sent: Wednesday, February 23, 2022 12:26 PM
To: Betsy Kellums <Elizabeth.Kellums@Greeleygov.com>; Scruggs777 <Scruggs777@gmail.com>
Subject: [EXTERNAL] 3rd attempt email response - vinyl brochure.

Walter / Betsy: I have attached the appropriate product literature for option A, and option B. To answer your question directly Betsy .. **"Is the only difference in the current vinyl windows and Option A that the Option A top sash will be 1/3 and the bottom 2/3 for all 6 windows, rather than the ½ and ½?"** Yes. That is the only difference between existing windows and Sash location. This is approximately 1/3 top, 2/3 bottom. It will be based on a specific measured dimension that I will give to either the vinyl manufacturer or the wood window manufacturer. I used a 1/3 , 2/3 because that is a standard option for manufacturers, measured allotment.

"Will there be any difference in the vinyl windows other than that?" **No**

What modifications would be required for using wood? **I'm not sure**. The interior trimout on all 6 windows will likely have to be modified because the window frame depth on wood windows is not 3 3/8 as is the standard for the vinyl windows currently installed. So the interior trim on the 6 windows would not be an period exact match because the moldings they did previously are not longer in production at this time. We would have to match mouldings based on what is currently available at current suppliers.

Feel free to contact me with any further questions you have.

--

Phill Crust

Greeley Glass LLC

Serving Greeley in Glass since 2013

970 984 8787 p

208 995 1670 c

--
Walter Scruggs
707-480-6800

CAUTION: This email is from an **external** source. Ensure you trust this sender before clicking on any links or attachments.

Walter Scruggs
Blue Oak Properties, LLC
7770 25th Ave #302-5
Greeley CO 80634
CC: Betsy Kellums Elizabeth.Kellums@greeleygov.com
CC: Bryony Huber Huberinteriors.com

Walter: Regarding the window rework the City of Greeley Historic district is requestion modification for, specifically the 2 floor of 825 12th Street, i.e. 2nd floor street frontage, Betsy identified 6 windows that the Historic District is asking for review and modification on. This is based on our in person meeting at 1100 10th street on Friday February 18. Betsy indicated at that time that the 3rd floor attic windows were not significant enough to address with this scope considering the operation of those windows, and the limited ventilation already available in the attic.

I have 2 proposals that I am bringing forth to you for consideration in the remediation of the districts complaint, and after reviewing the districts own policy statement regarding window treatments, I believe that either solution I present can and will satisfy their existing window treatments for structures within their district boundaries.

Proposal A.
Replace the 6 windows in question with the same make and style of vinyl window as is existing throughout the remainder of the structure, with one primary exception, to wit: Change the sash meeting height to match equivalently with the fixed window sash meeting height of the "bay buildout" of 3 windows. All 6 windows in question would then have an equivalent line of sight that the sash meeting height meets – unifying the architectural eye appeal of the total building. This would return the sash height of those 6 windows on 2nd story to original. All the interior / exterior trim and paint would remain original without disturbance as well. Keep in mind that as the white vinyl ages in the weather, the new recipes that manufacturers are using in their vinyl is much stronger and enduring. However, the weatherization on the finish of the white vinyl will dull with time and lose it's super high gloss effect. This dulling will occur within the first 12 – 16 months of the products life after installation. Furthermore using the same white vinyl window as is existing in the balance of the structure would really actually tie the totality of the street view architectural features together into a cohesive view. Any future maintenance requirements on the trim and windows would be timed in a similar aging cycle instead of having one product material aging at different cycles for maintenance than others. I present proposal A as a preferred proposal.

Proposal B.
Replace the 6 windows in question with a wood window product and again match the sash meeting height to match equivalently with the fixed window sash meeting height of the "bay buildout" of 3 windows. All 6 windows in question would then have an equivalent line of sight that the sash meeting height meets – unifying the architectural eye appeal of the total building. This would return the sash height of those 6 windows on 2nd story to original. However the interior trimout may require modifications as current wood window frame depths do not match those of the existing vinyl installations, nor the original frame depths. Modifications likely would have to be made to accommodate the new style wood window frame trimouts. The wood window replacement would be painted white inside and outside and would really have an indiscernible visual difference between the vinyl window and the wood version from the street.

* see Walter's email - fine w/ wood windows 2/23/22

825 12th Street Photos

1/10/2022

Photos by Betsy Kellums

S façade; View looking N

S & W facades; View looking NE

N façade; View looking S

N addition; View looking NE

Accessory structure S facade; View looking N

Accessory structure N façade; View looking S

North addition E façade; View looking SW

Porch piers, S façade; View looking N

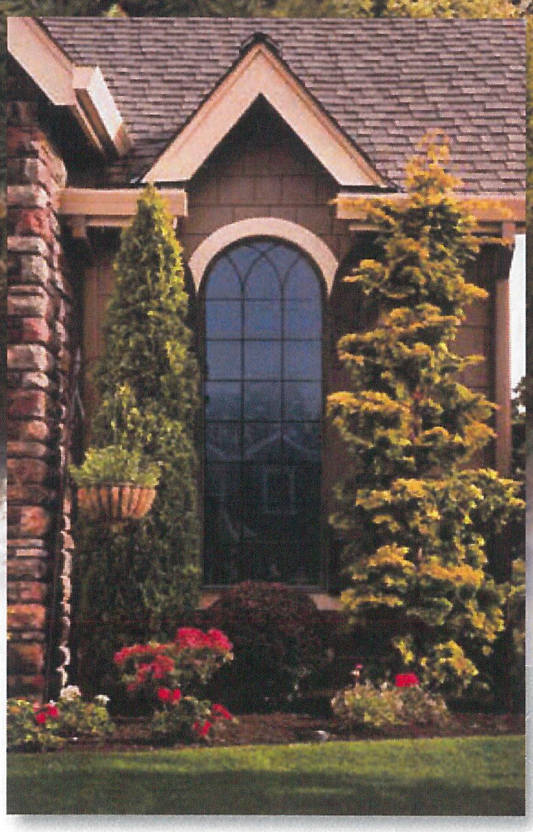
Fairfield 80

80 Series Fusion-Welded Vinyl Windows

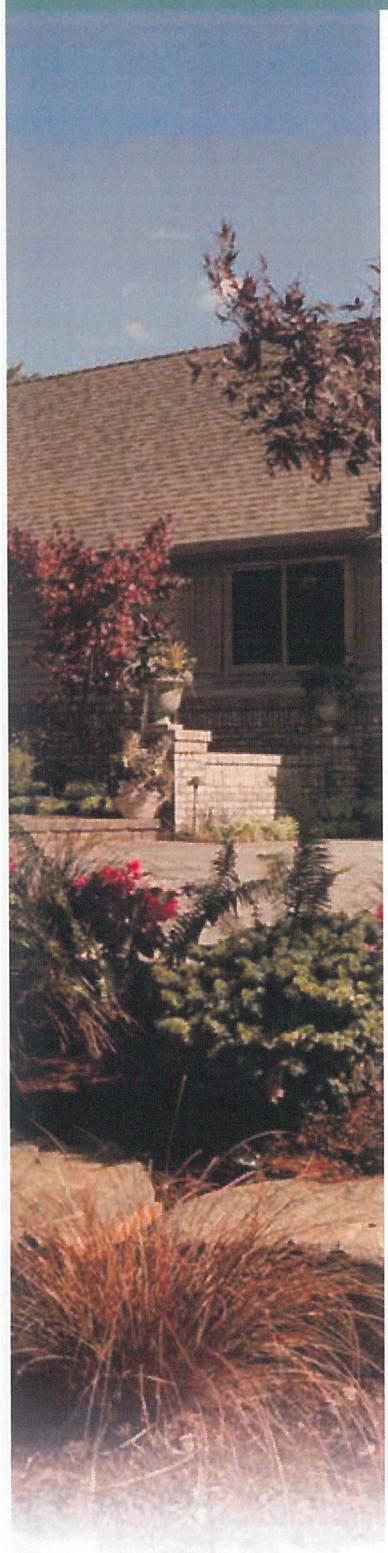
Beautifully engineered –
for exceptional style, strength and energy savings.

Alside®

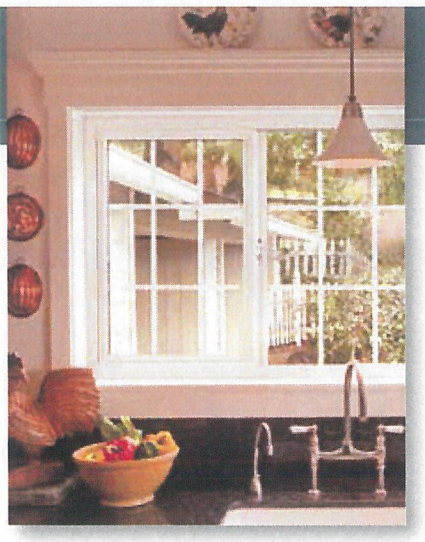
Innovations in Window Technology



A smart choice. Fairfield 80



Series Windows.



Designed for year-round energy conservation – and beautiful transformation.

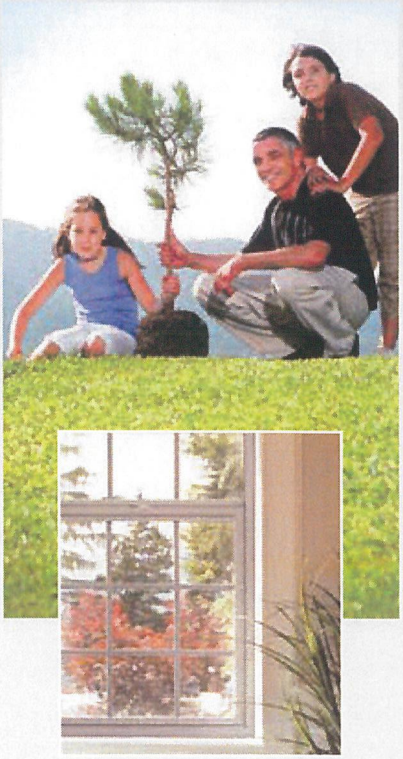
In Fairfield 80 Series Windows, you have discovered a window that will reduce your energy use while enhancing the beauty of your home, inside and out. Masterfully crafted with a premium vinyl construction, fusion-welded technology and high-performance glass, Fairfield 80 Series will exceed your every expectation for quality and value.

Experience you can trust.

When you buy Fairfield 80 Series Windows, you know you're getting more than just a frame, sashes and glass. You're getting the knowledge and technical skill of Alside's Product Development Group – experts with a proven track record of designing, building and testing superior, energy-efficient windows. These specialists know that to build the best windows, you have to start with the best materials and components. Their experience is your assurance of total satisfaction.

Future-forward window systems for advanced energy savings.

Fairfield 80 Series Windows incorporate precision-engineered components for a powerful thermal shield that keeps homes cooler in the summer and warmer in the winter with less energy use. Beginning with the fusion-welded mainframe and sashes, the weathertight construction features multi-chambered extrusions that trap dead air for an effective insulating barrier. Double-pile weatherstripping, interlocking sash meeting rails and ultra-efficient glass further prevent energy loss.



Go Green

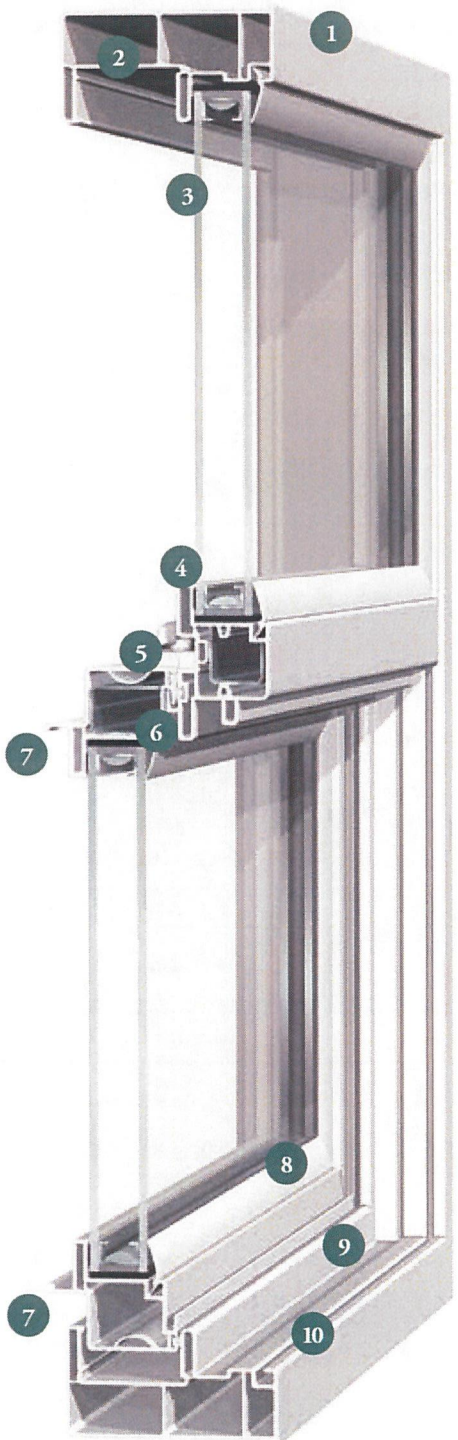
Exceptionally energy-smart and weathertight, Alside Windows not only help reduce fuel consumption needed to heat and cool homes, they also boast a long service life and achieve optimal material use and minimal waste in production. The majority of all in-plant vinyl scrap is recycled into other useful products, further reducing the environmental impact of waste. As well, a principal component in the production of vinyl is salt,[1] a sustainable and abundant natural resource!

[1] *The Vinyl Institute, //vinylinfo.org/resources/diagrams-vinyl-resin-processing/ (accessed 1-21-21).*

Functionality and Refinement

Leave it to Fairfield 80 Series Windows to deliver energy-saving innovations while lending the perfect touch of elegance to your home.

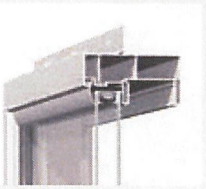
1. ***Premium vinyl mainframe and sashes*** are colored throughout – won't chip, peel, crack or warp and never need to be painted.
2. ***Multi-chambered mainframe and sash construction*** create effective insulating air spaces for thermal efficiency.
3. ***1" thick insulated glass unit*** with optimal air space improves year-round performance.
4. ***Intercept® Warm-Edge Spacer System*** helps block the transfer of heat and cold for reduced energy use.
5. ***Interlock at sash locking rail*** increases strength and reduces air infiltration.
6. ***Metal reinforcement in the locking rail*** increases rigidity and strength.
7. ***Fully extruded dual lift rails*** provide easy and convenient operation of the sash.
8. ***Drop-in glazing*** for added energy efficiency and interior aesthetic appeal.
9. ***Full capture sill*** enhances protection from air and water infiltration.
10. ***Hidden screen track*** for added beauty.



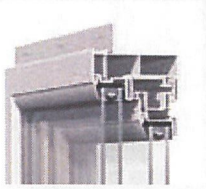
Plus these additional features:

- Fusion-welded frame and sashes for increased strength and structural integrity.
- 3 3/8" frame depth for multiple applications.
- Side-load sash operates on two concealed, pre-calibrated block and tackle sash balances.
- Double-pile weatherstripping at the meeting rail for added thermal protection.
- 1" thick glazing standard – triple glazing is also available.
- Side-load bottom sash makes cleaning convenient from inside the home.
- Water management system with offset drainage to the exterior.

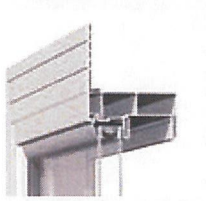
Fairfield 80 Series Windows come standard with a 1 3/8" nail fin. For enhanced appearance and ease of installation, three additional options – 1" set back nail fin, stucco fin and a block frame – also are available.



1 3/8" Nail Fin (standard)



1" Set Back Nail Fin



Stucco Fin

Block Frame

ENERGY STAR PARTNER

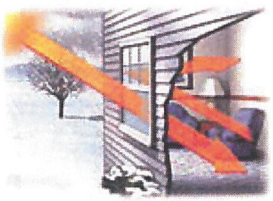
Alside offers a variety of ENERGY STAR® qualified products. Consult your window professional for the optimal glass package required for your home and climate zone.

Ultra-Efficient Insulated Glass Packages

Windows are about 80% glass, so it's important to choose a glass system that meets the specific challenges of your climate.

Upgrading your windows with a ClimaTech® insulated glass package will further optimize your windows. ClimaTech combines multi-layered, low-emissivity (Low-E) glass, argon gas† and the Intercept Warm-Edge Spacer System for improved energy efficiency compared to a standard clear glass unit. Low-E also reduces damaging UV rays that cause carpets and furnishings to fade.

In summer months, Low-E glass filters the sun's rays and reduces heat penetration from solar energy.

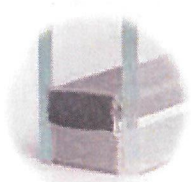


In winter months, Low-E glass lets warm solar rays into your home, while preventing indoor heat from escaping.

High-performance spacer systems.

Another key component to a window's energy efficiency is the spacer system.

The Intercept Warm-Edge Spacer features a unique, one-piece metal alloy, U-channel design that reduces heat loss through the window. It's stronger and better at retaining insulating gas than traditional box metal spacers, further reducing the transfer of heat at the edge of the glass unit for improved energy efficiency.



The Optional Foam Spacer combines a structural foam spacer with a seal of hot melt butyl to create a "warm" non-conductive edge. This non-metal design eliminates any metal-to-glass contact, thereby increasing the edge of the glass temperature for a highly effective thermal barrier and greater energy efficiency than a traditional box metal spacer.

Save more energy with ClimaTech glass.

ClimaTech insulated glass packages have proven to be far more effective than ordinary clear glass units. The lower the U-Factor, the less energy you'll need to heat your home. The lower the Solar Heat Gain Coefficient (SHGC), the more you'll conserve on air-conditioning.

Fairfield 80 Series Glass Performance Comparison[2]

	Single-Hung		*Sliding*	
	U-Factor	*SHGC*	*U-Factor*	*SHGC*
Clear Insulated	0.48	0.61	0.48	0.61
ClimaTech LT	0.35	0.33	0.35	0.33
ClimaTech	0.31	0.33	0.31	0.33
ClimaTech iE	0.31	0.33	0.31	0.33
ClimaTech Elite	0.31	0.22	0.31	0.21
ClimaTech ThermD	0.30	0.33	0.30	0.33
ClimaTech ThermD Elite	0.30	0.22	0.30	0.21
ClimaTech Plus	0.30	0.33	0.30	0.33
ClimaTech Plus Elite	0.29	0.22	0.29	0.21
ClimaTech TG2[3]	0.24	0.28	0.23	0.28
ClimaTech TG2 Plus[3]	0.22	0.28	0.22	0.28
ClimaTech Elite Extreme[3]	0.31	0.14	0.31	0.14
Energy HSG[3]	0.33	0.53	0.33	0.53

[2]Whole window values / single-strength glass
[3]Whole window values / double-strength glass

Glass Package Terminology:

Clear Insulated: Clear double-pane insulated glass unit.

ClimaTech LT: Soft coat, multi-layer vacuum deposition Low-E glass and the Intercept Spacer System.

ClimaTech: Soft coat, multi-layer, vacuum deposition Low-E glass with argon gas and Intercept Spacer System.

ClimaTech iE: Soft coat, multi-layer, vacuum deposition Low-E glass with argon gas and Intercept Spacer System. Carbonized foam insulating liners in select frame channels.

ClimaTech Elite: Soft coat, SHGC multi-layer, vacuum deposition Low-E glass with argon gas and Intercept Spacer System.

ClimaTech ThermD: Soft coat, multi-layer, vacuum deposition Low-E glass, argon gas and Stainless Steel Intercept Spacer System.

ClimaTech ThermD Elite: Soft coat, SHGC multi-layer, vacuum deposition Low-E glass, argon gas and Stainless Steel Intercept Spacer System.

ClimaTech Plus: Soft coat, multi-layer, vacuum deposition Low-E glass with argon gas and Foam Spacer System.

ClimaTech Plus Elite: Soft coat, SHGC multi-layer, vacuum deposition Low-E glass with argon gas and Foam Spacer System.

ClimaTech TG2: Triple-glazed unit with two surfaces of Low-E glass and two air spaces of argon gas with the Intercept Spacer System.

ClimaTech TG2 Plus: Triple-glazed unit with two surfaces of Low-E glass and two air spaces of argon gas with the Foam Spacer System.

ClimaTech Elite Extreme: Soft coat, multi-layer, vacuum deposition 340 Low-E glass, argon gas and Intercept Spacer System.

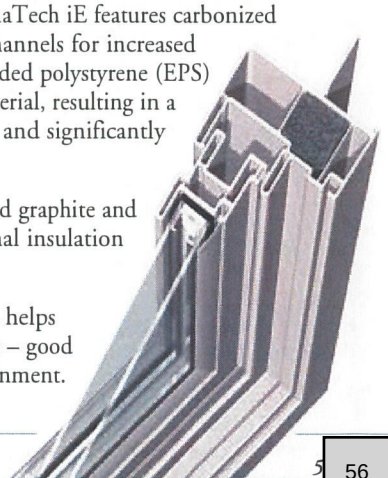
Energy HSG: High Solar Gain Low-E glass with argon gas and Intercept Spacer System.

Raising the Standard with iE Technology

Next-generation innovations. ClimaTech iE features carbonized foam liners in select mainframe channels for increased energy efficiency. iE features expanded polystyrene (EPS) with graphite added to the raw material, resulting in a carbonized foam that reflects heat and significantly improves insulation performance.

Highly efficient material. Integrated graphite and foam cell structure provides optimal insulation capacity but uses less material.

Reduced energy consumption. iE helps lower heating and cooling demands – good for your fuel budget and the environment.



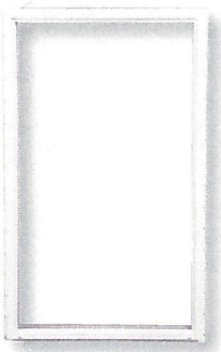
Picture and Fixed-Lite Windows / Specialty Shapes

Model A780 Picture Window**

	WIDTH	HEIGHT	U.I.
MINIMUM	10	10	
MAXIMUM	119.5	119.5	180

Unit Size is 1/2" smaller than Rough Opening

Fairfield 80 Series Picture Windows will lend a dramatic focal point to your room.

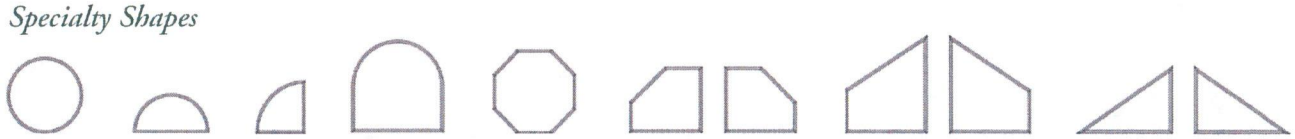


Large, beautiful picture windows expand your view without sacrificing comfort.

Paired with a beautiful outdoor view and an infusion of natural light, large picture windows can transform your home by creating a spacious and airy ambiance. Add specialty shape windows and fixed-lites to expand your window design and create an upscale appearance.

- Fusion-welded mainframe eliminates potential leak points at sill corners for improved energy efficiency and easy water drainage.
- Multi-walled extrusions provide superb welding strength and structural integrity.
- 1 1/8" wide nailing fin is welded in all four corners to ensure weathertight performance.
- 1" thick insulated glass with warm-edge technology helps deliver year-round energy savings.
- Narrow sight-lines for a clear, expanded view.
- Combine specialty shape windows and fixed-lites for dramatic appeal.

Specialty Shapes



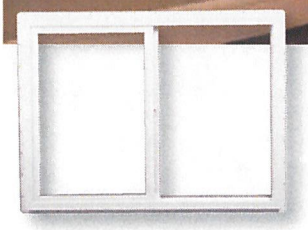
Full Round | *Half Round* | *Quarter Arch* | *Round Top* | *Octagon* | *Pentagon* | *Trapezoid* | *Triangle*

Sliding Windows

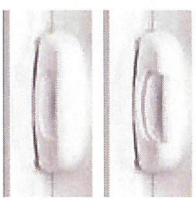
Available in 2- and 3-lite styles, Fairfield 80 Series Sliding Windows feature a generous glass area that offers a great outdoor view.

Distinctive for their smooth horizontal gliding action, sliding windows also feature sashes that lift out for easy cleaning.

- Fusion-welded mainframe and sashes eliminate potential leak points at sill corners for improved energy efficiency and easy water drainage.
- Multi-walled extrusions provide superb welding strength and structural integrity.
- Integral pull handle for easy and convenient opening and closing of the window.
- Integral full-length interlock with double-pile weatherstripping increases strength and thermal performance.
- Specially designed brass tandem roller system ensures smooth operation.
- Cam lock and keeper for a tight seal and increased energy efficiency.



Sliding windows combine casual elegance with a strong, weathertight construction.



Optional PAL lock shown unlocked and locked.

Model A282 Sliding Window**

	WIDTH	HEIGHT	U.I.
MINIMUM	20	14.5	
MINIMUM	29.5	10.5	
MAXIMUM	96	72	144

Unit Size is 1/2" smaller than Rough Opening

Model A283 Sliding Window**

	WIDTH	HEIGHT	U.I.
MINIMUM	40	10.5	
MAXIMUM	120	72	192

Unit Size is 1/2" smaller than Rough Opening

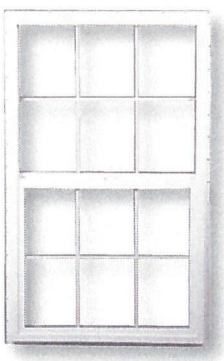
Single-Hung Windows

Model A581 Single-Hung Window**

	WIDTH	HEIGHT	U.I.
MINIMUM	15	24	
MINIMUM	10.5	30	
MAXIMUM	53.5	95.5	144

Unit Size is 1/2" smaller than Rough Opening

With simplicity and ease, Fairfield 80 Series Single-Hung Windows will beautify and protect your home.

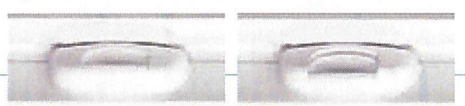


The traditional character and charm of the single-hung window will enhance any room of your home.

The classic elegance of single-hung windows complements a variety of architectural styles – from contemporary to rustic.

- Fusion-welded mainframe and sashes eliminate potential leak points at sill corners for improved energy efficiency and easy water drainage.
- Multi-walled extrusions provide superb welding strength and structural integrity.
- 1" thick insulated glass with warm-edge technology helps deliver year-round energy savings.
- Side load sash operates on two concealed, pre-calibrated sash balances.
- Integral lift rails ensure easy and convenient raising and lowering of the sash.
- Cam lock and keeper for a tight seal and increased energy efficiency.
- Full weatherstripping on the perimeter provides greater energy savings.

Optional PAL lock shown unlocked and locked.



Casement Windows

Fairfield Casement Windows feature an easy-touch crank handle for a gentle outward opening of the sash.

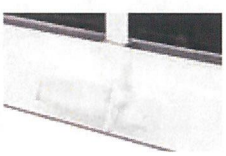
Combining casements with fixed-lites will enhance your window design and allow ventilation.

- A smooth, easy-to-operate heavy-duty positive crank mechanism that eliminates the need to strain and force windows open.
- Stainless steel hardware that provides years of trouble-free hinge operation.
- An energy-efficient custom design with double compression bulb seal to protect against air and water infiltration.
- Multiple lite configurations are available in a single mainframe.
- A lifetime limited warranty[¥] that covers your investment from top to bottom.

Model A682 Casement Window**

	WIDTH	HEIGHT	U.I.
MINIMUM	14.5	17.5	
MAXIMUM	35.5	77.5	114

Unit Size is 1/2" smaller than Rough Opening



Optional butterfly handle.

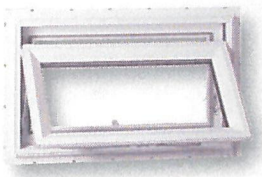
Totally revamp and enhance the look of any room with the addition of a casement window. They easily combine with fixed picture windows to let in the fresh breeze while keeping the weather out.

Awning Windows

Add a distinctive touch of style to your home with Awning Windows.

The unique design of the awning window is expertly crafted to impart a bold statement of style and dimension while allowing ample ventilation to any room.

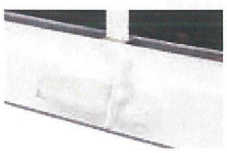
- Fusion-welded mainframe and sashes eliminate potential leak points at sill corners for improved energy efficiency and easy water drainage.
- Heavy-duty, state-of-the-art hinge system provides easy operation from inside the home.
- A dual locking system on each side of the window.
- Combine with fixed lites to allow for convenient ventilation while creating increased visibility.
- Multiple lite configurations are available in a single mainframe.



Model A681 Awning Window**

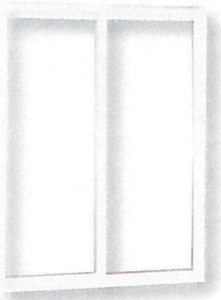
	WIDTH	HEIGHT	U.I.
MINIMUM	17.5	11.5	
MAXIMUM	47.5	47.5	96

Unit Size is 1/2" smaller than Rough Opening



Optional butterfly handle.

Sliding Patio Doors



With their pristine appearance, Sliding Patio Doors will create a stylish entry for your home.

A well-built patio door invites the beauty of outdoors inside, while providing an energy-efficient barrier against inclement weather.

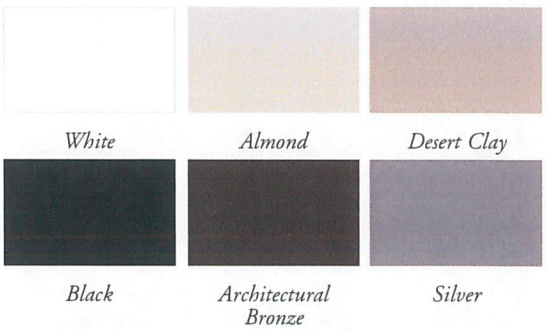
- Fusion-welded construction delivers long-lasting strength and durability.
- Sturdy 4 1/2" frame depth and 1" wide integral nailing fin with 1 3/8" set back for added structural integrity.
- Stucco fin option is also available.
- 1" thick insulated glass with warm-edge technology.
- Adjustable dual tandem roller system on a stainless steel track ensures easy operation.
- Keyed handle lock and foot lock options.
- Two, three, and four-panel configurations available.

The clean-line design and large glass area of patio doors will infuse your home with the warmth and beauty of natural light.

Decorative Options

Colors.

Fairfield 80 Series Windows are offered in White, Almond and Desert Clay with solid color formulated throughout. Black, Architectural Bronze and Silver exterior finishes are available with a White or Almond interior only.

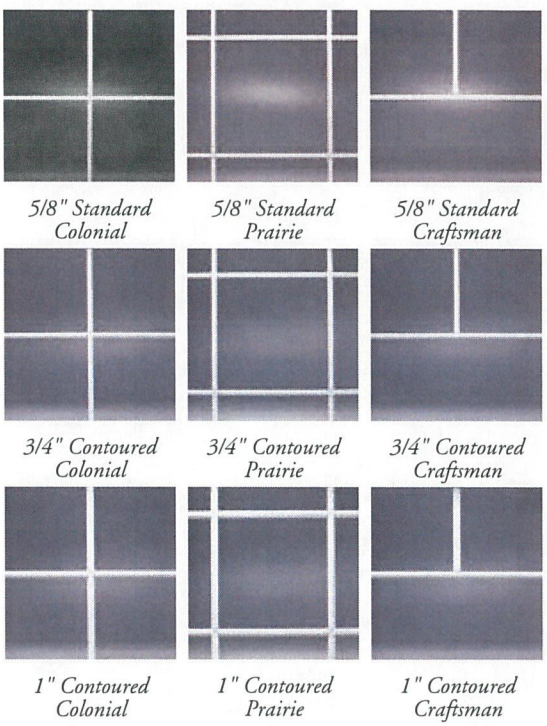


White *Almond* *Desert Clay*

Black *Architectural Bronze* *Silver*

Interior grids.

Decorative grids will lend style and dimension to your windows. Classic grids are available in white, almond and desert clay. All grid selections are offered in Colonial, Prairie and Craftsman patterns in a 5/8" standard flat grid, a 3/4" contoured grid and a 1" contoured grid.



5/8" Standard Colonial *5/8" Standard Prairie* *5/8" Standard Craftsman*

3/4" Contoured Colonial *3/4" Contoured Prairie* *3/4" Contoured Craftsman*

1" Contoured Colonial *1" Contoured Prairie* *1" Contoured Craftsman*

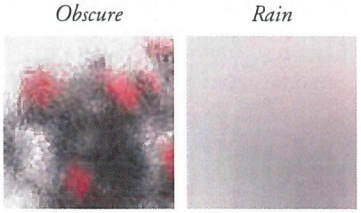
Obscure glass.

Obscure glass styles offer privacy for bathrooms and other areas of your home without blocking the natural light.

Obscure *Rain* *Narrow Reed*

The Alside Lifetime Limited Warranty.

Fairfield 80 Series Windows are made by Alside, a recognized leader in product innovation, manufacturing excellence and uncompromising quality control. That's a reputation you can count on, from the day your windows are installed until the day you sell your home. And to make your buying decision easier, Alside backs all Fairfield 80 Series Windows with its Lifetime Limited Warranty¥. . . one of the strongest in the industry.



Glue Chip *Satin Etched*

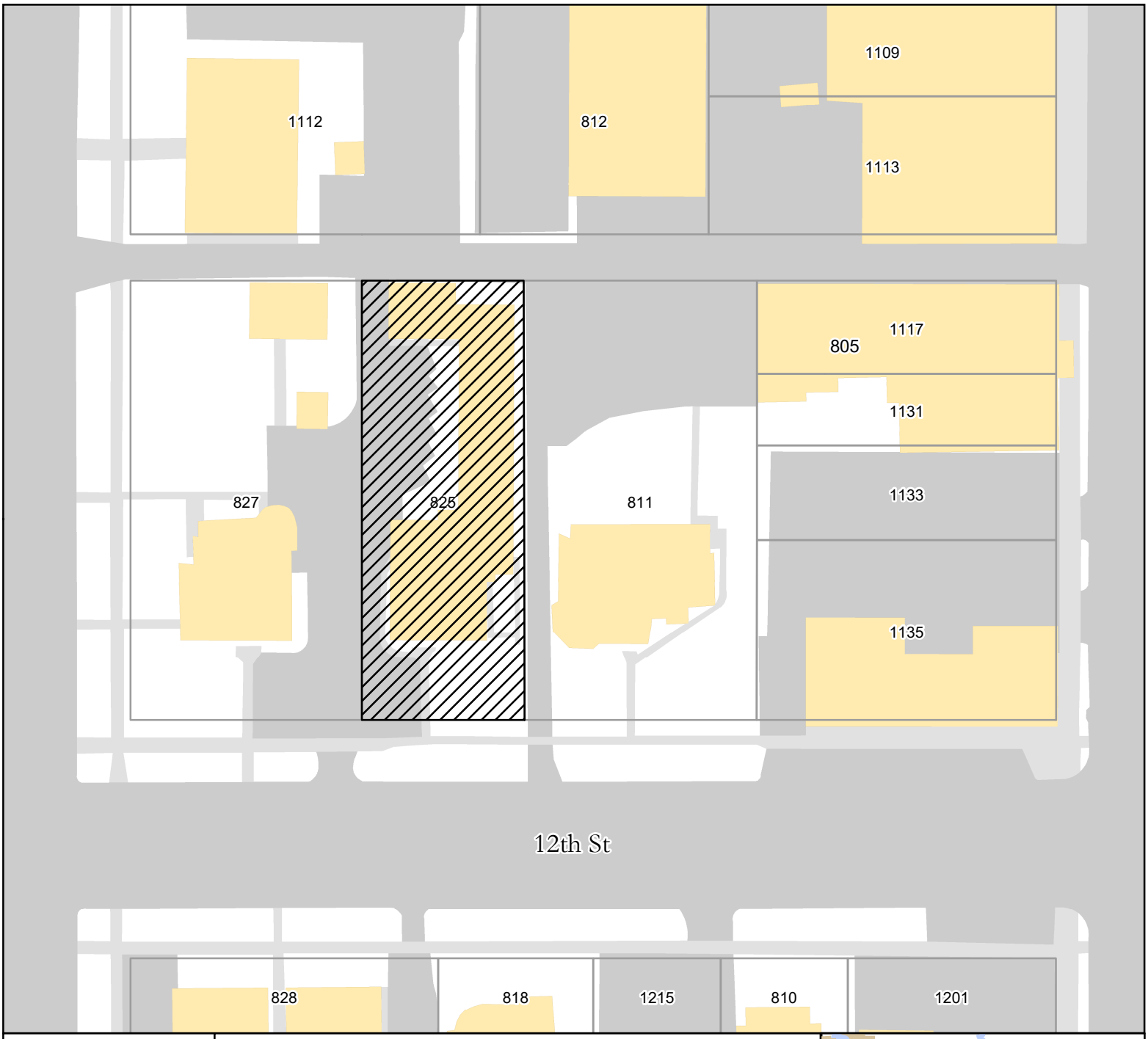
Alside 3773 State Road Cuyahoga Falls, Ohio 44223
1-800-922-6009 *www.alside.com*

Made in U.S.A.

Please recycle

Site Map - 825 12th Street

Attachment D



City of Greeley Colorado

Created: 1/20/2022
By: COG Planning, Hist Pres, GIS

* Based on Composite of 2007 Army Corps of Engineers Flood Study and Greeley Areas of Ecological Significance.

N
W E
S

Legend

825 12th Street

Parcels

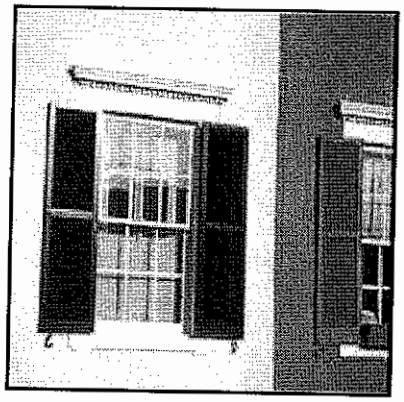
Structure

Notes:
All planimetric data was digitized from aerial photographs dated 1987, 1992, 1995, 2000, and 2005. Updates are continual and data representations will change over time. This product is not necessarily accurate to engineering or surveying standards but does meet National Mapping Accuracy Standards (NMAS). The information contained within this document is not intended to be used for the preperation of construction documents.

9 Preservation Briefs

Technical Preservation Services
National Park Service
U.S. Department of the Interior

The Repair of Historic Wooden Windows



John H. Myers

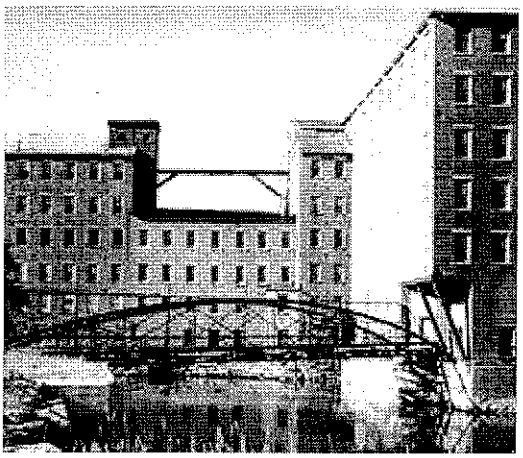
A NOTE TO OUR USERS: The web versions of the **Preservation Briefs** differ somewhat from the printed versions. Many illustrations are new, captions are simplified, illustrations are typically in color rather than black and white, and some complex charts have been omitted.

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. 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.

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.



Windows are frequently important visual focal points, especially on simple facades such as this mill building. Replacement of the multi-pane windows with larger panes could dramatically alter the appearance of the building. Photo: NPS files.

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.

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

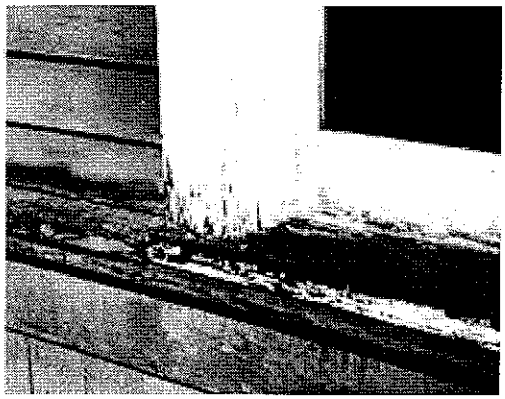
Physical Evaluation

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 runoff, 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.



Deterioration of poorly maintained windows usually begins on horizontal surfaces and at joints, where water can collect and saturate the wood. Photo: NPS files.

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. 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 endgrain 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 section 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.

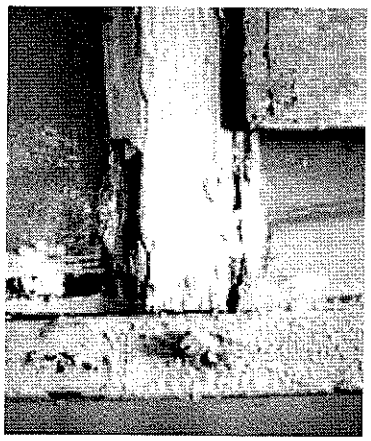
Another method of testing for soundness consists of pushing a sharp object into the wood, perpendicular to the surface. If deterioration has begun from the hidden side of a member and the core is badly decayed, the visible surface may appear to be sound wood. Pressure on the probe can force it through 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.

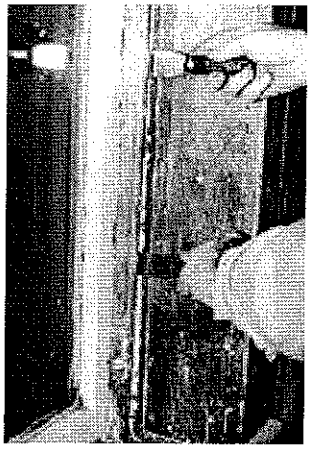
Repair Class I: Routine Maintenance

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.



This historic double-hung window has many layers of paint, some cracked and missing putty, slight separation at the joints, broken sash cords, and one cracked pane. Photo: NPS files.

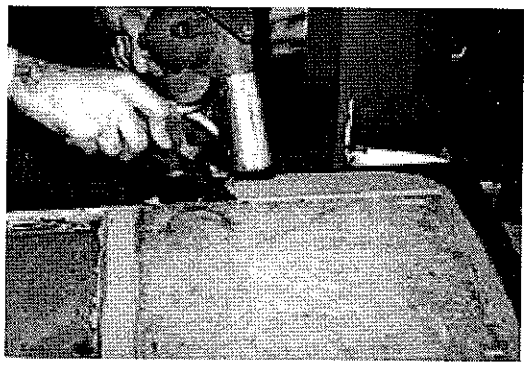
The routine maintenance required to upgrade a window to "like new" condition normally includes the following steps: 1) some degree of interior and exterior paint removal, 2) removal and repair of



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. Photo: NPS files.

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, 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.



Sash can be removed and repaired in a convenient work area. Paint is being removed from this sash with a hot air gun. Photo: NPS files.

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. 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.

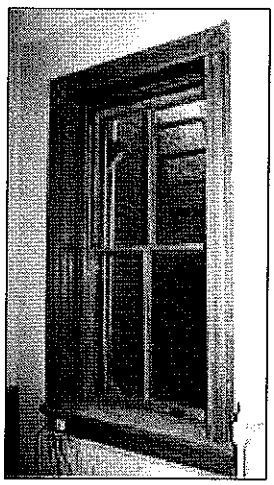
Removal of the upper sash on double-hung units is similar but the parting bead which holds it in place is set into a groove in the center of the stile and is thinner and more delicate than the interior stop. After removing any paint along the seam, the parting bead should be carefully pried out and worked 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, the glass should be removed or protected from the sudden temperature change which can cause breakage. An 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.

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 weather-tight 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. 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.



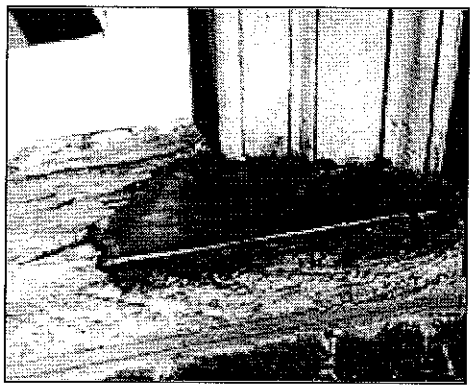
Following the relatively simple repairs, the window is weathertight, like new in appearance, and serviceable for many years to come.Photo: NPS files.

The operations just discussed summarize the efforts necessary to restore a window with minor deterioration to "like new" condition. 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.



This illustrates a two-part expoxy 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: NPS files.

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 semirigid epoxies which saturate the porous decayed wood and then harden. The surface of the consolidated wood can then be filled with a semirigid epoxy patching compound, sanded and painted. Epoxy patching compounds can be used to build up 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. 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. More information on epoxies can be found in the publication "Epoxies for Wood Repairs in Historic Buildings," cited in the bibliography.

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.

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. 024016000951), 1978.

Rehab Right. Oakland, California: City of Oakland Planning Department, 1978 (pp. 7883).

"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.

Weeks, Kay D. and David W. Look, "Preservation Briefs: 10 Exterior Paint Problems on Historic Woodwork." Washington, DC: Technical Preservation Services, U.S. Department of the Interior, 1982.

Washington, D.C. 1981

Home page logo: Historic six-over-six windows--preserved. Photo: NPS files.

This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), Heritage Preservation Services Division, National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments for a broad public.

Questions

Attachment F

Some of the web versions of the Preservation Briefs differ somewhat from the printed versions. Many illustrations are new and in color; Captions are simplified and some complex charts are omitted. To order hard copies of the Briefs, see Printed Publications.

PRESERVATION BRIEFS

Repointing Mortar Joints in Historic Masonry Buildings

Robert C. Mack, FAIA, and John P. Speweik

Download the PDF

Soft mortar for repointing. Photo: John P. Speweik.

Masonry—brick, stone, terra-cotta, and concrete block—is found on nearly every historic building. Structures with all-masonry exteriors come to mind immediately, but most other buildings at least have masonry foundations or chimneys. Although generally considered "permanent," masonry is subject to deterioration, especially at the mortar joints. Repointing, also known simply as "pointing"or—somewhat inaccurately—"tuck pointing"*, is the process of removing deteriorated mortar from the joints of a masonry wall and replacing it with new mortar. Properly done, repointing restores the visual and physical integrity of the masonry. Improperly done, repointing not only detracts from the appearance of the building, but may also cause physical damage to the masonry units themselves.

The purpose of this Brief is to provide general guidance on appropriate materials and methods for repointing historic masonry buildings and it is intended to benefit building owners, architects, and contractors. The Brief should serve as a guide to prepare specifications for repointing historic masonry buildings. It should also help develop sensitivity to the particular needs of historic masonry, and to assist historic building owners in working cooperatively with architects, architectural conservators and historic preservation consultants, and contractors. Although specifically intended for historic buildings, the guidance is appropriate for other masonry buildings as well. This publication updates *Preservation Briefs 2: Repointing Mortar Joints in Historic Brick Buildings* to include all types of historic unit masonry. The scope of the earlier Brief has also been expanded to acknowledge that the many buildings constructed in the first half of the 20th century are

now historic and eligible for listing in the National Register of Historic Places, and that they may have been originally constructed with portland cement mortar.

**Tuckpointing technically describes a primarily decorative application of a raised mortar joint or lime putty joint on top of flush mortar joints.*

Historical Background

Mortar consisting primarily of lime and sand has been used as an integral part of masonry structures for thousands of years. Up until about the mid-19th century, lime or quicklime (sometimes called lump lime) was delivered to construction sites, where it had to be slaked, or combined with water. Mixing with water caused it to boil and resulted in a wet lime putty that was left to mature in a pit or wooden box for several weeks, up to a year. Traditional mortar was made from lime putty, or slaked lime, combined with local sand, generally in a ratio of 1 part lime putty to 3 parts sand by volume. Often other ingredients, such as crushed marine shells (another source of lime), brick dust, clay, natural cements, pigments, and even animal hair were also added to mortar, but the basic formulation for lime putty and sand mortar remained unchanged for centuries until the advent of portland cement or its forerunner, Roman cement, a natural, hydraulic cement.

Portland cement was patented in Great Britain in 1824. It was named after the stone from Portland in Dorset which it resembled when hard. This is a fast-curing, hydraulic cement which hardens under water. Portland cement was first manufactured in the United States in 1872, although it was imported before this date. But it was not in common use throughout the country until the early 20th century. Up until the turn of the century portland cement was considered primarily an additive, or "minor ingredient" to help accelerate mortar set time. By the 1930s, however, most masons used a mix of equal parts portland cement and lime putty. Thus, the mortar found in masonry structures built between 1873 and 1930 can range from pure lime and sand mixes to a wide variety of lime, portland cement, and sand combinations.

In the 1930s more new mortar products intended to hasten and simplify masons' work were introduced in the U.S. These included **masonry cement**, a premixed, bagged mortar which is a combination of portland cement and ground limestone, and **hydrated lime**, machine-slaked lime that eliminated the necessity of slaking quicklime into putty at the site.

Identifying the Problem Before Repointing

The decision to repoint is most often related to some obvious sign of deterioration, such as disintegrating mortar, cracks in mortar joints, loose bricks or stones, damp walls, or damaged plasterwork. It is, however, erroneous to assume that repointing alone will solve deficiencies that result from other problems. The root cause of the deterioration—leaking roofs or gutters, differential settlement of the building, capillary action causing rising damp, or extreme weather exposure—should always be dealt with prior to beginning work.

Without appropriate repairs to eliminate the source of the problem, mortar deterioration will continue and any repointing will have been a waste of time and money.

Masons practice using lime putty mortar to repair historic marble. Photo: NPS files.

Use of Consultants

Because there are so many possible causes for deterioration in historic buildings, it may be desirable to retain a consultant, such as a historic architect or architectural conservator, to analyze the building. In addition to determining the most appropriate solutions to the problems, a consultant can prepare specifications which reflect the particular requirements of each job and can provide oversight of the work in progress. Referrals to preservation consultants frequently can be obtained from State Historic Preservation Offices, the American Institute for Conservation of Historic and Artistic Works (AIC), the Association for Preservation Technology (APT), and local chapters of the American Institute of Architects (AIA).

Finding an Appropriate Mortar Match

Preliminary research is necessary to ensure that the proposed repointing work is both physically and visually appropriate to the building. Analysis of unweathered portions of the historic mortar to which the new mortar will be matched can suggest appropriate mixes for the repointing mortar so that it will not damage the building because it is excessively strong or vapor impermeable.

Examination and analysis of the masonry units—brick, stone or terra cotta—and the techniques used in the original construction will assist in maintaining the building's historic appearance. A simple, non- technical, evaluation of the masonry units and

mortar can provide information concerning the relative strength and permeability of each—critical factors in selecting the repointing mortar—while a visual analysis of the historic mortar can provide the information necessary for developing the new mortar mix and application techniques.

This late 19th century granite has recently been repointed with the joint profile and mortar color carefully matched to the original. Photo: NPS files.

Although not crucial to a successful repointing project, for projects involving properties of special historic significance, a mortar analysis by a qualified laboratory can be useful by providing information on the original ingredients. However, there are limitations with such an analysis, and replacement mortar specifications should not be based solely on laboratory analysis. Analysis requires interpretation, and there are important factors which affect the condition and performance of the mortar that cannot be established through laboratory analysis. These may include: the original water content, rate of curing, weather conditions during original construction, the method of mixing and placing the mortar, and the cleanliness and condition of the sand. *The most useful information that can come out of laboratory analysis is the identification of sand by gradation and color.* This allows the color and the texture of the mortar to be matched with some accuracy because sand is the largest ingredient by volume.

In creating a repointing mortar that is compatible with the masonry units, the objective is to achieve one that matches the historic mortar as closely as possible, so that the new material can coexist with the old in a sympathetic, supportive and, if necessary, sacrificial capacity. The exact physical and chemical properties of the historic mortar are not of major significance as long as the new mortar conforms to the following criteria:

- The new mortar must match the historic mortar in **color, texture and tooling.** (If a laboratory analysis is undertaken, it may be possible to match the binder components and their proportions with the historic mortar, if those materials are available.)
- The **sand must match the sand** in the historic mortar. (The color and texture of the new mortar will usually fall into place if the sand is matched successfully.)
- The new mortar must have **greater vapor permeability** and be **softer** (measured in compressive strength) than the masonry units.
- The new mortar must be **as vapor permeable** and **as soft or softer** (measured in compressive strength) than the historic mortar. (Softness or hardness is not necessarily an indication of permeability; old, hard lime mortars can still retain high permeability.)

Mortar Analysis

Methods for analyzing mortars can be divided into two broad categories: **wet chemical** and **instrumental**. Many laboratories that analyze historic mortars use a simple **wet-chemical** method called acid digestion, whereby a sample of the mortar is crushed and then mixed with a dilute acid. The acid dissolves all the carbonate-containing minerals not only in the binder, but also in the aggregate (such as oyster shells, coral sands, or other carbonate-based materials), as well as any other acid-soluble materials. The sand and fine-grained acid-insoluble material is left behind. There are several variations on the simple acid digestion test. One involves collecting the carbon dioxide gas given off as the carbonate is digested by the acid; based on the gas volume the carbnate content of the mortar can be accurately determined (Jedrzejewska, 1960). Simple acid digestion methods are rapid, inexpensive, and easy to perform, but the information they provide about the original composition of a mortar is limited to the color and texture of the sand. The gas collection method provides more information about the binder than a simple acid digestion test.

This mortar is the proper consistency for repointing historic brick. Photo: John P. Speweik.

Instrumental analysis methods that have been used to evaluate mortars include polarized light or thin-section microscopy, scanning electron microscopy, atomic absorption spectroscopy, X-ray diffraction, and differential thermal analysis. All instrumental methods require not only expensive, specialized equipment, but also highly-trained experienced analysts. However, instrumental methods can provide much more information about a mortar. Thin-section microscopy is probably the most commonly used instrumental method. Examination of thin slices of a mortar in transmitted light is often used to supplement acid digestion methods, particularly to look for carbonate-based aggregate. For example, the new ASTM test method, ASTM C 1324-96 "Test Method for Examination and Analysis of Hardened Mortars" which was designed specifically for the analysis of modern lime-cement and masonry cement mortars, combines a complex series of wet chemical analyses with thin-section microscopy.

The drawback of most mortar analysis methods is that mortar samples of known composition have not been analyzed in order to evaluate the method. Historic mortars were not prepared to narrowly defined specifications from materials of

uniform quality; they contain a wide array of locally derived materials combined at the discretion of the mason. While a particular method might be able to accurately determine the original proportions of a lime-cement-sand mortar prepared from modern materials, the usefulness of that method for evaluating historic mortars is questionable unless it has been tested against mortars prepared from materials more commonly used in the past.

Properties of Mortar

Mortars for repointing should be softer or more permeable than the masonry units and no harder or more impermeable than the historic mortar to prevent damage to the masonry units. It is a common error to assume that hardness or high strength is a measure of appropriateness, particularly for lime-based historic mortars. Stresses within a wall caused by expansion, contraction, moisture migration, or settlement must be accommodated in some manner; in a masonry wall, these stresses should be relieved by the mortar rather than by the masonry units. A mortar that is stronger in compressive strength than the masonry units will not "give," thus causing stresses to be relieved through the masonry units—resulting in permanent damage to the masonry, such as cracking and spalling, that cannot be repaired easily.

While stresses can also break the bond between the mortar and the masonry units, permitting water to penetrate the resulting hairline cracks, this is easier to correct in the joint through repointing than if the break occurs in the masonry units.

This early 19th century building is being repointed with lime mortar. Photo: Travis McDonald.

Permeability, or rate of vapor transmission, is also critical. High lime mortars are more permeable than denser cement mortars. Historically, mortar acted as a bedding material—not unlike an expansion joint—rather than a "glue" for the masonry units, and moisture was able to migrate through the mortar joints rather than the masonry units. When moisture evaporates from the masonry it deposits any soluble salts either on the surface as *efflorescence* or below the surface as *subflorescence.* While salts deposited on the surface of masonry units are usually relatively harmless, salt crystallization within a masonry unit creates pressure that can cause parts ofthe outer surface to spall off or delaminate. If the mortar does not permitmoisture or moisture vapor to migrate out of the wall and evaporate, theresult will be damage to the masonry units.

Components of Mortar

Sand

Sand is the largest component of mortar and the material that gives mortar its distinctive color, texture and cohesiveness. Sand must be free of impurities, such as salts or clay. The three key characteristics of sand are: particle shape, gradation and void ratios.

When viewed under a magnifying glass or low-power microscope, particles of sand generally have either rounded edges, such as found in beach and river sand, or sharp, angular edges, found in crushed or manufactured sand. For repointing mortar, rounded or natural sand is preferred for two reasons. It is usually similar to the sand in the historic mortar and provides a better visual match. It also has better working qualities or plasticity and can thus be forced into the joint more easily, forming a good contact with the remaining historic mortar and the surface of the adjacent masonry units. Although manufactured sand is frequently more readily available, it is usually possible to locate a supply of rounded sand.

The gradation of the sand (particle size distribution) plays a very important role in the durability and cohesive properties of a mortar. Mortar must have a certain percentage of large to small particle sizes in order to deliver the optimum performance. Acceptable guidelines on particle size distribution may be found in ASTM C 144 (American Society for Testing and Materials). However, in actuality, since neither historic nor modern sands are always in compliance with ASTM C 144, matching the same particle appearance and gradation usually requires sieving the sand.

A scoop of sand contains many small voids between the individual grains. A mortar that performs well fills all these small voids with binder (cement/lime combination or mix) in a balanced manner. Well-graded sand generally has a 30 per cent void ratio by volume. Thus, 30 per cent binder by volume generally should be used, unless the historic mortar had a different binder: aggregate ratio. This represents the 1:3 binder to sand ratios often seen in mortar specifications.

For repointing, sand generally should conform to ASTM C 144 to assure proper gradation and freedom from impurities; some variation may be necessary to match the original size and gradation. Sand color and texture also should match the original as closely as possible to provide the proper color match without other additives.

Lime

Mortar formulations prior to the late-19th century used lime as the primary binding material. Lime is derived from heating limestone at high temperatures which burns off the carbon dioxide, and turns the limestone into quicklime. There are three

types of limestone—calcium, magnesium, and dolomitic—differentiated by the different levels of magnesium carbonate they contain which impart specific qualities to mortar. Historically, calcium lime was used for mortar rather than the dolomitic lime (calcium magnesium carbonate) most often used today. But it is also important to keep in mind the fact that the historic limes, and other components of mortar, varied a great deal because they were natural, as opposed to modern lime which is manufactured and, therefore, standardized. Because some of the kinds of lime, as well as other components of mortar, that were used historically are no longer readily available, even when a conscious effort is made to replicate a "historic" mix, this may not be achievable due to the differences between modern and historic materials.

Lime, itself, when mixed with water into a paste is very plastic and creamy. It will remain workable and soft indefinitely, if stored in a sealed container. Lime (calcium hydroxide) hardens by carbonation absorbing carbon dioxide primarily from the air, converting itself to calcium carbonate. Once a lime and sand mortar is mixed and placed in a wall, it begins the process of carbonation. If lime mortar is left to dry too rapidly, carbonation of the mortar will be reduced, resulting in poor adhesion and poor durability. In addition, lime mortar is slightly water soluble and thus is able to re-seal any hairline cracks that may develop during the life of the mortar. Lime mortar is soft, porous, and changes little in volume during temperature fluctuations thus making it a good choice for historic buildings. *Because of these qualities, high calcium lime mortar may be considered for many repointing projects, not just those involving historic buildings.*

Caulking was inappropriately used here in place of mortar on the top of the wall. As a result, it has not been durable. Photo: NPS files.

For repointing, lime should conform to ASTM C 207, Type S, or Type SA, Hydrated Lime for Masonry Purposes. This machine-slaked lime is designed to assure high plasticity and water retention. The use of quicklime which must be slaked and soaked by hand may have advantages over hydrated lime in some restoration projects if time and money allow.

Lime Putty

Lime putty is slaked lime that has a putty or paste-like consistency. It should conform to ASTM C 5. Mortar can be mixed using lime putty according to ASTM C 270 property or proportion specification.

Portland Cement

More recent, 20th-century mortar has used portland cement as a primary binding material. A straight portland cement and sand mortar is extremely hard, resists the movement of water, shrinks upon setting, and undergoes relatively large thermal movements. When mixed with water, portland cement forms a harsh, stiff paste that is quite unworkable, becoming hard very quickly. (Unlike lime, portland cement will harden regardless of weather conditions and does not require wetting and drying cycles.) Some portland cement assists the workability and plasticity of the mortar without adversely affecting the finished project; it also provides early strength to the mortar and speeds setting. Thus, it may be appropriate to add some portland cement to an essentially lime-based mortar even when repointing relatively soft 18th or 19th century brick under some circumstances when a slightly harder mortar is required. The more portland cement that is added to a mortar formulation the harder it becomes—and the faster the initial set.

For repointing, portland cement should conform to ASTM C 150. White, non- staining portland cement may provide a better color match for some historic mortars than the more commonly available grey portland cement. But, it should not be assumed, however, that white portland cement is always appropriate for all historic buildings, since the original mortar may have been mixed with grey cement. The cement should not have more than 0.60 per cent alkali to help avoid efflorescence.

Masonry Cement

Masonry cement is a preblended mortar mix commonly found at hardware and home repair stores. It is designed to produce mortars with a compressive strength of 750 psi or higher when mixed with sand and water at the job site. It may contain hydrated lime, but it always contains a large amount of portland cement, as well as ground limestone and other workability agents, including air-entraining agents. Because masonry cements are not required to contain hydrated lime, and generally do not contain lime, they produce high strength mortars that can damage historic masonry. *For this reason, they generally are not recommended for use on historic masonry buildings.*

Lime Mortar (pre-blended)

Hydrated lime mortars, and pre-blended lime putty mortars with or without a matched sand are commercially available. Custom mortars are also available with color. In most instances, pre-blended lime mortars containing sand may not provide an exact match; however, if the project calls for total repointing, a pre-blended lime mortar may be worth considering as long as the mortar is compatible in strength with the masonry. If the project involves only selected, "spot" repointing, then it may be better to carry out a mortar analysis which can provide a custom pre-blended lime mortar with a matching sand.

In either case, if a preblended lime mortar is to be used, it should contain Type S or SA hydrated lime conforming to ASTM C 207.

Water

Water should be potable—clean and free from acids, alkalis, or other dissolved organic materials.

Other Components

Historic components

In addition to the color of the sand, the texture of the mortar is of critical importance in duplicating historic mortar. Most mortars dating from the mid-19th century on—with some exceptions—have a fairly homogeneous texture and color. Some earlier mortars are not as uniformly textured and may contain lumps of partially burned lime or "dirty lime", shell (which often provided a source of lime, particularly in coastal areas), natural cements, pieces of clay, lampblack or other pigments, or even animal hair. The visual characteristics of these mortars can be duplicated through the use of similar materials in the repointing mortar.

Replicating such unique or individual mortars will require writing new specifications for each project. If possible, suggested sources for special materials should be included. For example, crushed oyster shells can be obtained in a variety of sizes from poultry supply dealers.

Pigments

Some historic mortars, particularly in the late 19th century, were tinted to match or contrast with the brick or stone. Red pigments, sometimes in the form of brick dust, as well as brown, and black pigments were commonly used. Modern pigments are available which can be added to the mortar at the job site, but they should not exceed 10 per cent by weight of the portland cement in the mix, and carbon black should be limited to 2 per cent. Only synthetic mineral oxides, which are alkali-proof and sun-fast, should be used to prevent bleaching and fading.

Modern Components

Admixtures are used to create specific characteristics in mortar, and whether they should be used will depend upon the individual project. *Air entraining agents*, for example, help the mortar to resist freeze-thaw damage in northern climates. *Accelerators* are used to reduce mortar freezing prior to setting while *retarders* help to extend the mortar life in hot climates. Selection of admixtures should be made by the architect or architectural conservator as part of the specifications, not something routinely added by the masons.

Generally, modern chemical additives are unnecessary and may, in fact, have detrimental effects in historic masonry projects. The use of antifreeze compounds is not recommended. They are not very effective with high lime mortars and may introduce salts, which may cause efflorescence later. A better practice is to warm the sand and water, and to protect the completed work from freezing. No definitive study has determined whether air-entraining additives should be used to resist frost action and enhance plasticity, but in areas of extreme exposure requiring high-strength mortars with lower permeability, air-entrainment of 10-16 percent may be desirable (see formula for "severe weather exposure" in Mortar Type and Mix). Bonding agents are not a substitute for proper joint preparation, and they should generally be avoided. If the joint is properly prepared, there will be a good bond between the new mortar and the adjacent surfaces. In addition, a bonding agent is difficult to remove if smeared on a masonry surface.

Mortar Type and Mix

Mortars for repointing projects, especially those involving historic buildings, typically are custom mixed in order to ensure the proper physical and visual qualities. These materials can be combined in varying proportions to create a mortar with the desired performance and durability. The actual specification of a particular mortar type should take into consideration all of the factors affecting the life of the building including: current site conditions, present condition of the masonry, function of the new mortar, degree of weather exposure, and skill of the mason.

Thus, no two repointing projects are exactly the same. Modern materials specified for use in repointing mortar should conform to specifications of the American Society for Testing and Materials (ASTM) or comparable federal specifications, and the resulting mortar should conform to ASTM C 270, Mortar for Unit Masonry.

Specifying the proportions for the repointing mortar for a specific job is not as difficult as it might seem. Five mortar types, each with a corresponding recommended mix, have been established by ASTM to distinguish high strength mortar from soft flexible mortars. The ASTM designated them in decreasing order of approximate general strength as Type M (2,500 psi), Type S (1,800 psi), Type N (750 psi), Type O (350 psi) and Type K (75 psi). (The letters identifying the types are from the words MASON WORK using every other letter.) Type K has the highest lime content of the mixes that

Here, a hammer and chisel are being correctly used to prepare a joint for repointing. Photo: John P. Speweik.

contain portland cement, although it is seldom used today, except for some historic preservation projects. The designation "L" in the accompanying chart identifies a straight lime and sand mix. Specifying the appropriate ASTM mortar by proportion of ingredients, will ensure the desired physical properties. Unless specified otherwise, measurements or proportions for mortar mixes are always given in the following order: cement-lime-sand. Thus, a Type K mix, for example, would be referred to as 1-3-10, or 1 part cement to 3 parts lime to 10 parts sand. Other requirements to create the desired visual qualities should be included in the specifications.

The strength of a mortar can vary. If mixed with higher amounts of portland cement, a harder mortar is obtained. The more lime that is added, the softer and more plastic the mortar becomes, increasing its workability. A mortar strong in compressive strength might be desirable for a hard stone (such as granite) pier holding up a bridge deck, whereas a softer, more permeable lime mortar would be preferable for a historic wall of soft brick. Masonry deterioration caused by salt deposition results when the mortar is less permeable than the masonry unit. A strong mortar is still more permeable than hard, dense stone. However, in a wall constructed of soft bricks where the masonry unit itself has a relatively high permeability or vapor transmission rate, a soft, high lime mortar is necessary to retain sufficient permeability.

Budgeting and Scheduling

Repointing is both expensive and time consuming due to the extent of handwork and special materials required. It is preferable to repoint only those areas that require work rather than an entire wall, as is often specified. But, if 25 to 50 per cent or more of a wall needs to be repointed, repointing the entire wall may be more cost effective than spot repointing.

Total repointing may also be more sensible when access is difficult, requiring the erection of expensive scaffolding (unless the majority of the mortar is sound and unlikely to require replacement in the foreseeable future). Each project requires judgement based on a variety of factors. Recognizing this at the outset will help to prevent many jobs from becoming prohibitively expensive.

When repairing this stone wall, the mason matched the raised profile of the original tuckpointing. Photo: NPS files.

In scheduling, seasonal aspects need to be considered first. Generally speaking, wall temperatures between 40 and 95 degrees F (8 and 38 degrees C) will prevent freezing or excessive evaporation of the water in the mortar. Ideally, repointing should be done in shade, away from strong sunlight in order to slow the drying process, especially during hot weather. If necessary, shade can be provided for large-scale projects with appropriate modifications to scaffolding.

The relationship of repointing to other work proposed on the building must also be recognized. For example, if paint removal or cleaning is anticipated, and if the mortar joints are basically sound and need only selective repointing, it is generally better to postpone repointing until after completion of these activities. However, if the mortar has eroded badly, allowing moisture to penetrate deeply into the wall, repointing should be accomplished before cleaning. Related work, such as structural or roof repairs, should be scheduled so that they do not interfere with repointing and so that all work can take maximum advantage of erected scaffolding.

A mechanical grinder improperly used to cut out the horizontal joint and incompatible repointing have seriously damaged the 19th century brick. Photo: NPS files.

Building managers also must recognize the difficulties that a repointing project can create.The process is time consuming, and scaffolding may need to remain in place for an extended period of time. The joint preparation process can be quite noisy and can generate large quantities of dust which must be controlled, especially at air intakes to protect human health, and also where it might damage operating machinery. Entrances may be blocked from time to time making access difficult for both building tenants and visitors. Clearly, building managers will need to coordinate the repointing work with other events at the site.

Contractor Selection

Contractor Selection The ideal way to select a contractor is to ask knowledgeable owners of recently repointed historic buildings for recommendations. Qualified contractors then can provide lists of other repointing projects for inspection. More commonly, however, the contractor for a repointing project is selected through a competitive bidding process over which the client or consultant has only limited control. In this situation it is important to ensure that the specifications stipulate that masons must have a minimum of five years' experience with repointing historic masonry buildings to be eligible to bid on the project. Contracts are awarded to the lowest responsible bidder, and bidders who have performed poorly on other projects usually can be eliminated from consideration on this basis, even if they have the lowest prices.

The contract documents should call for unit prices as well as a base bid. Unit pricing forces the contractor to determine in advance what the cost addition or reduction will be for work which varies from the scope of the base bid. If, for example, the contractor has fifty linear feet less of stone repointing than indicated on the contract documents but thirty linear feet more of brick repointing, it will be easy to determine the final price for the work. Note that each type of work—brick repointing, stone repointing, or similar items—will have its own unit price. The unit price also should reflect quantities; one linear foot of pointing in five different spots will be more expensive than five contiguous linear feet.

Execution of the Work

Test Panels

These panels are prepared by the contractor using the same techniques that will be used on the remainder of the project. Several panel locations—preferably not on the front or other highly visible location of the building—may be necessary to include all types of masonry, joint styles, mortar colors, and other problems likely to be encountered on the job.

Unskilled repointing has negatively impacted the character of this late-19th century building. Photo: NPS files.

If cleaning tests, for example, are also to be undertaken, they should be carried out in the same location. Usually a 3 foot by 3 foot area is sufficient for brickwork, while a somewhat larger area may be required for stonework. These panels establish an acceptable standard of work and serve as a benchmark for evaluating and accepting subsequent work on the building.

Joint Preparation

Old mortar should be removed to a minimum depth of 2 to 2-1/2 times the width of the joint to ensure an adequate bond and to prevent mortar "popouts." For most brick joints, this will require removal of the mortar to a depth of approximately Ω to 1 inch; for stone masonry with wide joints, mortar may need to be removed to a depth of several inches. Any loose or disintegrated mortar beyond this minimum depth also should be removed.

Although some damage may be inevitable, careful joint preparation can help limit damage to masonry units. The traditional manner of removing old mortar is through the use of hand chisels and mash hammers. Though labor-intensive, in most instances this method poses the least threat for damage to historic masonry units and produces the best final product.

The most common method of removing mortar, however, is through the use of power saws or grinders. The use of power tools by unskilled masons can be disastrous for historic masonry, particularly soft brick. Using power saws on walls with thin joints, such as most brick walls, almost always will result in damage to the masonry units by breaking the edges and by overcutting on the head, or vertical joints.

However, small pneumatically-powered chisels generally can be used safely and effectively to remove mortar on historic buildings as long as the masons maintain appropriate control over the equipment. Under certain circumstances, thin diamond-bladed grinders may be used to cut out *horizontal* joints only on hard portland cement mortar common to most early-20th century masonry buildings. Usually, automatic tools most successfully remove old mortar without damaging the masonry units when they are used in combination with hand tools in preparation for repointing. Where horizontal joints are uniform and fairly wide, it may be possible to use a power masonry saw to assist the removal of mortar, such as by cutting along the middle of the joint; final mortar removal from the sides of the joints still should be done with a hand chisel and hammer. Caulking cutters with diamond blades can sometimes be used successfully to cut out joints without damaging the masonry. Caulking cutters are slow; they do not rotate, but vibrate at very high speeds, thus minimizing the possibility of damage to masonry units. Although mechanical tools may be safely used in limited circumstances to cut out horizontal joints in preparation for repointing, they should never be used on vertical joints because of the danger of slipping and cutting into the brick above or below the vertical joint. Using power tools to remove mortar without damaging the surrounding masonry units also necessitates highly skilled masons experienced in working on historic masonry buildings. Contractors should demonstrate proficiency with power tools before their use is approved.

Using any of these power tools may also be more acceptable on hard stone, such as quartzite or granite, than on terra cotta with its glass-like glaze, or on soft brick or stone. The test panel should determine the acceptability of power tools. If power tools are to be permitted, the contractor should establish a quality control program to account for worker fatigue and similar variables.

Mortar should be removed cleanly from the masonry units, leaving square corners at the back of the cut. Before filling, the joints should be rinsed with a jet of water to remove all loose particles and dust. At the time of filling, the joints should be damp, but with no standing water present. For masonry walls—limestone, sandstone and common brick—that are extremely absorbent, it is recommended that a continual mist of water be applied for a few hours before repointing begins.

Mortar Preparation

Mortar components should be measured and mixed carefully to assure the uniformity of visual and physical characteristics. Dry ingredients are measured by volume and thoroughly mixed before the addition of any water. Sand must be added in a damp, loose condition to avoid over sanding. Repointing mortar is typically pre-hydrated by adding water so it will just hold together, thus allowing it to stand for a period of time before the final water is added. Half the water should be added, followed by mixing for approximately 5 minutes. The remaining water should then be added in small portions until a mortar of the desired consistency is reached. The total volume of water necessary may vary from batch to batch, depending on weather conditions. It is important to keep the water to a minimum for two reasons: first, a drier mortar is cleaner to work with, and it can be compacted tightly into the joints; second, with no excess water to evaporate, the mortar cures without shrinkage cracks. Mortar should be used within approximately 30 minutes of final mixing, and "retempering," or adding more water, should not be permitted.

Using Lime Putty to Make Mortar

Mortar made with lime putty and sand, sometimes referred to as roughage or course stuff, should be measured by volume, and may require slightly different proportions from those used with hydrated lime. No additional water is usually needed to achieve a workable consistency because enough water is already contained in the putty. Sand is proportioned first, followed by the lime putty, then mixed for five minutes or until all the sand is thoroughly coated with the lime putty. But mixing, in the familiar sense of turning over with a hoe, sometimes may not be sufficient if the best possible performance is to be obtained from a lime putty mortar. Although the old practice of chopping, beating and ramming the mortar has largely been forgotten, recent field work has confirmed that lime putty and sand rammed and beaten with a wooden mallet or ax handle, interspersed by chopping with a hoe, can significantly improve workability and performance. The intensity of this action increases the overall lime/sand contact and removes any surplus water by compacting the other ingredients. It may also be advantageous for larger projects to use a mortar pan mill for mixing. Mortar pan mills which have a long tradition in Europe produce a superior lime putty mortar not attainable with today's modern paddle and drum type mixers.

For larger repointing projects the lime putty and sand can be mixed together ahead of time and stored indefinitely, on or off site, which eliminates the need for piles of sand on the job site. This mixture, which resembles damp brown sugar, must be protected from the air in sealed containers with a wet piece of burlap over the top or sealed in a large plastic bag to prevent evaporation and premature carbonation. The lime putty and sand mixture can be recombined into a workable plastic state months later with no additional water.

If portland cement is specified in a lime putty and sand mortar—Type O (1:2:9) or Type K (1:3:11)—the portland cement should first be mixed into a slurry paste before adding it to the lime putty and sand. Not only will this ensure that the portland cement is evenly distributed throughout the mixture, but if dry portland cement is added to wet ingredients it tends to "ball up," jeopardizing dispersion. (Usually water must be added to the lime putty and sand anyway once the portland cement is introduced.) Any color pigments should be added at this stage and mixed for a full five minutes. The mortar should be used within 30 minutes to 1Ω hours and it should not be retempered. Once portland cement has been added the mortar can no longer be stored.

Filling the Joint

Where existing mortar has been removed to a depth of greater than 1 inch, these deeper areas should be filled first, compacting the new mortar in several layers. The back of the entire joint should be filled successively by applying approximately 1/4 inch of mortar, packing it well into the back corners. This application may extend along the wall for several feet. As soon as the mortar has reached thumb-print hardness, another 1/4 inch layer of mortar—approximately the same thickness—may be applied. Several layers will be needed to fill the joint flush with the outer surface of the masonry. It is important to allow each layer time to harden before the next layer is applied; most of the mortar shrinkage occurs during the hardening process and layering thus minimizes overall shrinkage.

When the final layer of mortar is thumb-print hard, the joint should be tooled to match the historic joint. Proper timing of the tooling is important for uniform color and appearance. If tooled when too soft, the color will be lighter than expected, and hairline cracks may occur; if tooled when too hard, there may be dark streaks called "tool burning," and good closure of the mortar against the masonry units will not be achieved.

If the old bricks or stones have worn, rounded edges, it is best to recess the final mortar slightly from the face of the masonry. This treatment will help avoid a joint which is visually wider than the actual joint; it also will avoid creation of a large, thin featheredge which is easily damaged, thus admitting water. After tooling, excess mortar can be removed from the edge of the joint by brushing with a natural bristle or nylon brush. Metal bristle brushes should never be used on historic masonry.

Curing Conditions

The preliminary hardening of high-lime content mortars—those mortars that contain more lime by volume than portland cement, i.e., Type O (1:2:9), Type K (1:3:11), and straight lime/sand, Type "L" (0:1:3)—takes place fairly rapidly as water

in the mix is lost to the porous surface of the masonry and through evaporation. A high lime mortar (especially Type "L") left to dry out too rapidly can result in chalking, poor adhesion, and poor durability. Periodic wetting of the repointed area after the mortar joints are thumb-print hard and have been finish tooled may significantly accelerate the carbonation process. When feasible, misting using a hand sprayer with a fine nozzle can be simple to do for a day or two after repointing. Local conditions will dictate the frequency of wetting, but initially it may be as often as every hour and gradually reduced to every three or four hours. Walls should be covered with burlap for the first three days after repointing. (Plastic may be used, but it should be tented out and not placed directly against the wall.) This helps keep the walls damp and protects them from direct sunlight. Once carbonation of the lime has begun, it will continue for many years and the lime will gain strength as it reverts back to calcium carbonate within the wall.

Aging the Mortar

This 18th century pediment and surrounding wall exhibit distinctively different mortar joints. Photo: NPS files.

Even with the best efforts at matching the existing mortar color, texture, and materials, there will usually be a visible difference between the old and new work, partly because the new mortar has been matched to the unweathered portions of the historic mortar. Another reason for a slight mismatch may be that the sand is more exposed in old mortar due to the slight erosion of the lime or cement. Although spot repointing is generally preferable and some color difference should be acceptable, if the difference between old and new mortar is too extreme, it may be advisable in some instances to repoint an entire area of a wall, or an entire feature such as a bay, to minimize the difference between the old and the new mortar. If the mortars have been properly matched, usually the best way to deal with surface color differences is to let the mortars age naturally. Other treatments to overcome these differences, including cleaning the non-repointed areas or staining the new mortar, should be carefully tested prior to implementation.

Staining the new mortar to achieve a better color match is generally not recommended, but it may be appropriate in some instances. Although staining may provide an initial match, the old and new mortars may weather at different rates, leading to visual differences after a few seasons. In addition, the mixtures used to stain the mortar may be harmful to the masonry; for example, they may introduce salts into the masonry which can lead to efflorescence.

Cleaning the Repointed Masonry

If repointing work is carefully executed, there will be little need for cleaning other than to remove the small amount of mortar from the edge of the joint following tooling. This can be done with a stiff natural bristle or nylon brush after the mortar has dried, but before it is initially set (1-2 hours). Mortar that has hardened can usually be removed with a wooden paddle or, if necessary, a chisel.

Further cleaning is best accomplished with plain water and natural bristle or nylon brushes. If chemicals must be used, they should be selected with extreme caution. Improper cleaning can lead to deterioration of the masonry units, deterioration of the mortar, mortar smear, and efflorescence. New mortar joints are especially susceptible to damage because they do not become fully cured for several months. Chemical cleaners, particularly acids, should never be used on dry masonry. The masonry should always be completely soaked once with water before chemicals are applied. After cleaning, the walls should be flushed again with plain water to remove all traces of the chemicals.

Several precautions should be taken if a freshly repointed masonry wall is to be cleaned. First, the mortar should be fully hardened before cleaning. Thirty days is usually sufficient, depending on weather and exposure; as mentioned previously, the mortar will continue to cure even after it has hardened. Test panels should be prepared to evaluate the effects of different cleaning methods. Generally, on newly repointed masonry walls, only very low pressure (100 psi) water washing supplemented by stiff natural bristle or nylon brushes should be used, except on glazed or polished surfaces, where only soft cloths should be used.**

New construction "bloom" or efflorescence occasionally appears within the first few months of repointing and usually disappears through the normal process of weathering. If the efflorescence is not removed by natural processes, the safest way to remove it is by dry brushing with stiff natural or nylon bristle brushes followed by wet brushing. Hydrochloric (muriatic) acid, is generally ineffective, and it should not be used to remove efflorescence. It may liberate additional salts, which, in turn, can lead to more efflorescence.

Surface grouting is sometimes suggested as an alternative to repointing brick buildings, in particular. This process involves the application of a thin coat of cement-based grout to the mortar joints and the mortar/brick interface. To be effective, the grout must extend slightly onto the face of the masonry units, thus widening the joint visually. The change in the joint appearance can alter the historic character of the structure to an unacceptable degree. In addition, although masking of the bricks is intended to keep the grout off the remainder of the face of the bricks, some level of residue, called

"veiling," will inevitably remain. Surface grouting cannot substitute for the more extensive work of repointing, and it is not a recommended treatment for historic masonry.

***Additional information on masonry cleaning is presented in Preservation Briefs 1: Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings, Robert C. Mack, FAIA, and Anne E. Grimmer, Washington, D.C.: Technical Preservation Services, National Park Service, U.S. Department of the Interior, 2000; and Keeping it Clean: Removing Exterior Dirt, Paint, Stains & Graffiti from Historic Masonry Buildings, Anne E. Grimmer, Washington, D.C.: Technical Preservation Services, National Park Service, U.S. Department of the Interior, 1988.*

Visually Examining the Mortar and the Masonry Units

A simple *in situ* comparison will help determine the hardness and condition of the mortar and the masonry units. Begin by scraping the mortar with a screwdriver, and gradually tapping harder with a cold chisel and mason's hammer. Masonry units can be tested in the same way beginning, even more gently, by scraping with a fingernail. This relative analysis which is derived from the 10-point hardness scale used to describe minerals, provides a good starting point for selection of an appropriate mortar. It is described more fully in "The Russack System for Brick & Mortar Description" referenced in **Reading List** at the end of this Brief.

Mortar samples should be chosen carefully, and picked from a variety of locations on the building to find unweathered mortar, if possible. Portions of the building may have been repointed in the past while other areas may be subject to conditions causing unusual deterioration. There may be several colors of mortar dating from different construction periods or sand used from different sources during the initial construction. Any of these situations can give false readings to the visual or physical characteristics required for the new mortar. Variations should be noted which may require developing more than one mix.

1. Remove with a chisel and hammer three or four unweathered samples of the mortar to be matched from several locations on the building. (Set the largest sample aside--this will be used later for comparison with the repointing mortar). Removing a full representation of samples will allow selection of a "mean" or average mortar sample.
2. Mash the remaining samples with a wooden mallet, or hammer if necessary, until they are separated into their constituent parts. There should be a good handful of the material.
3. Examine the powdered portion—the lime and/or cement matrix of the mortar. Most particularly, note the color. There is a tendency to think of historic mortars as having white binders, but grey portland cement was available by the last quarter of the 19th century, and traditional limes were also sometimes grey. Thus, in some instances, the natural color of the historic binder may be grey, rather than white. The mortar may also have been tinted to create a colored mortar, and this color should be identified at this point.
4. Carefully blow away the powdery material (the lime and/or cement matrix which bound the mortar together).
5. With a low power (10 power) magnifying glass, examine the remaining sand and other materials such as lumps of lime or shell.
6. Note and record the wide range of color as well as the varying sizes of the individual grains of sand, impurities, or other materials.

Other Factors to Consider

Color

Regardless of the color of the binder or colored additives, the sand is the primary material that gives mortar its color. A surprising variety of colors of sand may be found in a single sample of historic mortar, and the different sizes of the grains of sand or other materials, such as incompletely ground lime or cement, play an important role in the texture of the repointing mortar. Therefore, when specifying sand for repointing mortar, it may be necessary to obtain sand from several sources and to combine or screen them in order to approximate the range of sand colors and grain sizes in the historic mortar sample.

Pointing Style

Close examination of the historic masonry wall and the techniques used in the original construction will assist in maintaining the visual qualities of the building. Pointing styles and the methods of producing them should be examined. It is important to look at both the horizontal and the vertical joints to determine the order in which they were tooled and whether they were the same style. Some late-19th and early-20th century buildings, for example, have horizontal joints that were raked back while the vertical joints were finished flush and stained to match the bricks, thus creating the illusion of horizontal bands. Pointing styles may also differ from one facade to another; front walls often received greater attention to mortar

detailing than side and rear walls. **Tuckpointing** is not true repointing but the application of a raised joint or lime putty joint on top of flush mortar joints. **Penciling** is a purely decorative, painted surface treatment over a mortar joint, often in a contrasting color.

Masonry Units

The masonry units should also be examined so that any replacement units will match the historic masonry. Within a wall there may be a wide range of colors, textures, and sizes, particularly with hand-made brick or rough-cut, locally-quarried stone. Replacement units should blend in with the full range of masonry units rather than a single brick or stone.

Matching Color and Texture of the Repointing Mortar

New mortar should match the unweathered interior portions of the historic mortar. The simplest way to check the match is to make a small sample of the proposed mix and allow it to cure at a temperature of approximately 70 degrees F for about a week, or it can be baked in an oven to speed up the curing; this sample is then broken open and the surface is compared with the surface of the largest "saved" sample of historic mortar.

If a proper color match cannot be achieved through the use of natural sand or colored aggregates like crushed marble or brick dust, it may be necessary to use a modern mortar pigment.

During the early stages of the project, it should be determined how closely the new mortar should match the historic mortar. Will "quite close" be sufficient, or is "exactly" expected? The specifications should state this clearly so that the contractor has a reasonable idea how much time and expense will be required to develop an acceptable match.

The same judgment will be necessary in matching replacement terra cotta, stone or brick. If there is a known source for replacements, this should be included in the specifications. If a source cannot be determined prior to the bidding process, the specifications should include an estimated price for the replacement materials with the final price based on the actual cost to the contractor.

Mortar Types (Measured by volume)

Designation	Cement	Hydrated Lime or Lime Putty	Sand
M	1	1/4	3 - 3 3/4
S	1	1/2	4–4 1/2
N	1	1	5–6
O	1	2	8–9
K	1	3	10–12
"L"	0	1	2 1/4–3

Suggested Mortar Types for Different Exposures

	Exposure		
Masonry Material	Sheltered	Moderate	Severe
Very durable: granite, hard-cored brick, etc.	O	N	S
Moderately durable:limestone, durable stone, molded brick	K	O	N
Minimally durable:soft hand-made brick	"L"	K	O

Summary and References

For the Owner/Administrator

The owner or administrator of a historic building should remember that repointing is likely to be a lengthy and expensive process. First, there must be adequate time for evaluation of the building and investigation into the cause of problems. Then, there will be time needed for preparation of the contract documents. The work itself is precise, time-consuming and noisy, and scaffolding may cover the face of the building for some time. Therefore, the owner must carefully plan the work to avoid problems. Schedules for both repointing and other activities will thus require careful coordination to avoid

unanticipated conflicts. The owner must avoid the tendency to rush the work or cut corners if the historic building is to retain its visual integrity and the job is to be durable.

For the Architect/Consultant

Because the primary role of the consultant is to ensure the life of the building, a knowledge of historic construction techniques and the special problems found in older buildings is essential. The consultant must assist the owner in planning for logistical problems relating to research and construction. It is the consultant's responsibility to determine the cause of the mortar deterioration and ensure that it is corrected before the masonry is repointed. The consultant must also be prepared to spend more time in project inspections than is customary in modern construction.

For the Masons

Successful repointing depends on the masons themselves. Experienced masons understand the special requirements for work on historic buildings and the added time and expense they require. The entire masonry crew must be willing and able to perform the work in conformance with the specifications, even when the specifications may not be in conformance with standard practice. At the same time, the masons should not hesitate to question the specifications if it appears that the work specified would damage the building.

Conclusion

A good repointing job is meant to last, at least 30 years, and preferably 50- 100 years. Shortcuts and poor craftsmanship result not only in diminishing the historic character of a building, but also in a job that looks bad, and will require future repointing sooner than if the work had been done correctly. The mortar joint in a historic masonry building has often been called a wall's "first line of defense." Good repointing practices guarantee the long life of the mortar joint, the wall, and the historic structure. Although careful maintenance will help preserve the freshly repointed mortar joints, it is important to remember that mortar joints are intended to be sacrificial and will probably require repointing some time in the future. Nevertheless, if the historic mortar joints proved durable for many years, then careful repointing should have an equally long life, ultimately contributing to the preservation of the entire building.

Useful Addresses

Brick Institute of America
11490 Commerce Park Drive
Reston, VA 22091

National Lime Association
200 N. Glebe Road, Suite 800
Arlington, VA 22203

Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077

Acknowledgments

Robert C. Mack, FAIA, is a principal in the firm of MacDonald & Mack, Architects, Ltd., an architectural firm that specializes in historic buildings in Minneapolis, Minnesota. **John P. Speweik, CSI**, Toledo, Ohio, is a 5th-generation stonemason, and principal in U.S. Heritage Group, Inc., Chicago, Illinois, which does custom historic mortar matching. **Anne E. Grimmer**, Senior Architectural Historian, National Park Service, was responsible for developing and coordinating the revision of this Preservation Brief, incorporating professional comments, and the technical editing.

The authors and the editor wish to thank the following for the professional and technical review they provided: Mark Macpherson and Ron Peterson, Masonry Restoration Contractors, Macpherson-Towne Company, Minneapolis, MN; Lorraine Schnabel, Architectural Conservator, John Milner Associates, Inc., Philadelphia, PA; Lauren B. Sickels-Taves, Ph.D., Architectural Conservator, Biohistory International, Huntington Woods, MI; and the following National Park Service professional staff, including: E. Blaine Cliver, Chief, Historic American Buildings Survey/Historic American Engineering Record; Douglas C. Hicks, Deputy Superintendent, Historic Preservation Training Center, Frederick, MD; Chris McGuigan, Supervisory Exhibits Specialist, Historic Preservation Training Center, Frederick, MD; Charles E. Fisher, Sharon C. Park, FAIA, John Sandor, Technical Preservation Services Branch, Heritage Preservation Services, and Kay D. Weeks, Heritage Preservation Services.

The original version of this brief, *Repointing Mortar Joints in Historic Brick Buildings*, was written by Robert C. Mack in 1976, and was revised and updated in 1980 by Robert C. Mack, de Teel Patterson Tiller, and James S. Askins.

This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical

Preservation Services (TPS), National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments for a broad public.

October 1998

Reading List

Ashurst, John & Nicola. *Practical Building Conservation. Vol. 3: Mortars, Plasters and Renders.* New York: Halsted Press, a Division of John Wiley & Sons, Inc., 1988.

Cliver, E. Blaine. "Tests for the Analysis of Mortar Samples." *Bulletin of the Association for Preservation Technology.* Vol. 6, No. 1 (1974), pp. 68-73.

Coney, William B., AIA. *Masonry Repointing of Twentieth-Century Buildings.* Illinois Preservation Series. Number 10. Springfield, IL: Division of Preservation Services, Illinois Historic Preservation Agency, 1989.

Davidson, J.I. "Masonry Mortar." *Canadian Building Digest.* CBD 163. Ottawa, ONT: Division of Building Research, National Research Council of Canada, 1974.

Ferro, Maximillian L., AIA, RIBA. "The Russack System for Brick and Mortar Description: A Field Method for Assessing Masonry Hardness." *Technology and Conservation.* Vol. 5, No. 2 (Summer 1980), pp. 32-35.

Hooker, Kenneth A. "Field Notes on Repointing." *Aberdeen's Magazine of Masonry Construction.* Vol. 4, No. 8 (August 1991), pp. 326-328.

Jedrzejewska, H. "Old Mortars in Poland: A New Method of Investigation." *Studies in Conservation*. Vol. 5, No. 4 (1960), pp. 132-138.

"Lime's Role in Mortar." *Aberdeen's Magazine of Masonry Construction*. Vol. 9, No. 8 (August 1996), pp. 364-368.

Phillips, Morgan W. "Brief Notes on the Subjects of Analyzing Paints and Mortars and the Recording of Moulding Profiles: The Trouble with Paint and Mortar Analysis." *Bulletin of the Association for Preservation Technology.* Vol. 10, No. 2 (1978), pp. 77-89.

Preparation and Use of Lime Mortars: An Introduction to the Principles of Using Lime Mortars. Scottish Lime Centre for Historic Scotland. Edinburgh: Historic Scotland, 1995.

Schierhorn, Carolyn. "Ensuring Mortar Color Consistency." *Aberdeen's Magazine of Masonry Construction.* Vol. 9, No. 1 (January 1996), pp. 33-35.

"Should Air-Entrained Mortars Be Used?" *Aberdeen's Magazine of Masonry Construction.* Vol. 7, No. 9 (September 1994), pp. 419-422.

Sickels-Taves, Lauren B. "Creep, Shrinkage, and Mortars in Historic Preservation." *Journal of Testing and Evaluation, JTEVA.* Vol. 23, No. 6 (November 1995), pp. 447-452.

Speweik, John P. *The History of Masonry Mortar in America*, 1720-1995. Arlington, VA: National Lime Association, 1995.

Speweik, John P. "Repointing Right: Why Using Modern Mortar Can Damage a Historic House." *Old-House Journal.* Vol. XXV, No. 4 (July-August 1997), pp. 46-51.

Technical Notes on Brick Construction. Brick Institute of America, Reston, VA.

"Moisture Resistance of Brick Masonry: Maintenance." 7F. February 1986.

"Mortars for Brick Masonry." 8 Revised II. November 1989.

"Standard Specification for Portland Cement-Lime Mortar for Brick Masonry." 8A Revised. September 1988.

"Mortar for Brick Masonry-Selection and Controls." 8B Reissued. September 1988. (July/August 1976).

"Guide Specifications for Brick Masonry, Part V Mortar and Grout." 11E Revised. September 1991.

"Bonds and Patterns in Brickwork." 30 Reissued. September 1988.