BETH SALEM PRESBYTERIAN CHURCH
McMINN COUNTY, TENNESSEE
PRESERVATION PLAN

Spring 2016
Table of Contents

Introduction 2
Location 2
Architectural Description 3
Cemetery Description 5
Conditions Assessment 6
Preservation Priorities 16
Cemetery Preservation 16

Appendices
  A. National Register nomination 19
  B. Exterior Paint Problems on Historic Woodwork 26
  C. The Repair of Historic Wooden Windows 32
  D. Repointing Mortar Joints in Historic Masonry Buildings 36
  E. Cemetery Survey Form 44

Report Prepared By:
Leigh Ann Gardner, Interpretive Specialist, Tennessee Civil War National Heritage Area
A Professional Services Project
Tennessee Civil War National Heritage Area
Middle Tennessee State University

*The Tennessee Civil War National Heritage Area (TCWNHA) is a statewide program dedicated to the interpretation and preservation of Tennessee's Civil War and Reconstruction legacies. Partially funded by the National Park Service, the TCWNHA is one of several projects administered by the Center for Historic Preservation at Middle Tennessee State University.
INTRODUCTION

MTSU Center for Historic Preservation (CHP) staff and students visited the Beth Salem Presbyterian Church in March 2016. CHP Director Dr. Carroll Van West, Fieldwork Coordinator Ashley Brown, Trail of Tears Project Coordinator Amy Kostine, Tennessee Civil War National Heritage Area Interpretive Specialist Leigh Ann Gardner, and M.A. student Tiffany Momen met with community members and Melissa Mortimer, Historic Preservation Planner with the Southeast Tennessee Development District to discuss preservation needs and priorities for the building. At that meeting it was decided to develop a Preservation Plan with a Heritage Development Plan to begin in Fall 2016. Beth Salem Presbyterian Church has a long and rich history stretching back to Reconstruction, and as such, is a worthy part of the Tennessee Civil War National Heritage Area.

The focus of this report is to document the condition of and discuss preservation priorities of both the Beth Salem Presbyterian Church and cemetery.

LOCATION

Beth Salem Presbyterian Church is located on Arbin Watson Road (County Road 602) in McMinn County. Although the current building dates to 1920, the congregation dates to 1866, making it the oldest African American congregation in the county.

The church was placed on the National Register of Historic Places on June 22, 2000 (NR #00000728) under Criterion C for its local significance as a rare, extant example of African-American architecture from the early 20th century.

As the building is listed on the National Register, you will want to consult with the State Historic Preservation Office (SHPO) before making any repairs so as to not endanger your listing on the National Register. The contact person at the Tennessee Historical Commission, the SHPO for this state, is Ms. Claudette Stager. Her telephone number is 615-770-1089, and her email address is claudette.stager@tn.gov. All work must be done to the Secretary of the Interior’s Standards for Preservation (https://www.nps.gov/tps/standards/four-treatments/treatment-preservation.htm).
ARCHITECTURAL DESCRIPTION
(Adapted from Carroll Van West, “Beth Salem Presbyterian Church,” National Register nomination, June 22, 2000, NR# 00000728)

Figure 3. East elevation of the building. Note the Z-bracing on the original wooden shutters.

The Beth Salem Presbyterian Church is a one-room, rectangular, weatherboard-covered building, with a metal-covered gable roof, that rests on brick piers. The north facade of the church contains the only entrance to the building, a symmetrically placed original two-panel door. Above the door is a hand-written sign identifying the building as "Bethsalem Presbyterian Church."

Figure 4. West elevation.

The west elevation contains three symmetrical bays, with original wooden shutters protecting original two-over-two double-hung windows. The east elevation is similar to the west elevation. It contains three symmetrical bays, with original wooden shutters protecting original two-over-two double-hung windows.
The south elevation is a solid weatherboard wall, except for a small original ventilation grill located at the gable point of the roofline.

The interior retains a high degree of architectural integrity. The walls and ceiling are bead board and the floor has its original hardwood boards. The pulpit stands at the south end, on an original wooden platform. A chalkboard remains on the south well, testifying to the time when the church also served as a school building for the community.

Arranged in two sections facing the pulpit the pews leave a central passage open to the wooden altar railing in front of the pulpit. The altar railing separates the pulpit from the seating for the congregation.

There are several features located on the property in addition to the church building and cemetery. An open pavilion, known as “Hattie’s Place,” lies west of the church building (c. 1990). A concrete monument dating to 1926 featuring three obelisks and early historical information about the church is located northwest of the church building. A Tennessee Historical Marker is located east of the concrete monument. An interpretive wayside, placed by the Tennessee Overhill Heritage Association, lies to the west of the concrete obelisks. Also present south of the church building are two wooden privies which have replaced the c. 1920 privies once located on the property.
Cemetery Description

The Beth Salem Church Cemetery is located northeast of the church across Arbin Watson Road. It is listed on the National Register nomination as a contributing site to the property. The cemetery has no signage and no fence. A creek bed lies at the edge of the cemetery. There are a number of trees and vinca growing in the cemetery. The burials are a mixture of irregularly and regularly placed graves. The cemetery also contains both marked and unmarked graves.

Figure 7. Monuments and markers at Beth Salem Presbyterian Church.

Figure 8. Beth Salem Church Cemetery

The cemetery is in good condition with trimmed grass and only a few broken monuments. The exact number of interments is unknown, although a website dedicated to cemeteries lists 96 internments.¹

Figure 9. Hand carved stone in the cemetery.

CONDITIONS ASSESSMENT

**Exterior**

Overall, the exterior of the building is in fair to good condition with some maintenance issues that do need addressing.

![Figure 10. The north elevation has some peeling paint issues and possible rotting at the door frame that needs to be addressed.](image)

There appears to be rotting or rotted wood at the door frame on the north elevation. The wood should be replaced at the frame. You may be able to use an epoxy to consolidate and repair the voids in the rotted wood. The north elevation also has peeling paint that should be addressed. The wood at the areas of peeling paint should be examined to insure it has not rotted. Peeling to the wood beneath is caused by moisture collecting behind the paint film, which reduces the adhesion of the paint to the wood. A first step is to take care of the issue causing the moisture before repainting the affected areas. After the moisture problem has been addressed, the wood should be dried out completely. Any rotted boards should be replaced. The damaged paint can be removed with a putty knife, the area sanded, primed, and painted. A great resource for information on painting the exteriors of historic woodwork is the National Park Service’s “Exterior Paint Problems on Historic Woodwork” preservation brief. A copy is located in the appendix.²

![Figure 11. Wood that needs repair at the entrance door threshold.](image)

On the east elevation, there is rotting around the window sills. Over time, water has accumulated at the sills, leading to wood rot. The rotted wood needs to be replaced and the window sill repaired. It may not be necessary to replace the entire sill as any wood that is only partially decayed may be patched or waterproofed. One repair technique for

²A copy may also be accessed digitally at [https://www.nps.gov/tps/how-to-preserve/briefs/10-paint-problems.htm](https://www.nps.gov/tps/how-to-preserve/briefs/10-paint-problems.htm).
rotted windows is, after the wood is dry, to treat the decayed wood with a fungicide. Following fungicide, waterproof the wood with multiple applications of boiled linseed oil. Once this is complete, cracks and holes can be filled with wood putty and then painted.

It must be mentioned that any repair of windows needs to be undertaken in consultation with a professional, such as a historic architect as windows are considered character defining features. Replacement of the windows could jeopardize the building’s listing in the National Register; therefore, it is highly recommended that you consult with the SHPO before undertaking any work on the windows. A good resource to consult before repairing historic windows is the National Park Service’s “The Repair of Historic Wooden Windows” preservation brief, a copy of which is located in the appendix.3

The south elevation has some preservation issues as well. One concern is the rafter at the southwest corner of the building. The fascia board is either rotted or missing, allowing moisture to penetrate between the roof and the roof joists. This should be repaired immediately.

The brick foundation piers, located on the south elevation, contain disintegrating and missing mortar although the bricks themselves appear to be in good condition. You should consult with an expert, such as historic architect or architectural conservator, to have the mortar repaired. A good repointing repair should last at least 30 years. A consultant can also determine the cause of the mortar disintegration and possibly make remediation recommendations.

3 A copy may be accessed digitally at https://www.nps.gov/tps/how-to-preserve/briefs/9-wooden-windows.htm.
It should be noted, however, that modern Portland cement is not recommended for repair as it is harder than the bricks. This leads to cracking bricks surrounding the Portland cement during temperature fluctuations. You should also not use a synthetic (plastic) caulking. Also avoid using the “scrub-coating” technique when repairing the joints. This involves applying a thin layer of mortar over the entire surface and then scrubbing away the mortar on the bricks so that only the mortar in the joints remain. Furthermore, repair of the masonry should never occur when the temperature is at or near freezing. Also, care needs to be taken when applying mortar in hot weather so that it does not dry too quickly. For more information on repointing masonry, see “Repointing Mortar Joints in Historic Masonry Buildings” preservation brief.\(^4\)

There is a significant amount of older building materials being stored beneath the building at the south elevation. This consists of lumber and parts of the former roof. This debris needs to be removed as it is both a fire and termite hazard for the building. A minimum of 18” of clearance should exist underneath the entire building in order to allow airflow under the building to keep sills and joists from rotting.

---

\(^4\) A copy may also be accessed digitally at [https://www.nps.gov/tps/how-to-preserve/briefs/2-repoint-mortar-joints.htm](https://www.nps.gov/tps/how-to-preserve/briefs/2-repoint-mortar-joints.htm).
Figure 16. This leaf debris should be removed to allow air flow beneath the building.

There is rotted wood at the roof rafter on the south elevation. This rotted wood needs to be replaced by either replacing the rotted board or using an epoxy to consolidate and repair the void in the wood. “Preservation Brief 26: The Preservation and Repair of Historic Log Buildings” by Bruce D. Bomberger offers excellent advice on the repair of rotted wood logs that could be applied to Beth Salem as well. The following comes from that brief:

Epoxies are versatile in performance, relatively easy to use by experts, and, after curing, may be shaped with woodworking tools. Their use requires that sufficient sound wood survives for the epoxy to adhere. But they can be used to stabilize rotted wood, return full or greater than original strength to decayed structure bearing members, and to reconstitute the shape of decayed log ends. Epoxies resist decay and insects, and while epoxy itself is resistant to moisture, epoxy tends to cause adjacent wood to retain moisture rather than dry out, and if not used in the right location, can actually further a continuing cycle of wood decay. Hence, epoxy repairs are most successful in areas where they are protected from moisture. Epoxies, of which there are a variety of commercially-available products on the market, are prepared in essentially two forms: a liquid consolidant and a flexible putty filler. Each consists of a resin and a hardener which must be mixed prior to use.5

5 You can access a full copy of Preservation Brief 26 digitally at https://www.nps.gov/tPS/how-to-preserve/briefs/26-log-buildings.htm.
There are a number of overhanging tree limbs around the building. These need to be trimmed so that limbs do not fall during a storm and cause damage to the building.

Figure 18. Overhanging limbs can cause damage in case of storms. They should be kept trimmed.

**Interior**

The primary preservation issue with the interior of the church is the water damage on the east wall and ceiling. This needs to be repaired, and is one of the highest priorities. As the building is listed on the National Register, significant materials and features of the building that contribute to its historic character should be preserved, and any physical treatments should be reversible, if possible. “Preservation Brief 39: Holding the Line: Controlling Unwanted Moisture in Historic Buildings” by Sharon C. Park is an excellent resource. The following is excerpted from that work:

---

Moisture comes from a variety of external sources. Most problems begin as a result of the weather in the form of rain or snow, from high ambient relative humidity, or from high water tables. But some of the most troublesome moisture damage in older buildings may be from internal sources, such as leaking plumbing pipes, components of heating, cooling, and climate control systems, as well as sources related to use or occupancy of the building. In some cases, moisture damage may be the result of poorly designed original details, such as projecting outriggers in rustic structures that are vulnerable to rotting, and may require special

---

treatment. The five most common sources of unwanted moisture include:

- Above grade exterior moisture entering the building
- Below grade ground moisture entering the building
- Leaking plumbing pipes and mechanical equipment
- Interior moisture from household use and climate control systems
- Water used in maintenance and construction materials.

At Beth Salem, it seems likely that the sources of the moisture issues are above grade exterior moisture and below grade ground moisture. Above grade exterior moisture generally results from weather related moisture entering through deteriorating materials as a result of deferred maintenance, structural settlement cracks, or damage from high winds or storms. Such sources as faulty roofs, cracks in walls, and open joints around window and door openings can be corrected through either repair or limited replacement.

Below grade ground moisture is a major source of unwanted moisture for historic and older buildings. Proper handling of surface rain run-off is one of the most important measures of controlling unwanted ground moisture. The ground, and subsequently the building, will stay much drier by 1) re-directing rain water away from the foundation through sloping grades, 2) capturing and disposing downspout water well away from the building, 3) developing a controlled ground gutter or effective drainage for buildings historically without gutters and downspouts, and 4) reducing splash-back of moisture onto foundation walls. The excavation of foundations and the use of damp-proof coatings and footing drains should only be used after the measures of reducing ground moisture listed above have been implemented.

There is also water damage at the west wall surrounding the brick chimney. This needs to be repaired as well.
The floor slopes to the rear west corner and appears to be “spongy” in places. The joists beneath the building, however, appear to be in good condition and do not appear to be rotted. You may wish to place shims between the floor joists and the floor.

As mentioned when discussing the exterior condition of the building, several of the wooden windows are rotted and are in need of repair. See the previous section on repairing the exterior windows for information on repairing the windows.

There is rotted and flaking wood at the door threshold that needs to be repaired. The damaged pieces could be replaced with new matching pieces or by splicing new wood into the existing threshold. See the previous section on use of epoxies for information on repairing with an epoxy.

There is a spot on the east wall, near the current location of the piano, where a piece of wood is missing. This needs to be replaced.

Part of the ceiling on the west wall appears to be bowed. You will want to check for water damage to the ceiling joists in that location.

There is a spot on the east wall, near the current location of the piano, where a piece of wood is missing. This needs to be replaced.
Moving forward, you will want to institute regular inspections of the building in order to maintain the property and to prevent further deterioration. Having a written maintenance plan will insure that every part of the building gets inspected on a regular basis.

According to “Preservation Brief 39: Holding the Line: Controlling Unwanted Moisture in Historic Buildings,” preservation maintenance relating to moisture is as follows:

**Exterior:** Apply cyclical maintenance procedures to eliminate rain and moisture infiltration.
- **Roofing/ guttering:** Make weather-tight and operational; inspect and clean gutters as necessary depending on number of nearby trees, but at least twice a year; inspect roofing at least once a year, preferably spring; replace missing or damaged roofing shingles, slates, or tiles; repair flashing; repair or replace cracked downspouts.

- **Walls:** Repair damaged surface materials; repoint masonry with appropriately formulated mortar; prime and repaint wooden, metal, or masonry elements or surfaces; remove efflorescence from masonry with non-metallic bristle brushes.

- **Window and door openings:** Eliminate cracks or open joints; caulk or repoint around openings or steps; repair or reset weather-stripping; check flashing; repaint, as necessary.

Some areas of the floor appear to have some minor previous water damage as well as gaps between the floor boards. You may wish to fill the gaps in to prevent any falls.
Ground: Apply regular maintenance procedures to eliminate standing water and vegetative threats to building/site.

- Grade: Eliminate low spots around building foundations; clean out existing downspout boots twice a year or add extension to leaders to carry moisture away from foundation; do a hose test to verify that surface drains are functioning; reduce moisture used to clean steps and walks; eliminate the use of chlorides to melt ice which can increase freeze/thaw spalling of masonry; check operation of irrigation systems, hose bib leaks, and clearance of air conditioning condensate drain outlets.

- Crawl space: Check crawl space for animal infestation, termites, ponding moisture, or high moisture content; check foundation grilles for adequate ventilation; seasonally close grilles when appropriate—in winter, if not needed, or in summer if hot humid air is diffusing into air conditioned space.

- Foliage: Keep foliage and vines off buildings; trim overhanging trees to keep debris from gutters and limbs from rubbing against building; remove moisture retaining elements, such as firewood, from foundations.

Interior: Maintain equipment to reduce leaks and interior moisture.

- Mechanical equipment: Check condensation pans and drain lines to keep clear; insulate and seal joints in exposed metal ductwork to avoid drawing in moist air.

- Cleaning: Routinely dust and clean surfaces to reduce the amount of water or moist chemicals used to clean building; caulk around tile floor and wall connections; and maintain floor grouts in good condition.

- Ventilation: Reduce household-produced moisture, if a problem, by increasing ventilation; vent clothes driers to the outside; install and always use exhaust fans in restrooms, bathrooms, showers, and kitchens, when in use.

Secretary of the Interior’s Standards for Preservation

1. A property will be used as it was historically, or be given a new use that maximizes the retention of distinctive materials, features, spaces, and spatial relationships. Where a treatment and use have not been identified, a property will be protected and, if necessary, stabilized until additional work may be undertaken.

2. The historic character of a property will be retained and preserved. The replacement of intact or repairable historic materials or alteration of features, spaces, and spatial relationships that characterize a property will be avoided.

3. Each property will be recognized as a physical record of its time, place, and use. Work needed to stabilize, consolidate, and conserve existing historic materials and features will be physically and visually compatible, identifiable upon close inspection, and properly documented for future research.

4. Changes to a property that have acquired historic significance in their own right will be retained and preserved.

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

6. The existing condition of historic features will be evaluated to determine the appropriate level of intervention needed. Where the severity of deterioration requires repair or limited replacement of a distinctive feature, the new material will match the old in composition, design, color, and texture.

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.

8. Archeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.
Below is a recommended inspection checklist from the National Park Service.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Min. Inspection Frequency</th>
<th>Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof</td>
<td>Annually</td>
<td>Spring or fall; every 5 years by roofer</td>
</tr>
<tr>
<td>Foundation and Grade</td>
<td>Annually</td>
<td>Spring or during wet season</td>
</tr>
<tr>
<td>Chimneys</td>
<td>Annually; every 5 years</td>
<td>Fall, prior to heating season; every 5 years by mason</td>
</tr>
<tr>
<td>Roof Drainage</td>
<td>6 months; more frequently as needed</td>
<td>Before and after wet season, during heavy rain</td>
</tr>
<tr>
<td>Exterior Walls and Porches</td>
<td>Annually</td>
<td>Spring, prior to summer/fall painting season</td>
</tr>
<tr>
<td>Entryways</td>
<td>Annually; heavily used entries may merit greater frequency</td>
<td>Winter, after leaves have dropped off trees</td>
</tr>
<tr>
<td>Doors</td>
<td>6 months; heavily used entry doors may merit greater frequency</td>
<td>Spring and fall; prior to heating/cooling seasons</td>
</tr>
<tr>
<td>Attic</td>
<td>4 months, or after a major storm</td>
<td>Before, during and after wet season</td>
</tr>
<tr>
<td>Basement/Crawlspace</td>
<td>4 months, or after a major storm</td>
<td>Before, during and after rain season</td>
</tr>
</tbody>
</table>

Figure 27. Taken from Sharon C. Park, “Maintaining the Exterior of Small and Medium Size Historic Buildings,” National Park Service Preservation Brief No. 47.

Tips for contracting maintenance work

1. Become familiar with work done on similar historic properties in your area so that you can obtain names of possible preservation contractors.
2. Be as specific as possible in defining the scope of work you expect to undertake.
3. Ask potential contractors for multiple references (three to five) and visit previous work sites. Contact the building owner or manager and ask how the job proceeded; if the same work crew was retained from start to finish; if the workers were of a consistent skill level; whether the project was completed in a reasonable time; and whether the person would use the contractor again.
4. Be familiar with the preservation context of the work to be undertaken. Use the written procedures in your maintenance plan to help define the scope of work in accordance with preservation standards and guidelines. Always request that the gentlest method possible be used. Use a preservation consultant if necessary to ensure that the work is performed in an appropriate manner.
5. Request in the contract proposal a detailed cost estimate that clearly defines the work to be executed, establishes the precautions that will be used to protect adjoining materials, and lists specific qualified subcontractors, if any, to be used.
6. Insure that the contractor has all necessary business licenses and carries worker compensation.

Taken from Sharon C. Park, “Maintaining the Exterior of Small and Medium Size Historic Buildings.”

https://www.nps.gov/tps/how-to-preserve/briefs/47-maintaining-exteriors.htm#inspection.
PRESERVATION PRIORITIES

Before any work is done to the building, you must consult with the SHPO regarding the plans, etc. so that you do not risk losing the National Register listing. The person to contact at the Tennessee Historical Commission is Louis Jackson, Historic Preservation Specialist. His contact information is as follows:

Louis Jackson  
Tennessee Historical Commission  
2941 Lebanon Road  
Nashville, TN 37243-0442  
(615) 770-1099  
Louis.Jackson@tn.gov

Immediate Tasks
- Address drainage and moisture issues. All current preservation needs stem from drainage or moisture damage.
- Repair rotted windows and any rotted boards.
- Remove all debris from beneath the building, allowing for proper ventilation and to prevent termites.

Repairs to be undertaken within the next year
- Trim overhanging tree limbs.
- Repair and/repoint the masonry and mortar of the brick foundation piers, particularly to the rear of the structure.
- Address peeling paint on the exterior of the building.

All other preservation tasks are outlined in the body of the report.

CEMETERY PRESERVATION

The cemetery associated with Beth Salem Presbyterian Church is listed as a contributing resource on its National Register listing, and it is a valuable historical asset not just for the church but also for the Beth Salem community. As such, its ongoing maintenance is important to the site.

The first step to preserving the cemetery is a thorough documentation. This documentation will uncover any preservation or maintenance issues, and will aid in long-term planning for its continuing maintenance.

The documentation of the cemetery should include the following:
- A written survey form for the cemetery as a whole that indicates the size of the cemetery, the overall condition of the cemetery, its location, types of grave markers, landscape features, and ownership information. An example of this type of survey form may be found in Appendix E.
- A written survey form for each individual grave site that lists the material of the marker, the type of grave marker, a transcription of the marker, and its location.
- Photographs of the cemetery as a whole, each individual marker, and the landscape features, such as fencing, trees, signage, and vegetation.
Once the cemetery has been surveyed and documented, a site map of the cemetery should be prepared.

After the information described above has been assembled, the Beth Salem Presbyterian Church can assess any potential preservation needs for the cemetery, such as the cleaning of markers, etc.

Figure 28. Example of grave marker in the cemetery that may be more readable once it is cleaned.

Once the cemetery is documented, the church or community may decide to clean the grave markers. Reasons to clean the markers include removing any soiling or potentially damaging vegetation as well as improving the readability of the markers. There are, however, some considerations to consider when choosing cleaning methods. These considerations are:

- Acceleration of deterioration
- Loss of original materials

The information on the documentation of cemeteries and cleaning of markers comes from a workshop presented by Jason Church, National Center for Preservation Technology and Training, April 2016.

- Long-term stability of the monument/marker
- Long term effect of cleaners.

In short, do not use the following when cleaning grave markers as they are damaging and can create further problems.

- Wire brushes
- Nylon brushes
- Power equipment
- High pressure washing
- Harsh cleansers such as acid or bleach.

The do’s and don’ts of cleaning of markers are:

- Do no harm
- Do select the gentlest cleaning method to accomplish the task
- Do perform small tests before cleaning the entire stone
- Do follow the manufacturers’ recommendations
- Do follow the manufacturers’ safety recommendations
- Do exercise patience.

Once you start cleaning grave markers, please follow these guidelines:

- Always soak the stone before cleaning
- Start cleaning from the bottom and work your way up
- Use a small circular motion
- Use lots of water.7

---

7 The information on the documentation of cemeteries and cleaning of markers comes from a workshop presented by Jason Church, National Center for Preservation Technology and Training, April 2016.
Regarding any markers that have fallen, it is best practice to leave those on the ground so as to prevent further damage to the stone.

For more information and articles on cemetery conservation, visit the section on Cemetery Conservation of the National Center for Preservation Technology and Training at [https://www.ncptt.nps.gov/articles/cemetery-conservation/](https://www.ncptt.nps.gov/articles/cemetery-conservation/).

Below you will find a short bibliography with more information on the preservation and conservation of cemeteries.


Figure 29. Grave marker at the Beth Salem Cemetery.
8. Statement of Significance

Applicable National Register Criteria (Mark "X" in one or more boxes for the criteria qualifying the property for National Register listing.)

- Property is associated with events that have made a significant contribution to the social, economic, or political life of the nation or State.
- Property is associated with individuals or groups whose achievements have made a significant contribution to the nation or State.
- Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic value, or represents a significant and distinguishable entity whose components lack individual distinction.

Classification of significance: (check one)

- Architecture
- Engineering
- Environmental
- Historical
- Social
- Recreation
- Scientific
- Aesthetic

Significant Dates

- Significant Person (if any other than those listed above)

Cultural Affiliation
- Native American
- African-American
- Hispanic
- Other

Architect/Builder

- Unknown
- Listed

Narrative Statement of Significance

(Explain the significance of the property on one or more continuation sheets.)

9. Major Bibliographical References

Bibliography

(Include the names, dates, and other sources used in preparing this form on one or more continuation sheets.)

Previous documentation on site (SBI): NA.
- Preliminary determination of individual listing (35 CFR 87.1) has been requested.
- Previously listed on the National Register.
- Previously determined eligible by the National Register.
- Designated a National Historic Landmark.
- Listed by Historic American Buildings Survey.
- Selected by Historic American Engineering Record.

10. Geographical Data

- Acreage of Property

- UTM References (Include additional UTM references on a continuation sheet.)

<table>
<thead>
<tr>
<th>Zone</th>
<th>Easting</th>
<th>Northing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>720</td>
<td>345070</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>37132</td>
</tr>
</tbody>
</table>

- Vertcal Boundary Description (Describe the boundaries of the property in a continuation sheet.)

- Boundary Adjustment (Describe any adjustments to the boundaries selected on the continuation sheet.)

11. Form Prepared By

- Name/Title
- Catherine Van West
- Organization: MTSU Center for Historic Preservation
- Date: January 1920
- Street & Number: PO Box 83 MTSU
- City or Town: Murfreesboro
- State: TN
- Zip Code: 37132

- Additional Documentation

Submit the following items with the completed form:

- Continuation Sheets

- Maps

- A USGS map (7.5 or 15 minute series) indicating the property's location

- A sketch map showing the boundaries and properties having large acreage or numerous resources.

- Photographs

- Representative black and white photographs of the property.

- Additional Items:
- Check the box for SBI or PFS for any additional items.

- Property Owner

- (Complete this line if all the request for SBI or PFS.

- Name: Dorothy Haycock (contact person)
- Street & Number: 600 Heatherwood Avenue
- City or Town: Murfreesboro
- Telephone: 423-203-6519
- Zip Code: 37132

- Paperwork Reduction Act Statement: This information is being collected for applications to the National Register of Historic Places to nominate properties for listing or determine eligibility for listing. It is required, and its refusal is likely to result in a delay in the processing of the application. If this form is used to request information from state and local government, it will be used for administrative purposes. The National Park Service is responsible for the collection and use of this information. The information is not subject to disclosure under the Freedom of Information Act. This form is approved by the Office of Management and Budget, Paperwork Reduction Act (1324-0020). Washington, DC 20503.)
### National Register of Historic Places

#### Continuation Sheet

<table>
<thead>
<tr>
<th>Section number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>

**Beth Salem Presbyterian Church**
McMinn County, Tennessee

#### 7. DESCRIPTION

The Beth Salem Presbyterian Church is located near the junction of Tennessee Highway 30 (Athens-Etoah Highway) and Watson Road in McMinn County, Tennessee. The nominated property includes the church and adjoining cemetery, which are both well preserved in an extant rural setting. The Beth Salem Presbyterian Church is a one-room, rectangular, weatherboard-covered building, with a metal-covered gable roof, that rests on brick piers.

The north facade of the church contains the only entrance to the building, a symmetrically placed original two-panel door. Above the door is a hand-written sign identifying the building as 'Bethsalem Presbyterian Church.'

The west elevation contains three symmetrical bays, with original wooden shutters protecting original two-over-two double-hung windows.

The south elevation is a solid weatherboard wall, except for a small original ventilation grill located at the gable point of the roofline.

The east elevation is similar to the west elevation. It contains three symmetrical bays, with original wooden shutters protecting original two-over-two double-hung windows.

The interior retains a high degree of architectural integrity. The walls and ceiling are bead board, and the floor has its original hardwood boards. The pulpit stands at the south end, on an original wooden platform. The pews in the church date to circa 1920. Arranged in two sections facing the pulpit, the pews leave a central passage open to the wooden altar railing in front of the pulpit. The altar railing separates the pulpit from the seating for the congregation.

To the west of the church building is an open picnic and kitchen pavilion (circa 1920), known as 'Hattie's Kitchen,' that has a metal-covered shed roof supported by six symmetrically placed wood posts.

Northwest of the church is a grouping of a monument and two markers about the history of Beth Salem Presbyterian Church. The oldest is a concrete monument (1928) that features three obelisks, with the center obelisk being the highest of the three. (On the front of the center obelisk is a metal plaque that details early historical information about the church.)

East of the concrete monument is a Tennessee Highway Historical Marker titled "Bethlehem Presbyterian Church," erected c. 1990. (NC, due to date of construction)

West of the obelisk is a metal and plastic interpretive sign titled "Bethlehem Presbyterian Church" erected circa 1986 by the Tennessee Overhill Heritage Association. (NC, due to date of construction)

Southwest of the church is an original men's privy (c. 1920), built with board-and-batten walls and a metal covered shed roof.

Southeast of the church is an original women's privy (c. 1920), built with board-and-batten walls and a metal covered shed roof.

Northeast of the church, across Watson Road, is the historic Beth Salem church cemetery, a contributing site to this property. It contains approximately 35 burials, with the oldest marked gravestone dating to 1911, and the majority of graves dating prior to 1950.

Beth Salem Presbyterian Church meets the registration requirements for Historic Rural African-American Churches in Tennessee, 1850-1970 MPN as an individual building that has extant outbuildings and a church cemetery on the same property lot. According to the integrity guidelines set forth in the MPN cover sheet, the church is exceptional in its location, association, setting, feeling, design, materials, and craftsmanship. Few alterations have occurred to the church building since its original construction and there are no additions on the building. The historic cemetery contains a majority of burials prior to 1950.
8. Statement of Significance

The Beth Salem Presbyterian Church in McMinn County, Tennessee, is eligible for listing in the National Register of Historic Places under Criterion C for its local significance as a rare, extant example of African-American church architecture from the early twentieth century. As discussed in the Historic Rural African-American Churches in Tennessee, 1950-1970 MiParks cover sheet, the church is architecturally significant local example of a type vernacular church architecture significant in the Jim Crow Era of segregation between 1950 and 1945. Its undamaged, no-style appearance reflected socioeconomic realities as well as presenting a non-threatening African-American appearance in the local built environment.

Organized in August 1859, the Beth Salem Presbyterian Church was the first African-American congregation established in the three-county area of Polk, McMinn, and Meigs. The church's establishment is a significant example of the impact of White missionaries on Tennessee's religious institutions in the wake of the Civil War. Among the founders were two African-American ministers, Rev. George Waterhouse and Rev. Joe Armstrong, and a white Presbyterian missionary, Rev. John Strood. Patsy Fitch, a white woman, donated land for the original church building of 1859. The Beth Salem congregation first met at a brush arbor on the current church property at an undated time. A log church was built. For rural African-American Presbyterians, Beth Salem became a religious and social gathering place, just as the First United Presbyterian Church in Athens, eight miles to the northwest, became a religious center for urban African-American Presbyterians in McMinn County.

This log church building also served as a public school for African Americans; the first black teacher was Smith Henderson. The congregation used the log building until a fire destroyed it circa 1920.

The leaders of the construction of the frame church building circa 1920 were John Melton, Jim Melton, George White, Calvin Oliver, Horace Melton, and Ray Leesey. Leesey was a white neighbor who donated the lumber for the building's construction. With a horse-drawn wagon, Horace Melton hauled the lumber sixteen miles to the church lot. The building also served as a school for an undetermined time. Most blacks in McMinn County attended school during the 1920s at the Rosenwald School Building Program's schools at Athens, East Elsberry, West Elsberry, and Union.

In 1928, the Beth Salem church hosted a two-week camp revival for African Americans from McMinn, Monroe, and Loudon counties. At this time the tradition of "Hattie's Kitchen" began. Hattie Buchanan wanted a kitchen for food preparation for the revival attendees. Nearby the church, where the current pavilion now stands, men from the congregation constructed an eight-foot by ten-foot frame kitchen. The men included Jim Caves, Luther Boyd, Alford Caldwell, and Adner King. Helping Hattie Buchanan in the kitchen were Mary Caves, Jane Springs, Alice Wilson, Callie Ferguson, and Mary Brown. "Hattie's Kitchen" became an important tradition at the church and the food preparation is still outdoors when the annual Beth Salem Homecoming takes place in August.

Regular church services at Beth Salem ended in the 1950s due to the migration of rural African Americans to the towns and cities and the ease of automobile travel. Many rural black Presbyterians could drive to Athens and attend services at the First United Presbyterian Church. Beth Salem then became the site of an annual August homecoming, which attracts one hundred or more former members and their descendants to this rural setting. As recorded in the Athens Daily Post-Athenian, August 31, 1988:

The tin roof is rusted and warped, and the sanctuary needs a little whitewash, but the church looks much as it did 60 years ago. An electric fan is the only modern convenience, and a lamp on the pulpit for the preacher to read the Bible, all powered by a generator out back. But visitors can understand why the church is special. It was built in a time of turmoil and still stands for what it was built for—a house of worship.

Since that 1988 report, the roof was repaired and the building painted. Otherwise, the church still retains its circa 1920 materials and appearance and is a rare and extremely important example of the type of undamaged, yet dignified architecture found in rural African-American churches during the Jim Crow Era. Most black congregations that still meet regularly have typically replaced their late nineteenth and early twentieth century frame buildings with brick or brick-veneer buildings. If the congregation had still been viable in the 1950s and 1960s, the church at Beth Salem perhaps would have been rebuilt in that manner. However, the end of the congregation also meant that there was no need to expand or remodel the old church building. Thus, it survives as a compelling artifact of the past African-American religious experience in McMinn County.
National Register of Historic Places
Continuation Sheet

Beth Salem Presbyterian Church
MCMN County, Tennessee

9. BIBLIOGRAPHY

*Beth Salem Presbyterian Church file.* Tennessee Rural African-American Church Project. MTSU Center for Historic Preservation.


10. GEOGRAPHICAL DATA

Verbal Boundary Description

The Beth Salem Presbyterian Church is adjacent to the junction of Watson Road and Tennessee Highway 30 and is Parcel 17 on the attached MCMN County Tax Map 92.

Boundary Justification

The nominated property contains all of the property historically associated with the Beth Salem Presbyterian Church.

The Tax Map for this nomination has the scale 1" = 600'. The Tennessee State Board of Equitation prepares this scale tax maps for rural areas, in the past, the Tennessee Historical Commission has used this scale map for nominations and has found that the 1" = 600' adequately meets our office needs. The Tennessee Historical Commission does not have the facilities to prepare maps to the scale preferred by the National Park Service.
PHOTOGRAPHS

Beth Salem Presbyterian Church, McMinn Co., TN
Photos by: Carroll Van West
MTSU Center for Historic Preservation
Date: June 1998
Negatives: Tennessee Historical Commission
2841 Lebanon Road
Nashville, TN 37243

Beth Salem Church and Cemetery, facing southwest
1 of 15

North facade, facing south
5 of 15

Front door detail, north facade, facing south
3 of 15

West elevation and south elevation, facing northwest
4 of 15

South elevation and east elevation, facing northwest
5 of 15

Pulpit and sanctuary, facing southwest
6 of 15

Ceiling detail
7 of 15

Sanctuary, facing west
8 of 15

Kitchen/picnic pavilion, facing northwest
9 of 15
United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet

Section number | Photos | Page
--- | --- | ---

1. Women’s privy, facing southeast
   10 of 15

2. Men’s privy, facing south
   11 of 15

3. Monument and markers, facing south
   12 of 15

4. Cemetery, facing north
   13 of 15

5. East Melton tombstone, facing east
   14 of 15

6. W. G. Carlock tombstone, facing east
   15 of 15

10 PRESERVATION BRIEFS
Exterior Paint Problems on Historic Woodwork
Kay D. Weeks and David W. Look, AIA

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

A continuation approach to paint removal is included in the guidelines to "The Summary of the Interim Standards for the Preservation of Historic Properties." Removing paint from historic wood surfaces using hand methods (where possible) is preferred. Surface preparation and application of protective coatings is essential.

This brief expands on that advice for the architect, building manager, contractor, or homeowner by identifying and describing common types of paint surface conditions and failures, and recommending appropriate treatments for preparing exterior wood surfaces for repainting to assure the best adhesion and greatest durability of the new paint. Although the Brief focuses on responsible methods of "paint removal," several paint surface conditions will be described which do not require any paint removal, and still others which can be successfully handled by limited paint removal. In all cases, the information is intended to address the concerns related to exterior wood. It will also be generally assumed that, because houses built before 1930 involve one or more layers of lead-based paint, the majority of conditions warranting paint removal will mean dealing with this toxic substance along with the dangers of the paint removal tools and chemical strippers themselves.

Purposes of Exterior Paint
Paint applied to exterior wood must withstand yearly extremes of both temperature and humidity. While not expected to be more than a temporary physical shield—requiring reapplication every 3-5 years—its importance should not be minimized. Because one of the main causes of wood deterioration is moisture penetration, a primary purpose for painting wood is to exclude such moisture, thereby slowing deterioration not only of a building's exterior siding and decorative features but, ultimately, its underlying structural members. Another important purpose for painting wood is, of course, to define and accent architectural features and to improve appearance.

Treating Paint Problems in Historic Buildings
Exterior paint is constantly deteriorating through the processes of weathering, and is a system of regular maintenance—assuming all other building systems are functioning properly—surfaces can be cleaned, lightly scraped, and hand washed in preparation for a new finish coat. Unfortunately, these are ideal conditions. More often, complex maintenance problems are inherited by owners of historic buildings, including areas of paint that have failed beyond the point of mere cleaning, scraping, and hand washing (although much so-called "paint failure" is attributable to interior or exterior moisture problems or surface preparation and application mistakes with previous coats).

Although paint problems are by no means unique to historic buildings, treating multiple layers of hardened, brittle paint can be complex, ornamental—and possibly fragile—exterior wood surfaces necessarily requires an extremely cautious approach (see Figure 1). In the case of recent construction, this level of concern is not needed, because the wood is generally less dried out and, in addition, retention of the sequence of paint layers as a partial record of the building's history is not an issue.

When historic buildings are involved, however, a special set of problems arises—varying in complexity depending upon their age, architectural style, historical importance, and physical soundness of the wood—which must be carefully evaluated so that decisions can be made that are sensitive to the longevity of the resource.

Justification for Paint Removal
At the outset of this Brief, it must be emphasized that removing paint from historic buildings—with the exception of cleaning, light scraping, and hand washing as part of routine maintenance—should be avoided unless absolutely essential. Once conditions warranting removal have been identified, the general approach should be to remove paint to the next sound layer using the gentlest means possible, thus to repent (see Figure 2). Practically speaking as well, paint can adhere just as effectively to existing paint as to bare wood, providing the previous coats of paint are also adhering uniformly and tightly to the wood and the surface is properly prepared for repainting—cleaned of dirt and chalk and dulled by sanding. But, if painted exterior wood surfaces display continuous patterns of deep cracks or if they are extensively blistering and peeling so that bare wood is visible, then the old paint should be completely removed before repainting. The only other justification for removing all previous layers of paint is if doors, shutters, or windows have literally been "painted shut," or if new wood is being placed in adjacent to old painted wood and a smooth transition is desired (see Figure 3).

Paint Removal Precautions
Because paint removal is a difficult and painstaking process, a number of costly, reputable services have arisen—and continue to occur—for both the historic building and the building owner. Historic buildings have been set on fire with blow torches, wood irreversibly scarred by sandblasting or by harsh chemical devices such as rotary sanders and rotary wire strippers: layers of historic paint inadvertently and unnecessarily removed. In addition, property owners, using techniques that substitute speed for safety, have been injured by toxic fumes or dust from the paint they were trying to remove or by misuse of the paint remover themselves.

Owners of historic properties considering paint removal should also be aware of the amount of time and labor involved. While removing damaged layers of paint from a door or porch railing might be readily accomplished within a reasonable period of time by one or two people, removing paint from larger areas of a building can, with...
our professional assistance, easily become unmanageable and produce less than satisfactory results. The amount of work involved in any paint removal project must therefore be analyzed on a case-by-case basis. Hiring qualified professionals will often be a cost-effective decision due to the expense of materials, the special equipment required, and the amount of time involved. Further, paint removal companies experienced in dealing with the inherent health and safety dangers of paint removal should have purchased such protective devices as are needed to mitigate any dangers and should also be aware of State or local environmental and/or health regulations for hazardous waste disposal.

All in all, paint removal is a messy, expensive, and potentially dangerous aspect of rehabilitating or restoring historic buildings and should not be undertaken without careful thought concerning its necessity, and second, which of the available recommended methods is the safest and most appropriate for the job at hand.

Repealing Historic Buildings for Cosmetic Effects

If existing exterior paint on wood siding, eaves, window sills, sash, and shutters, doors, and decorative features shows no evidence of paint deterioration such as chalking, blistering, peeling, or cracking, then there is no physical reason to repaint. Such less remove paint! Nor is color fudging; of itself, sufficient justification to repaint a historic building.

The decision to repaint may not be based altogether on paint failure. Where there is a new owner, or even where ownership has remained consistent through the years, taste in color often changes. Therefore, if repainting is primarily to alter a building's primary and accent colors, a technical factor of paint accumulation should be taken into consideration. When paint builds up to a thickness of approximately 1/32" (approximately 1-20 layer), one or more extra coats of paint may be enough to trigger cracking, peeling, and blistering. This can be limited to even small areas of the building's surface. This results because excessive thickness causes paint to withstand the detrimental pull of an additional coat at its surface, and is also less able to tolerate thermal stress. Think paint irritating to the weakest point of adhesion—the oldest layers next to the wood. Chemically, this can result. Therefore, if there are no signs of paint failure, it may be somewhat risky to add more coats of paint simply for the color's sake (extra charges in color may also require an adjustment). The cost for total paint removal need not be so high for complete color change.

Environmental "green" or organic matter that tends to cling to paint's exterior surfaces and, in particular, protected surfaces such as eaves, does not constitute a paint problem unless it overpowers the repellent and causes repainting. If not removed, the deposits can be a barrier to proper adhesion and cause paint to peel off before the end of the specified time. Therefore, exposure to the critical severe environmental "green" or organic matter (that is, just to limited portions of the trim) might be an acceptable compromise without changing cracking and peeling of paint to maintain a consistent color.

If the decision to repainting is nonetheless made, the "new" color or colors should, at a minimum, be appropriate to the style and setting of the building. On the other hand, roughly, the intent is to restore or accurately reproduce the colors originally used or those from a significant period in the building's evolution, they should be based on the results of a paint analysis.2

Identification of Exterior Paint Surface Conditions/Recommended Treatments

It is assumed that a preliminary check will have already been made to determine if paint surfaces are indeed wood—and not stone, metal, or other wood substrates—and that the wood has not decayed so that repainting would be superfluous. For example, if any area of bare wood such as window sills has been exposed for a long period of time to standing water, it is a strong possibility (see figure 4). Repair or replacement of deteriorated wood should take place before repainting. After these two basic issues have been resolved, the surface condition identification process may commence.

The historic building will undoubtedly exhibit a variety of exterior paint surface conditions. For example, paint on the wooden siding and doors may be adhering firmly; paint on the eaves and porches, and paint on the porch balusters and window sills cracking and delaminating. The complete identification of each paint problem is therefore the first step in planning an appropriate overall solution. At least some surface conditions can be grouped according to their relative severity. CLASS I conditions include minor blemishes or dirt collection and generally require no paint removal. CLASS II conditions include failure of the top layer or layers of paint and generally require limited paint removal. CLASS III conditions include substantial or multiple-layer failure and generally require total paint removal. It is precisely because conditions will vary at different points on the building that a careful inspection is critical. Each item of painted exterior woodwork (i.e., siding, doors, windows, eaves, shutters, and decorative elements) should be examined early in the planning phase and surface conditions noted.

CLASS I: Exterior Surface Conditions Generally Requiring No Paint Removal

- Dust, Soot, Pollution, Colloids, Insect Cocoon, etc.
- Environmental "green" or organic matter that tends to cling to paint's exterior surfaces and, in particular, protected surfaces such as eaves, does not constitute a paint problem unless it overpowers the repellent and causes repainting.
- If not removed, the deposits can be a barrier to proper adhesion and cause paint to peel off before the end of the specified time. Therefore, exposure to the critical severe environmental "green" or organic matter (that is, just to limited portions of the trim) might be an acceptable compromise without changing cracking and peeling of paint to maintain a consistent color.

Recommended Treatment

Most surface matter can be loosened by a strong, direct stream of water from the nozzle of a garden hose. Stubborn dirt and soil will need to be scrubbed off using a ⅓ cup household detergent to a gallon of water with a medium soft bristle brush. The cleaned surface should then be rinsed thoroughly, and permit to dry before further inspection to determine if repainting is necessary. Otherwise, color changes offer a satisfactory enough reason to postpone repainting.

CLASS II: Exterior Surface Conditions Generally Requiring Limited Paint Removal

Mildew

Mildew is caused by fungal feeding on residues contained in the paint film or dirt adhering to any surface. Because moisture is the single most important factor in its growth, mildew tends to thrive where wetness and lack of sunlight are problems such as window sills, under eaves, around gutters and downspouts, on the north side of buildings, or in shaded areas near shrubbery. It may sometimes be difficult to distinguish mildew from dirt, but there is a simple test to differentiate: if a drop of household bleach is placed on the suspected surface, mildew will immediately turn white whereas dirt will continue to look dirt.

Recommended Treatment

Because mildew can only exist in shady, warm, moist areas, attention should be given to altering the environment that is conducive to fungal growth. The area in question may be shaded by trees which need to be pruned back to allow sunlight to strike the building, or may lack rain gutter or proper drainage at the base of the building. If the shady or moist conditions can be altered, the mildew is less likely to reappear. A recommended solution for removing mildew consists of one cup non-grease detergent, one quart household bleach, and one gallon water. When the surface is scrubbed with this solution using a medium soft brush, the mildew should disappear. However, for particularly stubborn spots, an additional quart of bleach may be added. After the area is mildew-free, it should then be treated with a direct stream of water from the nozzle of a garden hose, and permitted to dry thoroughly.When repainting, especially formulated "mildew-resistant" primer and finish coats should be used to prevent the problem of mildew reappearing.

Excessive Chalking

Technically referred to as "Loss of Physical Adhesion," chalking is the process of new paint peeling off, leaving a chalky appearance on the exterior of the building. This is a result of the natural white powder/white substance which is formed when household paint cure/cure and continue to be used.

Recommended Treatment

In many cases, the peeling paint can be prevented by the application of a semi-matte, low-sheen, water-based sealer. This sealer will help to prevent the paint from cracking and peeling off. If the paint is peeling off, it can be repaired by applying a new coat of paint. If the paint is not peeling off, it is recommended to apply another coat of paint. This should be applied in a manner that is consistent with the original paint.

Staining of Paint Coatings Usually Results from Excess Moisture Within the Paint Film

Moisture within the paint film can cause the paint to become discolored or stained. This can happen if there is a lot of moisture present during the drying process. This can be caused by improper ventilation, improper application techniques, or excessive moisture in the environment. The paint will then become discolored and may require repainting. This can be prevented by applying a sealer to the surface before applying the paint. This will help to prevent the paint from becoming discolored. If the paint is already discolored, it can be repaired by applying a new coat of paint. If the paint is not discolored, it is recommended to apply another coat of paint. This should be applied in a manner that is consistent with the original paint.
has been rinsed and permitted to dry, a "stain-blocking primer" especially developed for preventing this type of stain should be applied (two primer coats are recommended for severe cases of bleeding prior to the finish coat). Each primer coat should be allowed to dry at least 6 hours.

**CLASS II Exterior Surface Conditions Generally Requiring Limited Paint Removal**

**Cracking**

*Cause of Condition*

Cracking—fine, jagged, intercostal breaks in the top layer of paint—results when paint that is several layers thick becomes excessively hard and brittle with age and is consequently no longer able to expand and contract with the wood in response to changes in temperature and humidity (see figure 2). As the wood swells, the bond between paint layers becomes broken, causing cracks to appear. Although somewhat more difficult to detect as opposed to other more obvious paint problems, it is well worth the time to scrutinize all surfaces for cracking. If not corrected, excessive moisture will enter the cracked surface, resulting in further swelling of the wood and, eventually, deep cracking and alligatoring; a Class III condition which requires total paint removal.

**Recommended Treatment**

Cracking can be treated by hand or mechanically sanding the surface, then repainting. Although the surface cracks may tend to show through the new paint, the surface will be protected against exterior moisture penetration.

---

**Intumescent Peeling**

*Cause of Condition*

Intumescent peeling can be the result of improper surface preparation prior to the last repainting. Most often occurs in protected areas such as eaves and covered porches because these surfaces do not receive a regular rinsing from rainfall, and salts from air-born pollutants may accumulate on the surface. If not cleaned off, the new paint coat will not adhere properly and that layer will peel.

Another common cause of intumescent peeling is incompatibility between paint types (see figure 4). For example, if oil paint is applied over latex paint, peeling of the top coat can sometimes result since, upon aging, the oil paint becomes harder and less elastic than the latex paint. If latex paint is applied over oil, chalking oil paint, peeling can also occur because the latex paint is unable to penetrate the chalky surface and adhere.

**Recommended Treatment**

First, where scale or impurities have caused the peeling, the affected area should be washed down thoroughly after scraping, then wiped dry. Finally, the surface should be hand- or mechanically-sanded, then repainted.

Where peeling was the result of using incompatible paints, the peeling top coat should be scraped and hand- or mechanically-sanded. Application of a high-quality oil-type exterior primer will provide a surface over which either an oil or a latex topcoat can be successfully used.

---

**Solvent Blistering**

*Cause of Condition*

Solvent blistering, the result of a less common application error, is not caused by moisture, but by the action of ambient heat on paint solvent or thinner in the paint film. If solvent-rich paint is applied in direct sunlight, the top surface can dry too quickly, and, as a result, solvents become trapped beneath the dried paint film. When the solvents vaporize, it forms in the way through the paint film, resulting in surface blisters. This problem occurs more often with dark colored paints because darker colors absorb more heat than lighter ones. To distinguish between solvent blistering and blistering caused by moisture, a blister should be cut open. If another layer of paint is visible, then solvent blistering is likely the problem whereas if bare wood is revealed, moisture is probably to blame. Solvent blisters are generally small.

---

**Recommenced Treatment**

Solvent-blistered areas can be scraped, hand- or mechanically-sanded to the next sound layer, then repainted. In order to prevent blistering of painted surfaces, paint should not be applied in direct sunlight.

- **Wrinkling**
  - **Cause of Condition**
    - Another error in application that can easily be avoided is wrinkling (see figure 7). This occurs when the top layer of paint dries before the layer underneath. The top layer of paint actually moves as the paint underneath (a primer, for example) is drying. Specific causes of wrinkling include:
      1. Applying paint too thick
      2. Applying a second coat before the first one is inadequate brushing out, and painting in temperatures higher than recommended by the manufacturer.

  - **Recommended Treatment**
    - The wrinkled layer can be removed by scraping followed by hand or mechanical sanding to provide as even a surface as possible, then repainted following manufacturer’s application instructions.

---

**Cracking: Alligatoring**

*Cause of Condition*

Cracking and alligatoring are advanced stages of crazing (see figure 4). Once the bond between layers has been broken due to intercost paint failure, exterior moisture is able to penetrate the surface cracks, causing the wood to swell and deeper cracking to take place. This process continues until cracking, which forms parallel to grains, extends to bare wood. Ultimately, the cracking becomes an overall pattern of horizontal and vertical breaks in the paint layers that looks like ragged split; hence, alligatoring.

*Recommended Treatment*

If cracking and alligatoring are present only in the top layers they can probably be scraped, hand or mechanically-sanded to the next sound layer, then repainted. However, if cracking or alligatoring have progressed to...
Selecting the Appropriate/Safest Method to Remove Paint

After having presented the "knack" of exterior paint surface conditions—from a mild condition such as strikewax which simply requires cleaning prior to repainting to serious conditions such as peeling and alligatoring which require total paint removal—one important thought bears repeating: If a paint problem has been identified that warrants either limited or total paint removal, the fastest method possible for the particular wooded element of the historic building should be selected from the many available methods.

The treatments recommended—based upon field testing as well as on-site monitoring of Department of Interior grant-in-aid and certification of rehabilitation projects—are those which take these over-riding issues into consideration: (1) the cost/protection and preservation of the historic exterior woodwork; (2) the retention of the sequence of historic paint layers; and (3) the health and safety of those individuals performing the paint removal.

By applying these criteria, it will be seen that no paint removal method is without its drawbacks and all recommendations are qualified in varying degrees.

Methods for Removing Paint

After a particular exterior paint surface condition has been identified, the next step in planning for repairing—or paint removal is required—is selecting an appropriate method for such removal.

The method or methods selected should be suitable for the specific paint problem as well as the particular wooded element of the building. Methods for paint removal can then be divided into three categories (frequently, however, a combination of the three methods is used).

Each method is defined below, then discussed further and specific recommendations made:

Abrasive—Surface preparation by mechanical means and/or chemical strippers, depending on the particular area involved. Bare wood should be primed within 48 hours, then painted.

Thermal—Softening and painting the paint layers by applying heat followed by scraping and sanding. Generally used for total paint removal.

Chemical—Softening of the paint layers with chemical strippers followed by scraping and sanding. Generally used for total paint removal.

Recommended Abrasive Methods (Manual)

Rustic Knife/Scraped Paint: Scenery is usually accomplished with either a putty knife or a paint scraper, or both. Putty knives range in width from one to six inches and have a beveled edge. A putty knife is used in a pushing motion going under the paint and working from an area of least paint toward the edge where the paint is still firmly adhered and, in effect, "feeling" the remaining layers so as to smooth a transition as possible to make between damaged and undamaged areas (see figure 19). Paint scrapers are commonly available in 1", 2", and 3" widths and have replaceable blades. In addition, profiled scrapers have been designed specifically for wooden moldings. As opposed to the putty knife, the paint scraper is used in a pulling motion while scraping the damaged areas of paint cover.

The obvious job in using the putty knives or the paint scraper is to selectively remove the affected layer or layers of paint; however, both of these tools, particularly the paint scraper with its beveled edge, must be used with care to properly prepare the surface and to avoid gouging the wood.

Sandpaper/Sanding Block/Sanding Sponges: After manually removing the damaged layer or layers by scraping, the uneven surface due to the inevitable removal of varying number of paint layers in a given area will need to be smoothed or "feathered" prior to repainting. As stated before, hand sanding, as opposed to the use of mechanical sanding is recommended if the area is relatively limited. A coarse grit, preferably 80 grit sandpaper—the least expensive kind—is used for this purpose. As the sandpaper gets dirty, it must be discarded and the process repeated until all layers adhere uniformly.

Blocks made of wood or hard rubber covered with sandpaper are useful for hand sanding flat surfaces. Sanding sponges—rectangular sponges with an abrasive aggregate on one surface—are also available for such use that requires reaching into grooves because the sponge easily conforms to curved or crevice surfaces. All sanding should be done with the grain.

Recommended Abrasive Methods (Mechanical)

If hand sanding for purposes of surface preparation has not been productive or if the affected area is too large to consider hand sanding by itself, mechanical abrasive methods, i.e., power-operated tools may be used. However, it should be noted that the majority of tools available for paint removal can cause damage to fragile wood and must be used with great care.

Recommended Abrasive Methods (Mechanical)

Orbital sander: Designed as a finishing or smoothing tool for the removal of multiple layers of paint—the orbital sander is thus recommended when limited paint removal is required prior to repainting. Because it works in a small circular motion (some models can also be attached to a back-and-forth vibrating action), this tool is particularly effective for "feathering" areas where paint has been scraped off (see figure 20). Grains vary from 280 grit (the abrasive surface ranges from about 3 x 7 inches to 4 x 4 inches and sandpaper is attached either by clamps or sliding clips. A medium grit, open-coat aluminum oxide sandpaper should be used; free sandpaper bags up so quickly that it is ineffective for smoothing paint.

Beltsander: A second type of power tool—the beltsander, can also be used for removing limited layers of paint, but, in this case, the abrasive surface is a continuous belt of sandpaper that travels at high speeds and consequently offers much less control than the orbital sander. Because of the potential for more damage to the wood, use of the beltsander (also with a medium grit sandpaper) should be limited to flat surfaces and only skilled operators should be permitted to operate it within a historic preservation project.
Summary of Abrasive Methods (Mechanical)

Recommended: Orbital sander, belt sander (skilled operator only).

Applicable areas of building: Flat surfaces, i.e., siding, eaves, doors, windows, sidewalks.

For use on: Class II and Class III conditions.

Health/Safety factor: Take precautions against lead dust and eye damage; dispose of lead paint samples properly.

Not Recommended: Rotary drill attachments, high pressure water blasting, sandblasting.

Thermal Methods

Where exterior surface conditions have been identified that warrant total paint removal such as peeling, cracking, or alligatoring, two thermal devices—the electric heat plate and the electric heat gun—have proven to be quite successful for use on different wooden elements of the historic building. One thermal method—the blowtorch—is not recommended because it can scorch the wood or even burn the building itself.

Recommended Thermal Methods

Electric heat plate: The electric heat plate (see figure 13) operates between 300 and 800 degrees Fahrenheit (not hot enough to vaporize lead paint), using about 15 amps of power. The plate is held close to the painted exterior surface until the layers of paint begin to soften and blister. Then, moved to an adjacent location on the wood, the softened paint is scraped off with a putty knife (it should be noted that the heat plate is most successful when the paint is very thick). With practice, the operator can successfully move the heat plate evenly across a flat surface such as windows siding or a window sill or door in a continuous motion, thus lessening the risk of scorched wood in an attempt to remove the edges of the paint sufficiently for effective removal. Since the electric heat plate’s coil is “red hot,” extreme caution should be taken to avoid igniting clothing or burning the skin. If an extension cord is used, it should be a heavy-duty cord (with spring-grounded plugs). A heat plate could overheat a circuit or, even worse, cause an electrical fire; therefore, it is recommended that this implement be used with a single circuit and that a fire extinguisher always be kept close at hand.

Electric heat gun: The electric heat gun is a versatile tool that can be used for removing paint from woodwork, metal, and plastic. It heats up quickly and can reach temperatures of up to 1200 degrees Fahrenheit. The heat gun is held close to the painted surface, and the paint will begin to soften and blister within a few minutes. The softened paint can then be scraped off with a putty knife. The heat gun is not recommended for removing paint from windows or metallic surfaces due to the risk of fire or damage. For use on: Class II and Class III conditions.

Health/Safety factor: Take precautions against lead dust and eye damage; dispose of lead paint samples properly.

Not Recommended: Blowtorch.

Thermal Methods

Where exterior surface conditions have been identified that warrant total paint removal such as peeling, cracking, or alligatoring, two thermal devices—the electric heat plate and the electric heat gun—have proven to be quite successful for use on different wooden elements of the historic building. One thermal method—the blowtorch—is not recommended because it can scorch the wood or even burn the building itself.

Recommended Thermal Methods

Electric heat plate: The electric heat plate (see figure 13) operates between 300 and 800 degrees Fahrenheit (not hot enough to vaporize lead paint), using about 15 amps of power. The plate is held close to the painted exterior surface until the layers of paint begin to soften and blister. Then, moved to an adjacent location on the wood, the softened paint is scraped off with a putty knife (it should be noted that the heat plate is most successful when the paint is very thick). With practice, the operator can successfully move the heat plate evenly across a flat surface such as windows siding or a window sill or door in a continuous motion, thus lessening the risk of scorched wood in an attempt to remove the edges of the paint sufficiently for effective removal. Since the electric heat plate’s coil is “red hot,” extreme caution should be taken to avoid igniting clothing or burning the skin. If an extension cord is used, it should be a heavy-duty cord (with spring-grounded plugs). A heat plate could overheat a circuit or, even worse, cause an electrical fire; therefore, it is recommended that this implement be used with a single circuit and that a fire extinguisher always be kept close at hand.

Electric heat gun: The electric heat gun is a versatile tool that can be used for removing paint from woodwork, metal, and plastic. It heats up quickly and can reach temperatures of up to 1200 degrees Fahrenheit. The heat gun is held close to the painted surface, and the paint will begin to soften and blister within a few minutes. The softened paint can then be scraped off with a putty knife. The heat gun is not recommended for removing paint from windows or metallic surfaces due to the risk of fire or damage. For use on: Class II and Class III conditions.

Health/Safety factor: Take precautions against lead dust and eye damage; dispose of lead paint samples properly.

Not Recommended: Blowtorch.
paint layers—can be removed with a putty knife. Detachable wood elements such as exterior shutters can also be "rip-stripped." (Jacket-base Stripper.) The formula tends to vary, but generally consists of combinations of organic solvents such as methyl chloride, isopropyl, alcohol, xylene, and methanol; thickener such as methyl cellulose; and various additives such as paraffin was used to prevent the volatile solvents from evaporating before they have time to soak through multiple layers of paint. Thus, while some solvent-base strippers are quite thin and therefore unsuitable for use on vertical surfaces, others, called "semi-permeable" strippers, are formulated for use on vertical surfaces or the underside of horizontal surfaces.

However, whether liquid or semi-solids, there are two important points to stress when using any solvent-base stripper. First, the vapors from the organic chemicals can be highly toxic if inhaled; skin contact is equally dangerous because the solvents can be absorbed second; many solvent-base strippers are flammable. Even though application of strippers are non-aromatic, exposure to high heat or fire can cause a flash fire; in such cases, special filters for organic solvents is recommended and, of course, solvent-base strippers should never be used around flames, lighted cigarettes, or with starch-based aerosol solvents.

Although appearing to be the simplest for exterior use, a particular type of solvent-base stripper needs to be mentioned here because it can actually cause more problems. Known as "water-based," such products have a high proportion of methylene chloride together with small amounts, although the dissolved paint can be rinsed off with water. A further problem is that a potential for misting, or the use of wet steam injected into the water. Still, there are times when a direct two-step procedure is required: the stripper and, finally, the use of steam to remove the old paint layer. The end result is a much cleaner surface, and the use of smaller strippers to aid in the cleaning process.

On balance, then, the regular strippers would seem to work just as well for exterior purposes and are perhaps even better from the standpoint of proper lead safety disposal because they must be handled as opposed to removal of a new car and a wire stretched across the top is one effective means to collect the sludge; when the paint is removed, the sludge is syphoned into the tank. Then, when the tank is filled, the tank is drained, the tank is drained, and the final tank is disposed of according to local health regulations.

Cavity-Stripper. Unlike the admit of solvent-base strippers, cavity-stripers were used exclusively when a chemical method was deemed appropriate for total paint removal prior to repainting or refinishing. Now, it is more difficult to find commercially prepared cavity solutions in hardware and paint stores for home-owner use with the larger quantity of lye (caustic soda) because solvent-base strippers packaged in small quantities tend to dominate the market.

Most commercial striping companies, however, continue to use variations of the caustic bath process because it is the simplest method available for removing paint. Generally, striping should be left to professional companies because caustic solutions can dissolve and permanently damage surfaces as well as present serious disposal problems in large quantities. If exterior shutters or other detachable elements are being sent out for stripping in a caustic solution, it is wise to see samples of the company's finished work. While some companies do a fine job, some can have a residue of oil in cavities and recesses. Wooden elements may also be attacked too long so that the wood grain is raised and roughened, requiring extensive hand sanding later. In addition, assurances should be given by these companies that caustic paint removers will be neutralized with a mild acid solution or at least thoroughly soaked with water after dipping (a caustic residue makes the wood (not slippery). If this is not done, the lye residue will cause new paint to fail.

Summary of Chemical Methods

Applicable areas: Buildings: decorative features, window sashes, doors, exterior shutters, columns, balconies, and railings.

General Paint Type Recommendations

Based on the assumption that the exterior wood has been painted with oil paint many times in the past and the existing top coat is therefore also an oil paint. It is recommended that for CLASS I and CLASS II paint surfaces in conditions, a top coat of high quality oil paint be applied when repainting. The reason for recommending oil paint rather than latex paints is that a coat of latex paint applied directly over oil paint is more apt to fail. The considerations are twofold. First, because oil paints continue to harden with age, the old surface is sensitive to the added stress of shrinkage which occurs as a new coat of paint dries. Oil paints shrink less upon drying than latex paints and thus do not have as great a tendency to pull the old paint loose. Second, when exterior oil paints age, the binder releases pigment particles, causing a chalky surface. Although for best results, the chalk (or dirt, etc.) should always be cleaned off prior to repainting, a coat of new latex paint is more able to penetrate a chalky residue and adhere to the latex paint; therefore, as it is possible to thoroughly clean a heavily chalked surface, oil paints—on balance—better adherence.

If, however, a latex top coat is going to be applied over several layers of oil paint, an oil primer should be applied first (the oil primer creates a flat, porous surface to which the latex can adhere). After the primer has thoroughly dried, a latex top coat may be applied. In the long run, changing paint types is more time consuming and expensive. An application of a new oil type top coat on the old oil paint is, thus, the preferred course of action.

CLASS III conditions have nonexistent total paint removal, there are two options, either of which assure protection of the exterior wood. (1) An oil primer may be applied followed by an oil-type top coat, preferably by the same manufacturer; or (2) an oil primer may be applied followed by a latex top coat, again using the same brand of paint. It should also be noted that sometimes there were never intended to withstand the effects of weathering; therefore, the top coat should be applied as soon as possible after the primer has dried.

Conclusion

The recommendations outlined in this Brief are cautious because there is not an entirely safe and effective method of removing old paint from exterior woodwork. This has necessarily eliminated descriptions of several methods still in a developmental or experimental stage, which can therefore be recommended only if they are the result of future recommendations. With the ever-increasing number of buildings being rehabilitated, however, paint removal technology should be streamlined and, in consequence, existing methods refined and new methods developed which will respect both the historic wood and the health and safety of the operator.

Reading List


"LeBlond, C. 'Selecting the Best Interior Paint.' The Old House Journal, Vol. 6, No. 7 July 1970, pgs. 5-10.


September 1970
Appendix C. The Repair of Historic Wooden Windows

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 monumental windows, but it can be equally true for warehouse or factories where the windows may be the most dominant visual element of an otherwise plain building (see Figure 1). Evaluating the significance of these windows and planning for their repair or replacement can be a complex process involving both objective and subjective considerations. The Secretary of the Interior’s Standards for Rehabilitation, and the accompanying Guidelines, call for reporting the significance of original materials and features, repairing and retaining them where 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 historic significance of windows is the first step in planning for window treatments, and a correct understanding of the function and history of windows is vital to making a proper evaluation. As part of this evaluation, one must consider four basic window functions: admitting light to the interior space, providing fresh air and ventilation to the space, providing a visual link to the outside world, and enhancing the appearance of a building. No single feature 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 pastel solar heat gain.

Historically, the windows in early American houses were casement windows; that is, they were hinged at the side and opened outward. The beginning of the eighteenth century saw single- and double-hung windows introduced. These features are characteristic of these very early sliding windows have now 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. More 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, whereas the windows are one architectural element (see Figure 2).

After all, the factors have been evaluated, windows should be considered significant to a building if they: 1) are original, 2) reflect the original appearance of the building, 3) reflect period or regional styles or building traditions, and 4) have characteristics not carried forward 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 (or 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 the window schedule which lists all of the parts of each window unit. Schedules can be made to note existing conditions and repair instructions. When such a schedule is completed, it indicates the specific tasks to be performed in the repair of each unit and become a part of the specifications. In any evaluation, one should note at a minimum, 1) window location, 2) condition of the pane, 3) condition of the frame and sill, 4) condition of the sash, 5) style and maintenance, 6) glazing problems, 6) hardware, and 7) the overall condition of the window (soil, face, paint, 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 sash should be caulked to eliminate this danger. The glazing putty should be checked for cracks, 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 jointery. The sill should be examined to insure that it slopes downward from the building and allows water to drain off. In addition, it may be advisable to cut a deflection on the underside of the sill. This almost invisible treatment will insure proper water run-off, particularly if the bottom of the sill is flat. Any conditions, including poor original design, which permit water to come in contact with the wood or to puddle on the sill must be corrected as they contribute to deterioration of the window.

One clue to the location of areas of excessive moisture is the condition of the paint; therefore, each window should be examined for areas of paint failure. Since excessive moisture is detrimental to the paint bond, areas of paint blistering, cracking, flaking, and peeling usually identity 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 recoated physical condition beneath unsightly paint. After noting areas of paint failure, the next step is to inspect the condition of the wood, particularly as the points identified during the paint examination.

Each window should be examined for operational soundness beginning with the lower portions of the frame and sash. Exterior rainwater and interior condensation can flow downward along the window, entering and collecting at points where the flow is blocked. These points between the sash and jambs, corners of the bottom rails and middle joints are typical points where water collects and deterioration begins (see Figure 2). The operation of the window (continuous opening and closing over the years and seasonal temperature changes) weakens the joints, causing movement and slight separation. This process makes the joints more vulnerable to water which is readily absorbed into the end-grain of the wood. If severe deterioration exists in these areas, it will usually be apparent on visual inspection, but other less obvious 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 the wetted wood surface at an angle and pry up a small sec-
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
putting 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 vis-
ible 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 skins where visual access
to the underlying 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 ac-
tions necessary to return a window to “like new” condi-
tion will fall into three broad categories: 1. routine main-
tenance procedures, 2. structural stabilization, and 3.
repair or 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 time. Note that most of the
points mentioned in Repair Class I are routine main-
tenance items and should be provided as a regular main-
tenance program for any building. The neglect of these
routine tests 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. All existing decay
fungi destroyed in order to arrest the deterioration pro-
cess. Many commercially available fungicides and wood
preservatives are toxic, so it is extremely important to
follow the manufacturer’s recommendations for applica-
tions, and to avoid chemical materials away from children
and animals. After fungicidal and preservative treatment
the affected areas may be stabilized, retained, and reused
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. Larger projects provide the
opportunity for time and resource which might other-
wise be spent on the removal and replacement of
window units, to be spent on repairs, substantially saving all
or part of the material cost of new window units. Regard-
less of the actual cost, 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 elements priorities, and iden-
tify the level of skill needed by the labor force.

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) repair and removal of sash (including replac-
ing where necessary), 3) repairs to the frame, 4) weather-
stripping and reinstallation of the sash, and 5) repainting.
These operations are illustrated for a typical double-hung
wooden window (see Figure 4-6), 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 prop-
per surface preparation for subsequent refinishing (8 paint
color analysis is desired, it should be conducted prior to
the onset of the paint removal). There are several safe
and effective techniques for removing paint from wood,
depending on the amount of paint to be removed. Several
techniques such as scraping, chemical stripping, and the
use of a hot air gun are discussed in "Preservation Briefs: 10
Paint Removal from Historic Woodwork" (see Addi-
tional Reading section at end).

Paint removal should begin on the interior frames, be-
ing careful to remove the paint from the interior stop and
the parting bead, particularly along the sash where these
stops meet the jambs. This can be accomplished by run-
ing a utility knife along the length of the sash, 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 prised loose using
a pair of putty knives, working up and down the stop in
small increments (see Figure 4-6). With the stop removed,
the lower or interior sash may be withdrawn. The sash
cords should be detached from the sash and他们的 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
in a groove in the center of the stile and is thinner and
more delicate than the interior stop. After removing any
paint along the sash, the parting bead should be carefully
prised out and worked free in the same manner as the in-
terior stop. The upper sash can be removed in the same
manner as the lower one and both sash taken to a conven-
tient work area (in order to remove the sash, the interior
stop and parting bead must only be removed from one
side of the window). Window openings can be covered
with polyethylene sheets or plywood sheeting while the
sash are out for repair.

The sash can be stripped of paint using appropriate
techniques, but if any heat treatment is used (see figure
4-6), the glass should be removed or protected from the
sudden temperature change which can cause breakage. An

Figure 4-6. Regrouting or replacement of the poxy
resinous that the existing putty is to be removed.

Figure 4-7. After removing paint from the inside
between the interior stop and the sash, the
stop may be removed from the sash in much the
same manner as described above (see Figure 4). If
the sash is of putty wood, some cracked and missing
putty, slight scarring of the jamb, broken sail cord, and
one cracked pane. Photo: John H. Meyers.
overlay of aluminum foil on gypsum board or asbestos can protect the glass from such rapid temperature changes. It is advisable to protect the glass because it may be brittle and often adds character to the window. Decorative partitions may be removed manually, taking care not to damage the wood along the rebate. If the glass is to be removed, the glazing compounds that 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 pane out, the remaining patio can be removed and the sash can be sanded, primed, and painted with a preservative primer. Handpainted patio in the rebates may be obtained by installing with a soldering iron at the point of removal. Patio remaining on the glass may be softened by soaking the pans 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 rebate to cushion and seal the glass. Glazing compounds should only be used on wood which has been treated with linseed oil and primed with an oil base primer or paint. The paint is then pressed into place and the glazing compound is pushed into the wood around the perimeter of the pane (see figure 4a). 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" forms 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 waterproof seal. After the proper curing times have elapsed for paint and putty, the sash will be ready to reinstall. 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 time of the paint and putty used on the sash. One of the most common work items is the replacement of the sash, and it may be necessary to order new sash or rebars (chairs) (see figure 4c). The weight pocket is frequently accessible through a dowel hole in the frame near the sill, but if it does not exist, the trim on the interior face may be removed for access. Either option may be increased for secure window operation by elderly or handicapped persons. Additional security for the sash may be accomplished with a semi- or non-porous patching compound, sandblast and painted (see figure 3). Squeegee 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 the sash into the mold. Once the mold is made, the proper removal of the sash from the inside of the jamb will be more difficult. The repair of a window frame is made possible by the use of a sash repair frame. The sash repair frame is a boxlike structure that is able to support the sash and frame, and to secure the sash and installation of the sash, parts, and the trim. The sash repair frame should be placed on the floor, and the sash should be lifted into place. The sash repair frame should be removed after the sash has been installed.
the channels between the sash and jambs. Weatherstripping is a historic treatment, but old weatherstripping (till) 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. Storm window frames may be made of wood, aluminum, vinyl, or plastic; however, the use of unfinished aluminum storm windows should be avoided. The visual impact of storm windows may be minimized by selecting colors which match existing trim color. Arched top storm 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 storm is to create a seal on the interior storms while allowing some ventilation around the prime window. In actual practice, the creation of such a sealable, air-tight seal is difficult.

Window Replacement

Although the retention of original or existing windows is always desirable and this fact is intended to encourage that goal, there are points 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 opening and its size; 2) proportions of the frame and sash; 3) configuration of window panes; 4) material profile; 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 organizations, 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 replacement, 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 architecturally acceptable means. In fact, a historic wooden window with a high quality storm window added should thermally support 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 Btus 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-value for single pane glassed windows ranges from 0.06 to 0.09. The addition of a storm window should reduce these figures to a range of 0.04 to 0.05. A non-thermal break, double-glazed metal window has a U-value of about 0.08.

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 be preserved for the future.

Additional Reading


Richter, Richard. Oakland, California: City of Oakland Planning Department, 1975 (chapter 10).


1981
Appendix D. Repointing Mortar Joints in Historic Masonry Buildings

2 PRESERVATION BRIEFS
Repointing Mortar Joints in Historic Masonry Buildings
Robert C. Mack, FAIA
John P. Speweik
U.S. Department of the Interior
National Park Service
Cultural Resources
Heritage Preservation Services

Masonry — brick, stone, terra-cotta, and concrete block — is found on nearly every historic building. Structures with all masonry exterior came 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 — “brick pointing,” is the process of removing deteriorated mortar from the joints of a masonry wall and replacing it with new mortar. (Fig. 1) Properly done, repointing restores the visual and physical integrity of the masonry, improves drainage, repairing not only defects from the appearance of the building, but may also cause physical damage to the masonry units themselves.

The purpose of this brief is to present general guidelines: on appropriate materials and methods for repairing 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 repairing historic masonry buildings. It should also help develop sensitivity to the particular needs of historic masonry, and 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 Brief 2: Repointing Mortar in Historic Masonry 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 constructed with Portland cement masonry.

Figure 1. After removing deteriorated mortar, an experiential repair process on a 19th century limestone building. Photo: Robert C. Mack, AIA.

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 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 paste 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 marble shells (ashlar stones of limestone), brick dust, clay, natural cements, pigments, and even animal hair were 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 counterpart, Roman cement, a natural, hydraulic cement.

Portland cement was patented in Great Britain in 1824. It was named after the source in Portland, England which it resembled when made. This is a fast-setting, 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. Until the turn of the century, Portland cement was considered primarily an additive, or “cement 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 1872 and 1910 can range from pure lime and sand mix to a wide variety of lime, Portland cement, and sand combinations.

In the 1970s, when new mortar products intended to hasten and simplify mason’s work were introduced in the U.S., these included cement mortar, a proprietary, bagged mortar which is a combination of Portland cement, sand, lime putty, lime, and hydrated lime, machine-mixed lime that eliminated the necessity of slaking quicklime into putty at the site.

Identifying the Problem Before Repointing
The decision to repoint is more often related to some obvious sign of deterioration, such as disintegrating mortar blocks in mortar joints, loose bricks or stones, damp walls, or damaged plasterwork. It is, however, recommended that repointing alone will solve all deficiencies that result from other problems (Fig. 2). The next case of the deterioration — lacking roofs or gutters, differential settlement of the building, uplift acting on chimneys, 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.

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 problem, a consultant can propose specifications which reflect the particular requirements of each job and can provide oversight of the work in progress. Reference to preservation standards frequently can be obtained from State Historic Preservation Officers, 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
Preferably research is necessary to ensure that the proposed repointing work is both physically and visually appropriate to the building. Analysis of unweathered mortar of the historic masonry in which the new mortar will be matched can suggest appropriate ratios for the repointing mortar so that it will not damage the building because it is excessively strong or overly impermeable. Where old mortar is difficult to obtain or is being replaced by eroding, loose, or terra cotta — the techniques used in the original construction — new mortars can be designed to match the building’s historic appearance (Figs. 3-4). A simple, non-technical evaluation of the masonry condition and mortar can provide information concerning the relative strength and durability of such sections to ensure that the new mortar will maintain the historic appearance.

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 installation, the result of mixing and placing the mortar, and the cleanliness and condition of the hand. The most useful information that can be gained from laboratory analysis is the identification of send by
stresses should be relieved by the mortar rather than by the masonry units. A mortar that is stronger in compression than the masonry units will not "give," thus causing the stress to be relieved through the aggregate—crushing, in permanent damage to the masonry, such as cracking and spalling, that cannot be repaired easily (Fig. 5). While stresses can also break the bond between the mortar and the masonry units, permitting water to penetrate the resulting failure cracks, this is easier to correct by the joint through repointing than if the break occurs in the masonry units.

Formularity, or rate of vapor transmission, is also critical. High-line masonry units permit more vapor transmission than dense cement mortars. Historically, mortars acted as a bedding material as well as 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 departs any soluble salts either on the surface as efflorescence or below the surface as efflorescence. 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 of the outer surface to spall off or delaminate. If the mortar does not permit moisture or moisture vapor to migrate out of the wall and evaporate, the result 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 gradation ratio.

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 of 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 achieve the optimum performance. Acceptable guidelines for particle size distribution may be found in ASTM C 144 (American Society for Testing and Materials). However, in actuality, most historic mortar does not follow ASTM C 144, matching the same particle-apparatus and gradation usually requires selecting 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 50 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 lime—calcium, magnesium, and dolomitic—differentially 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 that the historic times, and other components of mortar, varied greatly 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.
**Morton 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 diluted acid. The acid dissolves all the carbonates containing minerals not only in the mortar, but also in the aggregate such as oyster shells, coral sand, 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 techniques. One involves collecting the carbon dioxide gas given off as the carbonate is digested by the acid, based on the gas volume the carbonate content of the mortar can be accurately determined (Lendferbrooke, 1963). Simple acid digestion methods are rapid, inexpensive, and easy to perform, but few information is provided 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.

**Instrumental analysis methods** that have been used to evaluate mortars include polarized light or **diffraction microscopy**, scanning electron microscopy, **atomic absorption** spectroscopy, X-ray **diffraction**, and **diffractometric/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. This microscopy provides additional information on the mortars and the mortars used in the entire North American area, which may be appropriate to add some Portland cement to an essentially lime-based mortar; even when testing relatively soft 18th or 19th century brick under some circumstances when a slightly harder mortar is required. The presence of Portland cement that is added to a mortar formulation the harder it becomes—

**Concrete**

The drawback is more common in the initial set.

For replicating, Portland cement should conform to ASTM C 115, and when age-stained Portland cement may provide a better color match for some historic mortars than the more commonly available gray Portland cement. But it should be noted, however, that while Portland cement is appropriate for all historic buildings, since the original mortar may have been mixed with gray cement, the color should not have more than 60% of cement to help avoid efflorescence.

**Masonry cement**

Masonry cement is a Portland cement with the same added materials commonly found at hardware and home-repair stores. It is designed to produce mortars with a comprehensive 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-retention agents. Because masonry mortars are not required to contain hydrated lime, and generally do not contain lime, they produce high-strength mortars that can damage historic masonry. For the masonry, they generally are not recommended for use on historic masonry buildings.

**Lime mortar (pre-bleded).** Hydrated lime mortars, and pre-bleded lime putty mortars with or without a matched sand are commercially available. Custom mortars are also available with color. In most instances, pre-bleded lime mortars containing sand may not provide an exact match, however, if the project calls for total retention, a pre-bleded lime mortar may be worth considering as long as the mortar is compatible in strength with the masonry. If the project involves only selective "spot" repointing, then it may be better to carry out a mortar analysis which can provide a custom pre-bleded lime mortar with a matching sand. In either case, if a pre-bleded lime mortar is to be used, it should contain Type V or 5A hydrated lime conforming to ASTM C 115. Lime. Lime should be possible—clean and free from acids, alkalis, or other chlorides and organic materials.

**Other Components**

In addition to the color of the sand, the texture of the mortar is of critical importance in duplicating historic mortars. Most mortars dating from the mid-19th century—on—with some exceptions—have a fairly consistent texture and color. Some earlier mortars are not as uniformly formed and may contain laps of partially burned lime or "ditty lime" which can provide 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 previous techniques in the repairing mortar. Replacing such unique or individual mortars will require testing new specifications for each application. 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-18th century, were tinted to match or contrast with the brick or stone (Fig. 6). Bright colors, sometimes to the form of brick dust, as well as iron oxides, and black pigments were commonly used. Modern pigments are available which can be added to the mortar at the job site but should not exceed 10% by volume of the Portland cement in the mix, and carbon black should be limited to 1% by volume. Only synthetic mineral pigments, which are acid-proof and non-toxic, should be used to prevent blushing and fading.

**Modern components**

Admixtures are used to control specific characteristics in mortar, and whether they should be used will depend upon the individual project. Air-entraining agents, for example, help to mortar to resist freeze-thaw damage in colder climates. Accelerators are used to reduce mortar setting time to prevent setting while containers help to extend the mortar life in hot climates. Selection of admixtures should be made by the architect or structural engineer as part of the specific, not something routinely added to the mixes.

Generally, modern chemical additives are unnecessary and may, in fact, have detrimental effects to historic masonry projects. The use of inorganic compounds is not recommended. They are not very effective with high-strength mortars and may introduce solvents, 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 extreme physical conditions, but in areas of excessive freeze requiring high-strength mortars with lower permeability, air-entrainment of 10 to 15% may be desirable. (see formula for "soil weather exposure" in Mortar Type and Mix. Bending 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 mortars. In addition, a bending agent is difficult to remove if smeared on a masonry surface (Fig. 7).
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 mortars can be composed 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 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 mortars from low-strength mortars. The ASTM designated them in descending order of approximate general strength as Type M 60; Type S 40; Type N 20; Type O 10; and Type K 0. The letters identifying the type are from the word: MASONRY, using every other letter. Type K has the highest lime content of the mortars that contain portland cement, although it is seldom used today, except for some historic preservation projects. The designation "K" 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, the proportions or proportions for mortar mixes are always given in the following order: cement-lime-sand. Thus a Type K mortar, for example, would be specified as 1:3:10, or 1 part cement to 3 parts lime to 10 parts sand. Other requirements to ensure 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 time that is added, the color, and the mortars that the mortar becomes, increasing its workability. A mortar with high workability might be desirable for a hard stone such as granite per holding up a bridge deck, whereas a softer, more permissible 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 itself has a relatively high permeability or vapor transmission rate, a soft, high lime mortar is necessary to retain sufficient permeability.

Bidding and Scheduling

Repointing is both expensive and time consuming due to the extent of handheld and special materials required. It is preferable to receive only those areas that require work rather than an entire wall, as is often specified. But if 15 or 30 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 sensitive when work is done during or after conventional construction. The location of expensive scaffolding (unless the majority of the masonry is sound and unlikely to require replacement in the foreseeable future). Each project requires judgment based on a variety of factors. Recognizing this at the outset will help to prevent many jobs from becoming prohibitively expensive.

Scheduling, seasonal aspect, needs to be considered first. Generally speaking, wall temperatures between 40 and 80 degrees F and 30 degrees C will prevent finishing of excessive evaporation in the mortar. Ideally, repointing should be done in shade, away from strong winds in order to allow 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 repointing is already in progress, the masonry units are basically sound and need only selective repointing, it is generally better to postpone repointing.
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 surfaces 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 1 1/2 to 2 1/2 times the width of the joint to ensure an adequate bond and to prevent mortar "popout" (Fig. 15). For most brick joints, this will require removal of the mortar to a depth of approximately 1/2 to 1 inch for some mortar with wide joints, mortar may need to be removed to a depth of several inches. Dry blows or disintegration of mortar beyond this minimum depth should also be removed (Fig. 9).

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 steel hammers. 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 masonry, particularly soft brick. Using power saws on walls with thin joints, such as in most brick walls, almost always will result in damage to the masonry units by breaking the edges and by overstressing the bed, or vertical joints (Fig. 11).

However, small pneumatically-powered chisels generally can be used safely and effectively to remove mortar on historic buildings as long as the mason maintains appropriate control over the equipment.

Under certain circumstances, this diamond-bladed grinders may be used to cut out horizontal joints only on hard portland cement mortar common to most early-18th century masonry buildings (Fig. 12). Usually automatic tools most successfully remove old mortar without damaging the masonry units when they are used in combination with hand tools for preparation in repairing. Where horizontal joints are uniform and fairly wide, it may be possible to use a power masonry saw to avoid the removal of mortar, such as by cutting along the middle of the joint; final mortar removal from the sides of the joints should be done with a hand chisel and hammer. Caulking cutters with diamond bladed can sometimes be used successfully to cut out joints without damaging the masonry. Caulking cutters are slow; they do not cut, but chip or at very high speeds, thus minimizing the possibility of damage to masonry units. (Fig. 13). Although mechanical tools may be used safely 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 quarried or granite, than on terra cotta with the 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. (Fig. 14). After filling, the joints should be filled with a neat 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 mortar walls—limestone, sandstone and common brick—that are extremely absorbent, it is recommended that a continual mix 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. Dry 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 3 minutes. The remaining water should then be added in small portions until a mortar 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 compressed tightly into the joints, providing, with no excess water to evaporate, the mortar cores without shrinkage cracks. Mortar should be used within approximately 30 minutes of final mixing, and "stirring," 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 slaggage or course stuff, should be measured by volume, and may require slightly different proportions from those used with hydrated lime (Fig. 14). No additional water is generally used 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. That 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 as a bundle, interspersed with chopping with a hoe, can significantly improve workability and performance. The intensity of this action increases the overall lime sand content and removes any surplus water by compacting the other ingredients. It may also be advantageous for larger projects to use a mortar pan still for mixing. Mortar pan mill 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 necessity of carrying sand on the job site. This mixture, which resembles brown sugar, must be protected from moisture and stored in containers with a 3/4 piece of burlap over the top or sealed in a large plastic bag to prevent exposure and premature carbonation. The lime putty and sand mixture can be reconstituted into a workable condition much later with no additional water.

If Portland cement is species-matched to the putty and sand mortar—Type VII (2:8 or Type IX 3:1)—the Portland cement should be mixed into a dry mix of 3 parts of cement to 1 part of lime putty and sand. Not only will this ensure that the Portland cement is evenly distributed throughout the mixture, but also that the Portland cement is added to wet ingredients it tends to "ball up," requiring dispersion, usually water. Usually water should 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 1 hours and 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 thick, the deep, narrow areas should be filled first, compacting the new mortar in several layers. The top of the entire depth that would be filled successively by applying approximately 3/4 inch of mortar, packing it well into the back corners. This
Figure 15. The profile of the repainted areas on the left reflects the historic color around the center of the light in the front entryway building in Lisbon, OH. The contractor’s name in the repainting code is visible at the signature in the vertical joint. Photo: Anne O’Connor

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 repainting is generally preferable and some color differences should be acceptable, if the difference between old and new mortar is too extreme, it may be advisable in some instances to repeat 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 mortar must be properly matched, usually the best way to deal with surface color differences is to let the mortar age naturally. Other treatments to overcome these differences, including cleaning the new repainted areas or staining the new mortar, should be carefully tested prior to implementation.

Raising 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 mortar may weather at different rates, leading to visual differences after a few seasons. In addition, the mixture 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 Repainted Masonry. If repainting 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 troweling. 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 sensor, and efflorescence. New mortar joints are especially susceptible to damage because they have not been 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 flashed again with plain water to remove all traces of the chemicals.

Several precautions should be taken if a freshly repainted 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.
New construction "blowout" 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 bristle or nylon 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 Cleaning 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 will alter the historic character of the structure to an unacceptable degree. In addition, although marking of the bricks is intended to keep the grout off the remainder of the face of the bricks, some level of residue, called "velveting," will inevitably remain. Surface cleaning cannot substitute for the more extensive work of repointing, and it is not a recommended treatment for historic masonry.

Summary
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. There will be time needed for preparation of the contract documents. The work itself is precise, time-consuming, and costly. Therefore, the owner's skills and plan the work to avoid problems. Schedules for both repointing and other activities will thus require careful coordination to avoid unsatisfactory conditions. The owner must avoid the tendency to rush the work or cut corners if the historic character 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 the restoration and construction. It is the consultant's responsibility to determine the course of the masonry deterioration and ensure that it is corrected before the masonry is repointed. The consultant must also be prepared to spend more time to project the condition of the masonry to ensure it is reasonably accurate.

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 work must be handled and able to perform the work to standards of profession. The specifications should be clear, concise, and complete. The specifications may not be in conflict with the standards of profession. The specifications should be clear, concise, and complete. The specifications may not be in conflict with the standards of profession. The specifications should be clear, concise, and complete.

Other Factors to Consider
Color. Regardless of the color of the brick or colored additives, the sand is the primary color that gives masonry its unique appearance.
application of a raised joint or lime putty joint on top of brick mortar joints (Fig. 20). Pointing is a purely decorative, painted surface treatment over a mortar joint, often in a contrasting color.

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 Fahrenheit 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.

During the early stages of the project, it should be determined how closely the new mortar should match the historic mortar. Will “quasi clone” be sufficient, or is “exact” expected? The specifications should state this clarity 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.

Conclusion

A good repairing job is meant to last, at least 30 years, and perhaps 50-100 years. Shortcuts and poor craftsmanship result not only in diminishing the historic character of a building, but also in a thin film of mold that has, and will require future repointing sooner than if the work had been done correctly (Fig. 17). 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 at some time in the future. Nevertheless, if the historic mortar joint proved durable for many years, thus, careful repointing should have an equally long life, ultimately contributing to the preservation of the entire building.

Selected Reading


Useful Addresses

Brick Institute of America
11440 Commonwealth Drive
Huntersville, NC 28078

Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077

Acknowledgments

Robert C. Mack, BSA, is in principal in the firm of McDonald & Mack Architects, IA, an architectural firm that restores historic buildings in Minnesota, John F. Spescha, CEM, Toledo, Ohio in a 35-year career and principal in U.S. Heritage Group, Inc., Chicago, Illinois, which owns and curates historic masonry buildings. Anne Clotman, Senior Architectural Historian, Heritage Preservation, sits on the Board of Directors of the American Institute of Architects Minnesota Chapter and serves the Institute on the Advisory Board for developing and monitoring the standards of the Preservation Brief: incorporating professional standards, and the national edition. The author is grateful for this input.

The author and the editor wish to thank the following for their professional and technical review that provided valuable assistance: Paul McPherson and Iris D’Amato, Masonry Restoration, McPherson-Twose Company, Minneapolis, MN; Colleen Londergan, Architectural Conservator, John Miller Associates, Inc., Philadelphia, PA; Laura Brown, Drexel University, Philadelphia, PA; Scott A. Koeck, FIAIA, Architectural Conservation, University of Pennsylvania, Philadelphia, PA; and William J. Morgan, Historic Preservation Services, Inc., Philadelphia, PA.

The author is grateful to the following for their assistance: Nicholas Castoreo, Jim Smith, and James C. Clark, Historic Preservation Services, Inc.; Doreen Fuchs, Philadelphia Heritage Preservation Society, Philadelphia, PA; Bill McGarr, Heritage Preservation Services, Inc., Philadelphia, PA; and Pat McGarr, Heritage Preservation Services, Inc., Philadelphia, PA.

The author is also grateful to the following for their assistance: William J. Morgan, Historic Preservation Services, Inc.; and Fred V. Winkler, Heritage Preservation Services, Inc., Philadelphia, PA.

The original version of this report was prepared under the National Park Service. This publication was originally prepared pursuant to the National Park Service.
Appendix E. Cemetery Survey Form.

### Rapid Cemetery Assessment Form

**Inspection**
- Inspection date/time
- AM □ PM □

**Cemetery Description**
- Cemetery Name:
- Address:
- GPS Coordinates:
- County/State:
- Est Cemetery Size:

**Record Lot # or ID:**
- Sact. # or ID: __________

**Intersect Type:**
- Individual □ Family □ Multiple □ Other □

**Number of Structures:**
- 1-2: □ 3-5: □ 6-10: □ >10: □

This section of assessment describes the damaged structures and resources found within this section or lot. Check all items that display damage:

<table>
<thead>
<tr>
<th>Monuments</th>
<th>Materials Found</th>
<th>Coatings found</th>
<th>Type of damage</th>
<th>Level of damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Granite</td>
<td>Limestone</td>
<td>Limestone</td>
<td>Cracked</td>
</tr>
<tr>
<td></td>
<td>Bronze</td>
<td>Sandstone</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Limestone</td>
<td>Other</td>
<td>Broken</td>
<td>10-30%</td>
</tr>
<tr>
<td></td>
<td>Sandstone</td>
<td>Other</td>
<td>Missing Pieces</td>
<td>30-60%</td>
</tr>
<tr>
<td></td>
<td>Limestone</td>
<td>Other</td>
<td>Stained</td>
<td>60-60%</td>
</tr>
<tr>
<td></td>
<td>Sandstone</td>
<td>Other</td>
<td>Broken</td>
<td>30-60%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benches</th>
<th>Materials Found</th>
<th>Coatings found</th>
<th>Type of damage</th>
<th>Level of damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>Limestone</td>
<td>Limestone</td>
<td>Cracked</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Sandstone</td>
<td>Sandstone</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Concrete</td>
<td>Concrete</td>
<td>Broken</td>
<td>10-30%</td>
</tr>
<tr>
<td></td>
<td>Wood</td>
<td>Wood</td>
<td>Missing Pieces</td>
<td>30-60%</td>
</tr>
<tr>
<td></td>
<td>Concrete</td>
<td>Concrete</td>
<td>Stained</td>
<td>60-60%</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Other</td>
<td>Broken</td>
<td>30-60%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Landscapes</th>
<th>Materials Found</th>
<th>Type of damage</th>
<th>Level of damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees</td>
<td>Annual plants</td>
<td>Felled</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Perennial plants</td>
<td>Felled</td>
<td>10-30%</td>
</tr>
<tr>
<td></td>
<td>Shrubbery</td>
<td>Felled</td>
<td>60-60%</td>
</tr>
<tr>
<td></td>
<td>Grasses</td>
<td>Felled</td>
<td>60-60%</td>
</tr>
</tbody>
</table>

**Comments/observations**

---

**Threats**
- Abandonment □ Agriculture □ Desecration □ Development □ Vandalism □ Other □

**Other actions**
- Emergency Stabilization □ Urgent Attention □ Tree Care □ Cleaning □ Other □

**Posting**
- Inspected □ Unusual □ Restricted Use □ Historic Designation □ Detailed Evaluation Needed □ Other □