ERDC/CERL SR-05-43

Construction Engineering Research Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

Fort Leonard Wood Maintenance and Repair Manual

Rolling Heath School House

Adam Smith, Marcia Harris, and Sunny Stone

June 2005

Maintenance and Repair Manual
Rolling Heath School House

FINAL

April 2005

Prepared for

Department of the Army
Fort Leonard Wood
Directorate of Public Works

Prepared by

Engineer Research Development Center
Construction Engineering Research Laboratory
P.O. Box 9005
Champaign, IL 61826-9005

Project Manager: Adam Smith, M.Arch
Project Team: Marcia Harris and Sunny Stone, M.Arch

DISCLAIMER

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products. All product names and trademarks cited are the property of their respective owners.

The findings of this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

DESTROY THIS REPORT WHEN IT IS NO LONGER NEEDED. DO NOT RETURN IT TO THE ORIGINATOR.

TABLE OF CONTENTS

LIST OF FIGURES

Preface

This study was conducted for the U.S. Army Garrison Fort Leonard Wood, Directorate of Public Works/Environmental Division/Natural Resources Branch, Fort Leonard Wood, MO under project number CNC-Q093, "Cultural Resources Management Activities, M & R Manuals." Funding was provided by Military Interdepartmental Purchase Request 21/2020/220/A/MIPR3CERL07DE/PO, dated 30 April 2004. The Fort Leonard Wood technical monitor was Stephanie Nutt, Historic Archeologist.

The work was performed by the Land and Heritage Conservation Branch (CN-C) of the Installations Division (CN), Construction Engineering Research Laboratory (CERL). The CERL Project Manager was Adam Smith. Dr. Lucy A. Whalley is Chief, CN-C, and Mike Golish is Acting Chief, CN. The Acting Director of CERL is Dr. Ilker R. Adiguzel.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of ERDC is COL James R. Rowan and the Director of ERDC is Dr. James R. Houston.

1.0 MAINTENANCE RECORD

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

This is a record of all of the maintenance proposed for the Fort Leonard Wood buildings. For a more detailed record, please consult each individual element section as well as the maintenance and management guidelines and procedures, which follow for site, masonry, metal, wood, roofing, doors and windows, and furnishings. Preservation and rehabilitation should be undertaken as sensitively as possible strictly following recommendations for treatment for particular zones correcting all deficiencies of the element. Recommendations for maintenance and management of each particular element should be strictly followed, and work should be logged in the back of this manual (date, weather conditions, supervisor signature, contractor information, work performed, and problems).

Concrete- Stairs:

- They should be cleaned where they have become rusty due to the corrosion of the metal handrails.
- NR Rating: 316

Masonry- CMU Walls:

- Concrete masonry walls should be repaired as necessary with materials that are like in appearance and mechanical properties.
- CMU walls should be cleaned and repointed after CMU blocks which have large exposed aggregate and are deteriorated beyond repair have been replaced.
- Mortar matching existing in both appearance and mechanical properties should be used to repair the walls.
- NR Rating: 312

Masonry- Chimney:

- Brick should be treated for mold and lichen growth as laid out in the masonry portion of this manual.
- Mortar should be repointed where necessary using one which matches existing color and mechanical properties.
- Soil, dirt, and plantings should be cleared from the base of the chimney and between the stones.
- NR Rating: 312

Metal- Hardware:

- Broken doorknobs should be replaced with hardware similar to the original.
- Deteriorating and delaminating finishes on the doorknobs; these should be replaced with hardware more similar to the original.
- Clean rusty hardware and replace if beyond surface cleaning.
- NR Rating: 366

Metal- Railing:

- Clean rusting metal and seal in order to protect the element from further deterioration.
- NR Rating: 314

Roof- Galvanized Sheet Metal:

- Clean rusty portions.
- Inspect yearly for signs of wear and localized failure.
- Replace portions which are beyond repair.
- NR Rating: 314

Wood- Doors:

- Wood should be cleaned.
- Due to an improper seal before installation, the windows and doors will need to be prematurely replaced within the next 5 years. This should be done in a manner consistent with the original appearance of these elements assuring they are sealed before installation and they are installed neatly unlike this installation.
- NR Rating: 366

Wood- Windows:

- Wood should be cleaned.
- Due to an improper seal before installation, the windows and doors will need to be prematurely replaced within the next 5 years. This should be done in a manner consistent with the original appearance of these elements assuring they are sealed before installation and they are installed neatly unlike this installation.
- NR Rating: 366

2.0 STAGE I—GENERAL INFORMATION

2.1 Background

The Fort Leonard Wood (FLW) historic building maintenance and repair program is based on three successive steps with each step providing a foundation for the next level. The first step is the identification and documentation of the historic building and classification of each building so that it may be compared to others. Steps two and three provide additional levels of documentation within each building. Step two allows the identification and prioritization of significant interior and exterior areas, or zones. Step three allows the identification and rating of the significant architectural elements of each zone, as well as providing maintenance and repair instructions, where deficiencies exist.

The building data is gathered through field inspections conducted by teams of architects and/or related professionals. This data is then gathered into three stages described below. The stages are:

> Stage I is the general identification information, including the background material necessary to establish a "frame of reference" for the building. It includes data on location, identification, size, codes, and related programs.
>
> Stage II allows the organization of the building into one or more zones, or areas of varying importance for historical and architectural reasons. Stage II contains descriptive information plus photographs and drawings to identify the areas.
>
> Stage III contains the identification, evaluation, and description of individual architectural features or elements within each zone established in Stage II. Stage III also identifies deficient elements and allows work recommendations and cost estimates to correct these deficiencies. The elements are organized into several divisions, such as Exterior, Interior, or Electrical. It is the data in Stage III, which is most applicable to the maintenance, repair, and rehabilitation of the building.

The data collected by the FLW historic building maintenance and repair program is reported in a maintenance and repair manual. It is organized into two parts: graphic documentation and written information. The graphic portion consists of photographs and floor plans of the building as it existed at the time of the inspection, plus the zoned building plans. The written portion consists of the various elements of the building and potential repair/replacement options guided by the Secretary of the Interior Standards.

NR RATING - The objective of Stage I is the classification of all historic properties. The purpose of the classification is to establish a ranking of architectural and/or historical significance. NR Rating, therefore, is a number from 1 to 8, which represents this classification. The definitions are as follows:

> CLASS 1 - A building, which is highly distinctive or unique. A National Historic Landmark or National Register building of National significance.
>
> CLASS 2 - A building on, or eligible for, the National Register at the National significance level. A typical example of a recognized architectural style, having all the primary features and details intact.
>
> CLASS 3 - A building on, or eligible for, the National Register at the State or Local significance level.
>
> CLASS 4 - A building which is potentially eligible for the National Register because it appears to meet the criteria, but which has not been listed or evaluated.
>
> CLASS 5 - A building 50 years old or older which has not been evaluated for National Register eligibility.

CLASS 6 - 45-50 - Pending. A building 45 to 50 years old which is not eligible for the National Register, but with the passing of time may become eligible and needs re-evaluation.

CLASS 7 - A building which has been determined to be ineligible for the National Register.

CLASS 8 - Non-Historic.

2.2 General Information

LOCATION: On FLW 25, north of the Big Piney Bridge, Fort Leonard Wood, Pulaski County, Missouri

USGS Devils Elbow, Missouri, United States Quadrangle,

Universal Transverse Mercator Coordinates: Zone 15

Northing 4177076

Easting 581442

PRESENT OWNER: Department of Defense

Department of the Army

Fort Leonard Wood

ORIGINAL USE: School House

PRESENT USE: Museum/Education

DATE OF CONSTRUCTION: circa 1912

SIGNIFICANCE:

The area of significance is education with Rolling Heath being an excellent example of an early 20th century rural schoolhouse, which exemplifies the American and Missouri tradition and law since 1874 of providing education for all their citizens within autonomous school districts, which placed schools within easy walking distance, 3-4 miles, of every student. Rolling Heath is of common form, but constructed of an unusual material, rusticated cast concrete block. This material, along with its corrugated metal roof, has probably accounted for its retention of integrity since the Army purchased it in 1939-40. This retention of integrity and relative rarity of surviving schoolhouses in Pulaski County make the school an excellent example of its property type.

BUILDING NUMBER - 10230

NR - Eligible

HABS/HAER - None

NR RATING - CLASS 3

DESCRIPTION:

Building 10230 is a one-story building constructed of concrete masonry. The roof has a front-gabled form and the windows are one-over-one wood double-hung. The south facade of Building 10230 is symmetrical with a centered six-paneled door. A poured concrete stair, with metal rails to either side, leads to the door from the sloping grade. The west facade of Building 10230 is symmetrical with four evenly spaced double-hung windows. A chimney is located on the north facade of Building 10230 in the center of the facade, rising from grade to above the ridge of the roof. The east facade of Building 10230 is asymmetrical with three evenly spaced double-hung windows to the left and a six-paneled door where the fourth window would have been placed. A poured concrete pad and path leads to this door, with metal rails on the east and south side of the pad.

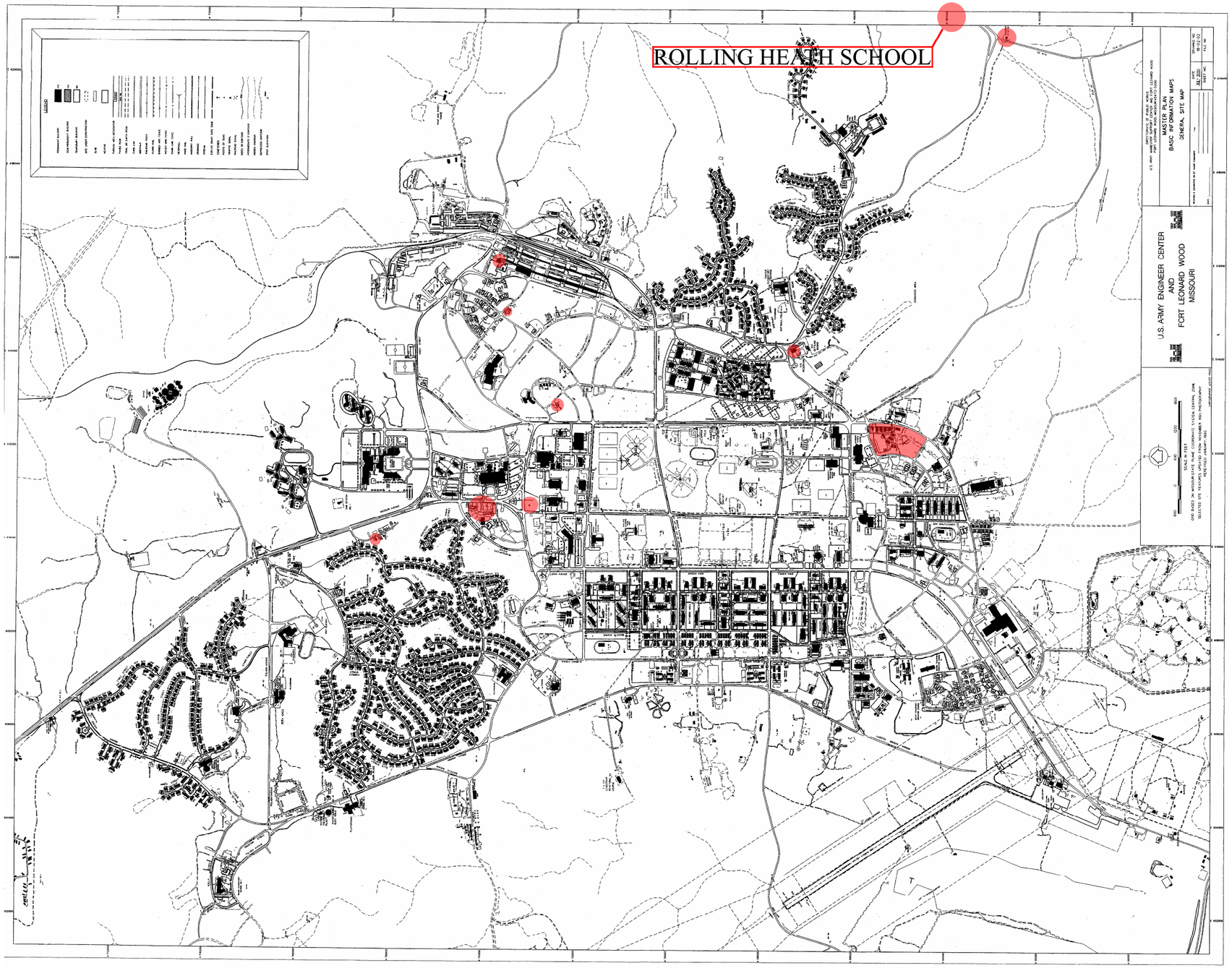


Figure 1: Fort Leonard Wood Cantonment Map

3.0 STAGE II – BUILDING ZONES

Building zones establish the framework for planning for the operation, maintenance, and rehabilitation of an individual building by dividing the building into logical areas consistent with their use, original design, public access, and integrity. The concept of zoning, while establishing a logical framework, is also consistent with techniques of original architectural programming, design, and construction.

The zoning of the building seeks to identify the differences between more and less significant interior and exterior building areas and assigns a numerical rating, or level, to each zone. The zone ratings establish management and treatment requirements for each zone, i.e., highly significant public spaces may be in a "preservation zone" where maintenance is tightly controlled and replacements are restricted. At the other end of the spectrum, larger, more private work areas may be subject to normal maintenance and open to a much broader range of architectural modification. The treatment guidelines for each level convey the general principles of preservation to be applied within the zone.

3.1 SUMMARY OF ZONES:

Level 1 - Preservation Zone (Red)

Level 2 - Preservation Zone (Yellow)

Level 3 - Rehabilitation Zone (Green)

Level 4 - Free Zone (White)

Level 5 - Hazardous Zone (Black Outline)

Level 6 - Impact Zone (Red Stripes)

The Rolling Heath School House, Building 10230, has three zones:

3.1.1 LEVEL 1 - PRESERVATION ZONE

Areas, both in plan and elevation, that exhibits unique or distinctive qualities, original materials or elements, or representing examples of skilled craftsmanship, or work of a known architect or builder, or associated with a person or event of preeminent importance. Level 1 areas may be distinguished from Level 2 areas by concentrations of detailing or "richness" of finish material and detail.

The area of significance is education with Rolling Heath being an excellent example of an early 20th century rural schoolhouse, which exemplifies the American and Missouri tradition and law since 1874 of providing education for all their citizens within autonomous school districts, which placed schools within easy walking distance, 3-4 miles, of every student. Rolling Heath is of common form, but constructed of an unusual material, rusticated cast concrete block. This material, along with its corrugated metal roof, has probably accounted for its retention of integrity since the Army purchased it in 1939-40. This retention of integrity and relative rarity of surviving schoolhouses in Pulaski County make the school an excellent example of its property type.

Areas which need the most attention are the north facade and chimney as well as improperly pointed mortar repairs. These areas are of significant historic value and should be maintained, mold and lichen growth removed, cleaned, and repointed to prevent further deterioration. Any missing elements should be replaced in kind. Care should be taken in the repair of these walls with materials as near to the original color and with similar mechanical properties as the stone. Areas which need attention on Building 10230 are, but not limited to; CMU walls, mortar, corrugated sheet metal roof, and the chimney and its components. These areas are marked in red on the plans.

EXAMPLE: Spaces or areas of a building representing the highest degree of detailing and finish level such as the main lobby or public spaces as might be found in an office building or public building, the foyer and parlors of an historic residence, the offices of the most "important" tenants within a building or

space, assembly spaces such as courtroom or a library reading room, parlor etc., or the primary building facade(s), i.e., that facade which is the most visible to the public.

GUIDELINE: The character and qualities of this zone should be maintained and preserved as the highest priority.

3.1.2 LEVEL 2 - PRESERVATION ZONE

Areas that exhibits distinguishing qualities or original materials and/or features, or representing examples of skilled craftsmanship. These areas are marked in yellow on the floor plan.

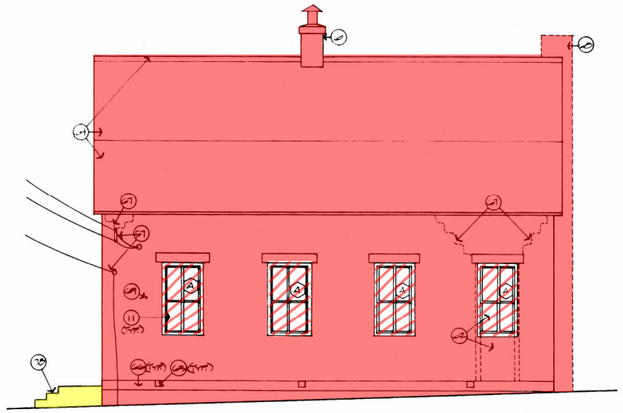
GUIDELINE: Every effort should be made to maintain and preserve the character and qualities of this zone. This includes but is not limited to the use of the same color mortar with mechanical properties more closely mimicking those of the stone used for the original construction of these structures.

3.1.3 LEVEL 6 - IMPACT ZONE

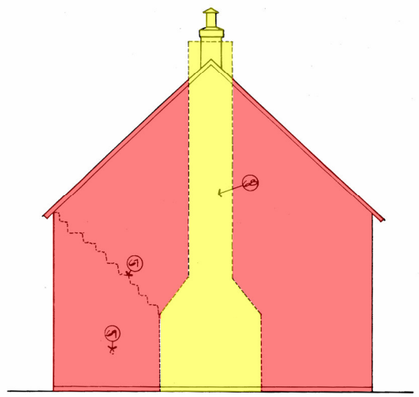
Areas that are improperly used and may result in code violations or areas insensitively adapted, resulting in a general loss or concealment of character and/or loss or obscuring of significant historic fabric or features. Adequate existing fabric must be available to support or provide guidance for the rehabilitation of the zone and the restoration of the character of the original area. These areas are striped red on the elevations.

EXAMPLE: Corridor walls constructed from non-rated materials creating potential fire hazard. Large stylistically distinctive public spaces such as a lobby or ballroom which has been subdivided into smaller spaces using full height permanent partitions and which results in loss of character, spaces which have been insensitively rehabilitated using modern materials such as pre-finished wall panels over original decorative materials, or important elevations which have been insensitively modified.

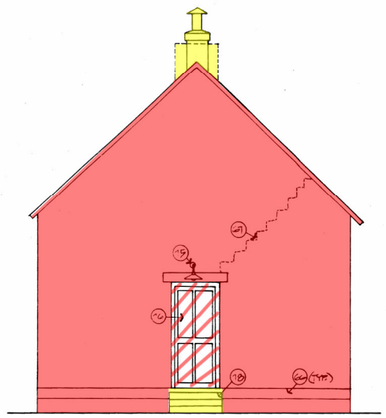
GUIDELINE: Deficiencies in this zone should be corrected and loss of character, fabric, and/or features should be mitigated where possible.



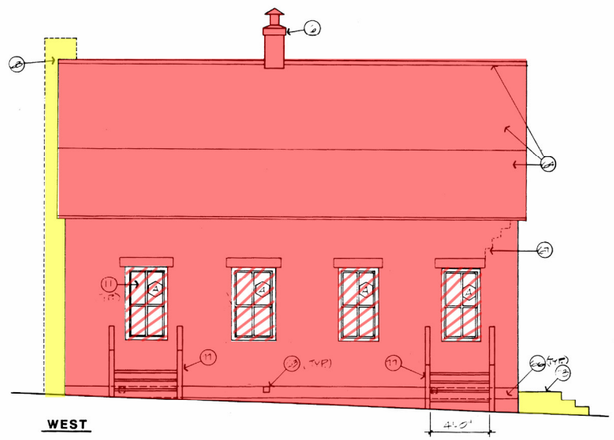
EAST



NORTH



SOUTH



WEST

EXTERIOR ELEVATIONS
1/4" = 1'-0"

PLAN
1/4" = 1'-0"

ROLLING HEATH SCHOOL

LEVEL 1 - Preservation Zone

LEVEL 2 - Preservation Zone

LEVEL 3 - Rehabilitation Zone

LEVEL 4 - Free Zone

LEVEL 5 - Hazardous Zone

LEVEL 6 - Impact Zone

Figure 2: Building 10230
Building Zone Diagram

4.0 STAGE III—ELEMENT REPORT

4.1 GENERAL ASSESSMENT

There are specific trouble areas for the Fort Leonard Wood buildings, which should be more closely inspected, and more rigidly maintained.

The overall element conditions for Fort Leonard Wood buildings are good, except where identified in the individual maintenance reports. All masonry areas will need maintenance, as surfaces have become uneven and mold and lichen have been allowed to grow. A common problem with recent repair work on these elements has been the use of the incorrect mortar mixture as well as improper (haphazard) technique. The area and general problems of particular concern are:

4.1.1 CMU WALLS

The exterior is composed of a rusticated prefabricated CMU. The block is poured into a mold with a rusticated design; this is evident, as all stone faces are identical. Most blocks now have exposed aggregate due to surface erosion and weathering. The joint should be a V-joint, as the joints were originally struck, in order to maintain the artistry of the original construction assembly. The mold for the CMU may be reconstructed from a block or blocks in very good condition, showing as little exposed aggregate as possible. Past joint repairs have not been of matching color, texture, or quality to the original. Proper tooling does not consume more time and it saves money in the long run, as the repair lasts longer.

4.2 GENERAL INFORMATION

Preservation: Defined as the act or process of applying measures to sustain the existing form, integrity, and material of a building or structure.

The Element Report is the first part of the inventory and condition assessment and provides an inventory of the materials, components, and systems found within the building. The inventory and condition assessment is organized into seven categories or divisions. These include site, exterior, interior, foundation, furnishings, utilities/systems, and fire/life/health safety. An element may be an architectural feature, structural component, engineering system, or functional requirement. For each element found within the building a number of aspects are reported:

> DESCRIPTION - The description of the element provides information beyond the already descriptive name/title of the element. This can include the location on or within a building, unique characteristics, color, texture, design aspects, or whether or not the element is original.
>
> NR RATING - This three-digit number is in reality a three component rating system. The left digit is the NR Rating as defined above in Stage I. The middle digit indicates the level of the zone within which the element can be found defined above in Stage II. The right digit is a number from 1 to 6, which rates each individual element found within the building. It is also known as the element's TREATMENT RATING.

Maintenance personnel should be particularly concerned with the specific treatments associated with each numerical value, i.e., that a #1 rated element must be preserved, or that a #3 rated element should be preserved if at all possible, but if it must be replaced, modern materials are acceptable when used in a manner sympathetic to the historic character of the building. The classification levels and corresponding treatment standards are intentionally general at the building level. Their purpose is to heighten awareness, guide management, prevent unnecessary (potentially irreversible) damage, and to promote sensitive management and maintenance. The treatment ratings for individual elements are as follows:

4.3 SITE

4.3.1 Site Element

4.3.1.1 Site—Grounds

NR Rating: 312

Description:

Building 10230—the Rolling Heath School House is located on FLW 25. Its primary facades face east and west. The grounds around building 10230 slope to the southwest. A stair is necessary for entry on the south side of the building due to the slope. The building is surrounded by grass with a gravel access road on the west side of the building leading to a small gravel parking lot. There do not appear to be any major drainage problems around the building.

The grounds are well maintained and should be cared for regularly. Any overgrowth should be cleared from the surrounding sidewalks and stonework.

Treatment Rating 2: PRESERVE WHEREVER POSSIBLE

IF TOO DETERIORATED TO SAVE, ELEMENT MUST BE REPLACED IN KIND.

Statement of Importance:

- The site makes a significant contribution to the property's historic appearance as a building from the World War II period.

Condition: ***Good – Preserve***

Fair to good - Preserve

Poor - Replace

Inventory Quantity and Condition

The site is evaluated as Good when:

- the grounds are well maintained, and
- the front and side concrete walks are in good condition and clear of overgrown plantings, and
- large gravel and slight slope support soil drainage, but are promoting the deterioration of the base of the building as a direct result of water splashing off the gravel.

Minor deficiency of the site exists where:

- All walks should be kept clear of debris and overgrown plantings, and
- standard preventive maintenance practices and building conservation methods have not been followed, and/or
- there is a reduced life expectancy of affected or related building materials and/or systems, and/or
- there is a condition with long-term impact beyond 5 years.

4.3.2 Maintenance / Management Guidelines for Site

According to *The Secretary of Interior's Standards for Rehabilitation*, the proper procedure is to respect the significance of the original materials and features, repair and retain them wherever possible, and replace them only when absolutely necessary.

The following recommendations for care of the historic site are to be thoroughly read and understood before a treatment is specified. *The Secretary of the Interior's Standards for Rehabilitation* should also be consulted to determine the appropriateness of any treatment.

The following is an excerpt from *The Secretary of the Interior's Standards for Rehabilitation*. Full documentation can be found at http://www2.cr.nps.gov/tps/tax/rhb/stand.htm

4.3.2.1 Identify, Retain, and Preserve

Recommended…

- Identifying, retaining, and preserving buildings and their features as well as features of the site that are important in defining its overall historic character.

- Site features may include circulation systems such as walks, paths, roads, or parking; vegetation such as trees, shrubs, fields, or herbaceous plant material; landforms such as terracing, berms or grading; and furnishings such as lights, fences, or benches; decorative elements such as sculpture, statuary or monuments; water features including fountains, streams, pools, or lakes; and subsurface archeological features which are important in defining the history of the site.
- Retaining the historic relationship between buildings and the landscape.

Not Recommended…

- Removing or radically changing buildings and their features or site features, which are important in defining the overall historic character of the property so that, as a result, the character is diminished.
- Removing or relocating buildings or landscape features thus destroying the historic relationship between buildings and the landscape.
- Removing or relocating historic buildings on a site or in a complex of related historic structures--such as a mill complex or farm--thus diminishing the historic character of the site or complex.
- Moving buildings onto the site, thus creating a false historical appearance.
- Radically changing the grade on the property, or adjacent to a building. For example, changing the grade adjacent to a building to permit development of a formerly below-grade area that would drastically change the historic relationship of the building to its site.

4.3.2.2 Protect and Maintain

Recommended…

- Protecting and maintaining the building and building site by providing proper drainage to assure that water does not erode foundation walls; drain toward the building; nor damage or erode the landscape.
- Minimizing disturbance of terrain around buildings or elsewhere on the site, thus reducing the possibility of destroying or damaging important landscape features or archeological resources.
- Surveying and documenting areas where the terrain will be altered to determine the potential impact to important landscape features or archeological resources.
- Protecting, e.g., preserving in place important archeological resources.
- Planning and carrying out any necessary investigation using professional archeologists and modern archeological methods when preservation in place is not feasible.
- Preserving important landscape features, including ongoing maintenance of historic plant material.
- Protecting the building and landscape features against arson and vandalism before rehabilitation work begin, i.e., erecting protective fencing and installing alarm systems that are keyed into local protection agencies.
- Providing continued protection of masonry, wood, and architectural metals that comprise the building and site features through appropriate cleaning, rust removal, limited paint removal, and re-application of protective coating systems.
- Evaluating the overall condition of the materials and features of the property to determine whether more than protection and maintenance are required, that is, if repairs to building and site features will be necessary.

Not Recommended…

- Failing to maintain adequate site drainage so that buildings and site features are damaged or destroyed; or alternatively, changing the site grading so that water no longer drains properly.
- Introducing heavy machinery into areas where they may disturb or damage important landscape features or archeological resources.
- Failing to survey the building site prior to the beginning of rehabilitation work that results in damage to, or destruction of, important landscape features or archeological resources.
- Leaving known archeological material unprotected so that it is damaged during rehabilitation work.
- Permitting unqualified personnel to perform data recovery on archeological resources so that improper methodology results in the loss of important archeological material.
- Allowing important landscape features to be lost or damaged due to a lack of maintenance.
- Permitting the property to remain unprotected so that the building and landscape features or archeological resources are damaged or destroyed.
- Removing or destroying features from the buildings or site such as wood siding, iron fencing, masonry balustrades, or plant material.
- Failing to provide adequate protection of materials on cyclical basis so that deterioration of building and site feature results.
- Failing to undertake adequate measures to assure the protection of building and site features.

4.3.2.3 Repair

Recommended…

- Repairing features of the building and site by reinforcing historic materials.

Not Recommended…

- Replacing an entire feature of the building or site such as a fence, walkway, or driveway when repair of materials and limited compatible replacement of deteriorated or missing parts are appropriate.
- Using a substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the building or site feature or that is physically or chemically incompatible.

4.3.2.4 Replace

Recommended…

- Replacing in kind an entire feature of the building or site that is too deteriorated to repair if the overall form and detailing are still evident. Physical evidence from the deteriorated feature should be used as a model to guide the new work. This could include an entrance or porch, walkway, or fountain. If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.
- Replacing deteriorated or damaged landscape features in kind.

Not Recommended…

- Removing a feature of the building or site that unrepairable and not replacing it; or replacing it with a new feature that does not convey the same visual appearance.
- Adding conjectural landscape features to the site such as period reproduction lamps, fences, fountains, or vegetation that is historically inappropriate, thus creating a false sense of historic development.

4.4 CONCRETE

4.4.1 Concrete Element

4.4.1.1 Concrete—Stoop

NR Rating: 326

Description:

The concrete stoop on the south facade appears to be in good condition. There does not appear to be any spalling or deterioration at this point, though the rusting of the metal handrail is staining the concrete in areas.

Concrete stoop should be cleaned and repaired with materials that are like in appearance and mechanical properties as detailed later in this chapter.

Treatment Rating 6: SPECIFIED TREATMENT IS NOT REQUIRED

IF ANY WORK IS DONE ON THIS ELEMENT IT SHOULD BE SYMPATHETIC TO THE SIGNIFICANT QUALITIES OF THE HISTORIC PROPERTY.

Statement of Importance:

- The stoop is not original to the construction of the Rolling Heath School and has no historic value.

Condition: ***Good – Preserve***

Fair to good - Preserve

Poor - Replace

Inventory Quantity and Condition

The concrete stoop is evaluated as Good when:

- the stoop is structurally and architecturally intact, and
- maintenance of the foundation wall is all that is needed for it to continue to function as it was designed, and
- damaged surfaces should be cleaned and repaired as per preservation standards laid out in this manual.

Minor deficiency of the concrete stoop may exist where:

- Repair as necessary with materials that are like in appearance and mechanical properties, and
- standard preventive maintenance practices and building conservation methods have not been followed, and/or
- there is a reduced life expectancy of affected or related building materials and/or systems, and/or
- there is a condition with long-term impact beyond 5 years.

Minor deficiencies can include, but are not limited to: rusting.

4.4.1.2 Concrete—Threshold

NR Rating: 323

Description:

The threshold on the south facade appears to be in fair condition. Any necessary repairs should be handled with caution replacing or repairing with materials that are like in both appearance and mechanical properties.

Concrete threshold should be cleaned and repaired with materials that are like in appearance and mechanical properties.

Treatment Rating 3: PRESERVE WHEREVER POSSIBLE

IF TOO DETERIORATED TO SAVE, ELEMENT MUST BE REPLACED WITH COMPATIBLE MATERIAL AND DESIGN.

Statement of Importance:

- The threshold contributes to the historic appearance of the building and dates either to the period of historic significance or represents later, sensitive repair or replacement work.

Condition: ***Fair – Preserve***

Fair to good - Preserve

Poor - Replace

Inventory Quantity and Condition

The concrete threshold is evaluated as Fair when:

- the threshold is structurally and architecturally intact, and
- poor patch work over the original threshold will need to be replaced, and
- maintenance of the threshold is needed for it to continue to function as it was designed, and
- damaged surfaces should be cleaned and repaired as per preservation standards laid out in this manual.

Minor deficiency of the concrete threshold may exist where:

- Repair as necessary with materials that are like in appearance and mechanical properties, and
- standard preventive maintenance practices and building conservation methods have not been followed, and/or
- there is a reduced life expectancy of affected or related building materials and/or systems, and/or
- there is a condition with long-term impact beyond 5 years.

Minor deficiencies can include, but are not limited to: poor repair job which should be cleaned and properly executed.

4.4.2 Maintenance / Management Guidelines for Concrete

According to *The Secretary of Interior's Standards for Rehabilitation*, the proper procedure is to respect the significance of the original materials and features, repair and retain them wherever possible, replace them only when absolutely necessary.

The following recommendations for care of historic concrete are to be thoroughly read and understood before a treatment is specified. *The Secretary of the Interior's Standards for Rehabilitation* should also be consulted to determine the appropriateness of any treatment.

Following is an excerpt from *The Secretary of the Interior's Standards for Rehabilitation*. Full documentation can be found at http://www2.cr.nps.gov/tps/tax/rhb/stand.htm

4.4.2.1 Protect and Maintain

Recommended…

- Provide proper drainage so water does not stand or accumulate.
- Clean walls only when necessary to halt deterioration or remove heavy soiling. Chemical cleaning, if utilized, should be conducted by experienced professionals.
- Tests should be conducted to determine the gentlest effective cleaning method possible; e.g., hand washing or low- to medium-pressure water cleaning. Tests should be observed over a sufficient period so that both the immediate and the long-range effects are known.

Not Recommended…

- Applying non-specified paint or other coatings such as stucco or insulation.
- Cleaning surfaces not heavily soiled.
- Cleaning without testing or without sufficient time for testing results to be of value.

- Sandblasting using dry or wet grit or other abrasive agent, high-pressure water-blasting or caustic solutions. These methods of cleaning or paint removal may permanently erode wall surface and accelerate deterioration.
- Wet cleaning when there is any possibility of freezing temperatures.

4.4.2.2 Repair

Recommended…

- Repair any cracks in concrete by sealing with specification-approved sealant.
- Patch damaged sections with in kind material finished to match existing.

Not Recommended…

- Replacing or rebuilding a major portion of foundation wall that could be repaired.
- Patching concrete without removing the source of deterioration.
- Patching with substitute material that is physically or chemically incompatible with the original concrete.

4.4.2.3 Replace

Recommended…

- Repair damaged concrete too deteriorated to patch by cutting damaged material back to remove the source of deterioration (often corrosion of metal reinforcement bars).
- New patch must be applied with in kind material finished to match existing.
- Replace sections too deteriorated to repair using materials compatible with the original materials.

TYPES OF CRACKS IN CONCRETE AND TYPICAL CAUSES[1]

U.S. General Services Administration
Historic Preservation Technical Procedures

03732-02

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

Cracks can be broadly classified as either active or dormant. If they are active, they show some movement in direction, width, or depth over a measured period. If the cracks are dormant, they remain unchanged. Some dormant cracks are of no danger, but if left unrepaired, cracks provide channels for moisture penetration, which can lead to future damage. For guidance on patching dormant cracks, see 03732-01-R "Repairing Cracks in Concrete by Injecting Epoxy Resin."

Cracks can be more specifically classified based on three factors:

1. direction
2. width
3. depth of the crack

They may be longitudinal, transverse, vertical, diagonal, or random. They may range in size from less than 1 mm (fine) to between 1 and 2 mm (medium) to over 2 mm (wide). The following are some crack classifications and a brief description.

- Pattern Cracking: Fine openings in regular pattern usually due to inconsistent volume of concrete, which is lower, near the surface.
- Checking: Shallow openings, closely and irregularly spaced.
- Hairline Cracking: Small cracks, randomly placed, in exposed areas.
- D-Cracking: Fine cracks at close intervals in a progressive random pattern.

Cracks can occur in hardened or unhardened concrete and may because by some of the following conditions:

- Shrinkage cracking: A crack that occurs only in unhardened concrete. It is often seen as relatively straight lines running parallel with the span of the floor.
- Plastic cracking: A type of shrinkage crack that also only occurs in unhardened concrete. It is seen as diagonal lines in the top of a slab. It is often caused by rapid drying of the surface due to delays in applying the curing membrane.
- Settlement cracking: Caused by local restraining of unhardened concrete around reinforcement or some other obstruction.
- Structural cracking: Usually a result of corrosion of the reinforcing steel or structural over stressing.
- Tension cracking: Only occurs in reinforced concrete and is caused by elongation of the reinforcement in tension zones. It is sometimes seen around columns in flat slabs and on beam soffits near the middle of a span.
- Rust cracking: The most common and most serious cause of structural cracking caused by inadequate reinforcement cover. It gradually develops at varying rates over time depending upon the degree of protection offered by the concrete cover.
- Thermally induced cracking: Results from stresses produced by temperature changes.

END OF SECTION

[1] The following excerpt is from the U.S. General Services Administration (GSA) Technical Procedures. Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

PATCHING SPALLED CONCRETE[2]

U.S. General Services Administration
Historic Preservation Technical Procedures

03732-04

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on patching spalls and holes in concrete with a cementitious patching material.

B. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:
   1. Safety Precautions
   2. Historic Structures Precautions
   3. Submittals
   4. Quality Assurance
   5. Delivery, Storage, and Handling
   6. Project/Site Conditions
   7. Sequencing and Scheduling
   8. General Protection (Surface and Surrounding)

1.02 QUALITY ASSURANCE

A. Masonry and Concrete Repair: Prepare sample panels of size indicated for each type of masonry material indicated to be patched, rebuilt, or replaced.

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. Sika Corporation
   201 Polito Ave.
   Lyndhurst, NJ 07071
   201/933-8800

B. General Polymers

C. Master Builders

[2] The following excerpt is from the U.S. General Services Administration (GSA) Technical Procedures. Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

2.02 MATERIALS

A. Concrete Patching Material: One component, early strength, cementitious patching material "SikeTop 222 or 223" (Sika Corporation); "TPM 723" (General Polymers); "Vertipatch" (Master Builders), or approved equal.

B. Water: Clean, free of oils, acids, alkalis, and organic matter.

2.03 EQUIPMENT

A. Trowels

B. Chisels

C. Stiff bristle brushes (non-metallic)

PART 3---EXECUTION

3.01 PREPARATION

A. Protection:

1. Protect persons, motor vehicles, surrounding surfaces of building whose masonry surfaces are being restored, building site, and surrounding buildings from injury resulting from masonry restoration work.
2. Erect temporary protection covers over pedestrian walkways and at points of entrance and exit for persons and vehicles, which must remain in operation during course of masonry restoration work.
3. Contractor shall test those areaway drains, window well drains, etc., which will be used to assure that drains are functioning properly prior to performing masonry restoration operations in those areas. The Contractor shall report immediately to the Construction Engineer the location of drains, which are found to be stopped up, or blocked.
4. Prevent grout or mortar used in repointing and repair work from staining face of surrounding masonry and other surfaces. Remove immediately grout and mortar in contact with exposed masonry and other surfaces.
5. Protect sills, ledges, windows, and projections from patching material droppings.

3.02 ERECTION, INSTALLATION, APPLICATION

A. Remove deteriorated concrete at spalls to sound material. Grind, chisel, or saw cut deep undercut around perimeter of patch. Clean with compressed air. Thoroughly remove any concrete showing traces of oils or grease.

B. Thoroughly wet patched area prior to casting concrete patching material. If cement patching material manufacturer recommends a different procedure, such procedure is to be followed and executed in accordance with published instructions and in accordance with approved test patch.

C. Install cement-patching material in strict accordance with manufacturer's published instructions.

D. Finish surface to match surface being patched, by grinding, troweling, sacking, or brushing.

3.03 ADJUSTING/CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter using stiff nylon or bristle brushes and clean water, spray applied at low pressure.

B. Use of metal scrapers or brushes will not be permitted.

C. Use of acid or alkali cleaning agents will not be permitted.

END OF SECTION

REMOVING SURFACE DIRT FROM CONCRETE[3]

U.S. General Services Administration
Historic Preservation Technical Procedures

03710-15

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

THE CLEANING OR REMOVAL OF STAINS FROM CONCRETE MAY INVOLVE THE USE OF LIQUIDS, DETERGENTS OR SOLVENTS WHICH MAY RUN OFF ON ADJACENT MATERIAL, DISCOLOR THE CONCRETE OR DRIVE THE STAINS DEEPER INTO POROUS CONCRETE. USE THE PRODUCTS AND TECHNIQUES DESCRIBED HERE ONLY FOR THE COMBINATIONS OF DIRT/STAIN AND CONCRETE SPECIFIED.

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on removing dirt from concrete using a detergent, chemical solvent or steam.

B. Dirt encompasses deposits of almost any material in a location where it is not wanted, but it usually includes fine, dark-colored solid particles, often surrounded by some kind of oily film. It is particularly troublesome on architectural and decorative concrete, including exposed aggregate surfaces.

C. Safety Precautions:
   1. DO NOT save unused portions of stain-removal materials.
   2. DO NOT store any chemicals in unmarked containers.
   3. EXCELLENT VENTILATION MUST BE PROVIDED WHEREVER ANY SOLVENT IS USED. USE RESPIRATORS WITH SOLVENT FILTERS.
   4. Whenever acid is used, the surface should be thoroughly rinsed with water as soon as its action has been adequate. Otherwise, it will continue etching the concrete even though the stain is gone.
   5. Provide adequate clothing and protective gear where the chemicals are indicated to be dangerous.
   6. Have available antidote and accident treatment chemicals where noted.

D. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:
   1. Safety Precautions
   2. Historic Structures Precautions
   3. Submittals
   4. Quality Assurance
   5. Delivery, Storage, and Handling
   6. Project/Site Conditions
   7. Sequencing and Scheduling
   8. General Protection (Surface and Surrounding)

[3] The following excerpt is from the U.S. General Services Administration (GSA) Technical Procedures. Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

PART 2---PRODUCTS

2.01 MATERIALS
NOTE: Chemical products are sometimes sold under a common name. This usually means that the substance is not as pure as the same chemical sold under its chemical name. The grade of purity of common name substances however, is usually adequate for stain removal work, and these products should be purchased when available, as they tend to be less expensive. Common names are indicated below by an asterisk (*).

A. Hydrochloric Acid:
   1. A strong corrosive irritating acid.
   2. Other chemical or common names include Chlorhydric acid; Hydrogen chloride; Muriatic acid*; Marine acid*; Spirit of salt*; Spirit of sea salt*.
   3. Available from chemical supply house, drugstore, hardware store.

B. Detergent:

CAUTION: SOME DETERGENTS CONTAIN AMMONIA AND MAY REACT VIGOROUSLY WITH HYDROCHLORIC ACID.

C. Clean, potable water

D. Clean white cloths or towels

2.02 EQUIPMENT
A. Steam cleaning equipment

B. Stiff bristle brushes (non-metallic)

PART 3---EXECUTION

3.01 PREPARATION
A. Protection:
   1. Provide adequate wash solutions (i.e. water, soap, and towels) before starting the job.
   2. Whenever acid is used, the surface should be thoroughly rinsed with water as soon as its action has been adequate. Otherwise, it will continue etching the concrete even though the stain is gone.

3.02 ERECTION, INSTALLATION, APPLICATION

NOTE: Do not try more than one treatment on a given area unless the chemicals used from prior treatment have been washed away.

A. Brush affected area with water and strong detergent.

B. Rinse the area thoroughly with clean, clear water and blot the surface dry with clean towels.

C. Repeat the treatment as necessary until the desired level of cleanliness is achieved.

-OR-

A. Mix 1 part hydrochloric acid in 19 parts water.

B. Scrub the concrete surface with this solution.

NOTE: This is a strong method and may roughen the concrete.

C. Rinse the area thoroughly with clean, clear water; blot the surface dry with clean towels.

D. Repeat the treatment as necessary until the desired level of cleanliness is achieved.

-OR-

A. Steam cleaning is generally effective and may be used in combination with proprietary materials, such as detergents for dirt removal.

B. If there is oil present in the dirt, follow the procedure described for removing lubricating oil, see 03710-31-R "Poulticing Lubricating and Petroleum Oil Stains from Concrete."

END OF SECTION

REPAIRING CRACKS IN CONCRETE BY INJECTING EPOXY RESIN[4]

U.S. General Services Administration
Historic Preservation Technical Procedures

03732-01
The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on patching cracks in concrete by injecting an epoxy adhesive.

B. Epoxy Injection should be used for DORMANT CRACKS - cracks that remain unchanged. Dormant cracks generally pose little danger. However, if left unrepaired, they will provide channels for moisture penetration.

C. The calculated maximum crack width for concrete should not exceed 0.3 mm. Consult a professional to determine the cause for cracking and its source, as superficial repairs can aggravate the problem.

D. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:
   1. Safety Precautions
   2. Historic Structures Precautions
   3. Submittals
   4. Quality Assurance
   5. Delivery, Storage, and Handling
   6. Project/Site Conditions
   7. Sequencing and Scheduling
   8. General Protection (Surface and Surrounding)

E. For guidance in monitoring cracks, see 04200-02-S.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM),
   100 Barr Drive
   West Conshohocken, PA 19428
   (610) 832-9585
   or FAX (610) 832-9555.

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. Abatron, Inc.
   5501 95th Ave.
   Kenosha, WI 53144
   800/445-1754 or 414/653-2000

[4] The following excerpt is from the U.S. General Services Administration (GSA) Technical Procedures. Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

B. Sika Corporation
201 Polito Ave.
Lyndhurst, NJ 07071
201/933-8800

2.02 MATERIALS

A. Epoxy Resin (Abatron, Inc., Sika Corp.), or approved equal.

1. For Fine Cracks:

a. Epoxy shall be a two-part type, low viscosity epoxy adhesive material containing 100% solids and shall meet or exceed the following characteristics when tested in accordance with the standards specified.

b. Characteristics of Components:
1) Component A - shall be a blend of modified epoxy resins.
2) Component B - shall be a blend of modified amine curing agents.

c. Test Method Requirements:
1) Component A - Brookfield RVT, 700 maximum; Viscosity @ 77 +/- 3ºF., cps; Spindle No. 2 @ 20 rpm.
2) Component B - Brookfield RVT, 240 maximum; Viscosity @ 77 +/- 3ºF, cps; Spindle No. 2.

d. Properties of Combined Components: When mixed in the ratio of two parts Component A to one part Component B by volume, or 100 parts Component A to 44 parts Component B by weight, shall be:
1) Potlife, 60g @ 77 +/- 3ºF., minutes; 25 minutes maximum.

e. Properties of the Cured Adhesive: When cured for seven days @ 77 +/- 3ºF., unless otherwise specified, shall be:
1) Ultimate Tensile Strength: ASTM D638; 8000 minimum.
2) Compressive Yield Strength, psi: ASTM D695*; 15,000 minimum.
3) Heat Deflection Temperature: ASTM D648*; 130 F. minimum.

NOTE: Test specimens must be cured in a manner such that the peak exothermic temperature of the adhesive does not exceed 77ºF.

2. For Wide Cracks:

a. Epoxy shall be a two-part gel epoxy adhesive material containing 100% solids and shall meet or exceed the following characteristics when tested in accordance with the standards specified.

b. Properties of Combined Components: When mixed in the ratio of two parts Component A to one part Component B by volume, or 100 parts Component A to 34 parts Component B by weight shall be:
1) Potlife, 200g @ 77ºF. +/- 3ºF., minutes.

c. Properties of the Cured Adhesive: When cured for seven days @ 77 degrees F. +/- 3 ºF., unless otherwise specified, shall be:
1) Ultimate Tensile Strength: ASTM D638; 1,500 psi minimum.
2) Compressive Yield Strength: ASTM D695; 6,000 psi minimum.
3) Heat Deflection Temperature: ASTM D648; 105 F. minimum.

B. Surface Seal: (Epoxy Mortar or Oil-free Clay)

1. Description: The surface seal material is that material used to confine the injection adhesive in the joints or cracks during injection and cure.

2. Properties: The surface seal material shall have adequate strength to hold injection fittings firmly in place and to resist injection pressures adequately to prevent leakage during injection. The material shall not leave a residue upon removal.

NOTE: Provide adhesive crack fillers and other related materials that are compatible with one another and with substrates under conditions of severe weather, demonstrated by sealant manufacturer based on testing and field experience.

2.03 EQUIPMENT

A. Equipment for Injection:
   1. Type: The equipment used to meter and mix the two injection adhesive components and inject the mixed adhesive into the crack shall be portable, positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at the nozzle. The pumps shall be electric or air powered and shall provide in-line metering and mixing.
   2. Discharge Pressure: The injection equipment shall have automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to 200 psi + 5 psi and shall be equipped with a manual pressure control override. For injection of the gel epoxy, the equipment shall be equipped with the above features and be able to pump at up to 5,000 psi.
   3. Ratio Tolerance: The equipment shall have the capability of maintaining the volume ratio for the injection adhesive prescribed by the manufacturer of the adhesive within a tolerance of + 5% by volume at any discharge pressure up to 200 psi. For gel epoxies, the ratio will be checked by weight at up to 5,000 psi.
   4. Automatic Shut-Off Control: The injection equipment shall be equipped with sensors on both the Component A and B reservoirs that will automatically stop the machine when only one component is being pumped to the mixing head.
   5. The manufacturer of the injection equipment and the manufacturer of the epoxy resin adhesive for injection shall be the same.

PART 3---EXECUTION

3.01 EXAMINATION

A. Examine the nature and severity of the crack:
   1. What direction are the cracks going and where are they the widest?
   2. Note sloped floors, bulging walls and doors that do not fit.

B. Determine the probable cause:
   1. Foundation erosion
   2. Decay of materials
   3. Structural failure
   4. Change in materials or geometry
   5. Thermal and moisture changes

C. Determine possible consequences if left unrepaired.

D. Evaluate alternative methods of repair.

E. For cracks associated with thermal movement, look for:
   1. Horizontal or diagonal cracks near the ground at piers in long walls due to horizontal shearing stresses between the upper wall and the wall where it enters the ground.
   2. Vertical cracks near the ends of walls.
   3. Vertical cracks near the top and ends of the facade.
   4. Cracks around stone sills or lintels: due to expansion of the masonry against both ends of the tight fitting stone piece that cannot be compressed.

3.02 PREPARATION

A. Surface Preparation:
   1. Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.
   2. Surfaces adjacent to joints or other areas of application shall be cleaned of dirt, dust, grease, oil, or other foreign matter detrimental to bond of epoxy injection surface seal system.
   3. Entry ports shall be provided along the crack at intervals of not less than the thickness of the concrete member at that location.
   4. Surface seal material shall be applied to the face of the crack or end. For through cracks, surface seal shall be applied to both faces.
   5. Enough time for the surface seal material to gain adequate strength shall pass before proceeding with the injection.

3.03 ERECTION, INSTALLATION, APPLICATION

A. If, before repairs are made, the crack is still damp, be sure to use an epoxy appropriate for damp conditions.

B. Seal both sides of cracks with an epoxy mortar or oil-free clay, leaving small holes through which epoxy resin will be injected. 1/8" to 1/4" diameter tubing can be used to form holes. Holes should be 2"-4" long, roughly 8" apart.

C. Inject 2-component epoxy using device as provided by manufacturer.

D. Injection of epoxy adhesive shall begin at lower entry port and continue until there is an appearance of epoxy adhesive at the next entry port adjacent to the entry port being pumped.

E. When epoxy adhesive travel is indicated by appearance at the next adjacent port, injection shall be discontinued on the entry port being pumped, and epoxy injection shall be transferred to next adjacent port where epoxy adhesive has appeared.

F. Perform epoxy adhesive injection continuously until cracks are completely filled.

G. If port-to-port travel of epoxy adhesive is not indicated, the work shall immediately be stopped and the engineer notified.

H. When cracks or joints are completely filled, epoxy adhesive shall be cured for sufficient time to allow removal of injection or port sealing devices.

I. The outermost quarter inch of the crack shall be filled with a colored epoxy material of the installers' choice subject to prior approval of the **Cultural Resources POC**. The colored epoxy filler shall match the existing material, which it is filling and shall not be discernible from a distance of 15 feet.

3.04 ADJUSTING/CLEANING

A. Upon completion of work, remove all seal material and other residue from site. Remove and clean exposed surfaces of residue or staining resulting from this work.

END OF SECTION

4.5 MASONRY

4.5.1 Masonry Element

4.5.1.1 Masonry—Chimney

NR Rating: 312

Description:

The brick chimney on the north side of Rolling Heath School is covered 20% by mold and lichen growth. It is composed of a white-hued brick where the crust has delaminated. The original color is a reddish tan that still remains on a few bricks. The mortar is brown gray and is not original. The top five courses are weak and the chimney top is leaning southward. This side of the building is not well lit and is shaded by large trees so this will be a continual problem. The only solution is to treat the brick and CMU on this elevation regularly for the mold and lichen growth as detailed in this manual. The chimney is generally in fair condition.

The brick chimney should be cleaned and treated for lichen growth.

Treatment Rating 2: PRESERVE WHEREVER POSSIBLE

IF TOO DETERIORATED TO SAVE, ELEMENT MUST BE REPLACED IN KIND.

Statement of Importance:

- The brick chimney contributes to the significance of the Rolling Heath School House as a building from the World War II period, and
- the brick chimney makes a significant contribution as an integral part of the buildings historic construction.

Condition: ***Fair– Preserve***

Fair to good - Preserve

Poor – Replace

Inventory Quantity and Condition

The brick chimney is evaluated as Fair when:

- the top five courses are weak and the chimney top is leaning southward, and
- the tops of the tapering courses, courses 24-35, are spalling at the corners, and

- dark discoloration may be seen only at the tapered part and down the sides of the chimney base, and
- lichen and mold are attached to the tapering brick, and
- some brick shows hairline cracking, and
- surface spalling amounts to the size of a quarter in some areas, and
- there is lichen and mold growth over 20% of the north facade, with primary concentration on the sides of the chimney near the base, and
- the chimney should be cleaned and treated for mold and lichen as detailed in this chapter, and
- mortar should be repointed where it has deteriorated matching the existing color and mechanical properties.

Minor deficiency of the brick chimney exists where:

- Treat for mold and lichen growth, and
- properly repoint mortar matching existing mortar color and mechanical properties, and
- patch damaged sections with in kind material finished to match existing, and
- replace sections too deteriorated to repair using materials compatible with the original materials, and
- realign top courses and stabilize to prevent failure and imminent injury as a result, and
- standard preventive maintenance practices and building conservation methods have not been followed, and/or
- there is a reduced life expectancy of affected or related materials and/or systems, and
- there is a condition with long-term impact beyond 5 years.

Minor deficiencies can include, but are not limited to: spalling, minor structural failure of the top courses, mortar deterioration, and mold and lichen growth.

4.5.1.2 Masonry—Concrete Masonry Unit Wall

NR Rating: 312

Description:

The exterior of the Rolling Heath School is constructed of rusticated, prefabricated concrete masonry units. The CMU are assembled using mortar as a bond detailed in a "V" joint. The CMU's are generally in fair condition, though they are showing deterioration, mold, and lichen growth. They are missing mortar in areas and in other areas the mortar has been poorly patched.

The mortar should be detailed as shown in this image. The original was detailed as a "V" joint therefore any repairs should be similar in appearance as well as mechanical properties.

The mortar in the top left image is a poor repair job and should be repointed to match the original in appearance using the proper "V" technique.

Treatment Rating 2: PRESERVE WHEREVER POSSIBLE

IF TOO DETERIORATED TO SAVE, ELEMENT MUST BE REPLACED IN KIND.

Statement of Importance:

- The CMU structure contributes to the significance of the Rolling Heath School House as a building from the World War II period, and
- the CMU walls make a significant contribution to the property's historic appearance as a building from the World War II period, and
- the CMU structure makes a significant contribution both to the property's historic appearance and as an integral part of the buildings historic construction.

Condition: ***Fair– Preserve***

Fair to good - Preserve

Poor – Replace

Inventory Quantity and Condition

The CMU walls are evaluated as Fair when:

- the walls are structurally and architecturally intact, and
- most blocks have exposed aggregate due to surface erosion and weathering, and
- the lower courses show more wear than the upper courses, and
- the mold for the CMU may be reconstructed from a block or blocks in very good condition showing as little exposed aggregate as possible, and
- spalled areas on the CMU blocks should be patched with a mortar compound that is like in both appearance and mechanical properties, and
- repairs to the CMU should be completed before repairing the mortar joints, and
- the base of the CMU walls are showing signs of deterioration, mold and lichen growth, and efflorescence, and
- mortar should be repointed where it has deteriorated and using a material that is both like in appearance and mechanical properties as the original and with the same "V" detail as the original, and
- maintenance of the foundation wall is needed for it to continue to function as it was designed as well as treatment for mold, lichen and efflorescence.

Minor deficiency of the CMU walls may exist where:

- Repair as necessary with materials that are like in appearance and mechanical properties, and
- repair poorly executed mortar repairs after replacing or patching any CMU which is deteriorated and showing large amounts of aggregate, and
- treat the base of the building and the north facade for mold and lichen growth as detailed in this chapter, and
- repoint mortar in same "V" detail as original and with material that is both like in appearance and mechanical properties as the original, and
- standard preventive maintenance practices and building conservation methods have not been followed, and/or
- there is a reduced life expectancy of affected or related building materials and/or systems, and/or
- there is a condition with long-term impact beyond 5 years.

Minor deficiencies can include, but are not limited to: missing and deteriorating mortar, poorly executed mortar repairs, efflorescence, mold, and lichen growth.

4.5.2 Maintenance / Management Guidelines for Masonry

According to *The Secretary of Interior's Standards for Rehabilitation*, the proper procedure is to respect the significance of the original materials and features, repair and retain them wherever possible, and replace them only when absolutely necessary.

The following recommendations for care of the historic masonry are to be thoroughly read and understood before a treatment is specified. *The Secretary of the Interior's Standards for Rehabilitation* should also be consulted to determine the appropriateness of any treatment.

The following is an excerpt from *The Secretary of the Interior's Standards for Rehabilitation*. Full documentation can be found at http://www2.cr.nps.gov/tps/tax/rhb/stand.htm

4.5.2.1 Identify, Retain, and Preserve

Recommended…

- Identifying, retaining, and preserving masonry features that are important in defining the overall historic character of the building such as walls, brackets, railings, cornices, window architraves, door pediments, steps, and columns; and details such as tooling and bonding patterns, coatings, and color.

Not Recommended…

- Removing or radically changing masonry features which are important in defining the overall historic character of the building so that, as a result, the character is diminished.
- Replacing or rebuilding a major portion of exterior masonry walls that could be repaired so that, as a result, the building is no longer historic and is essentially new construction.
- Applying paint or other coatings such as stucco to masonry that has been historically unpainted or uncoated to create a new appearance.
- Removing paint from historically painted masonry.
- Radically changing the type of paint or coating or its color.

4.5.2.2 Protect and Maintain

Recommended…

- Protecting and maintaining masonry by providing proper drainage so that water does not stand on flat, horizontal surfaces or accumulate in curved decorative features.
- Cleaning masonry only when necessary to halt deterioration or remove heavy soiling.
- Carrying out masonry surface cleaning tests after it has been determined that such cleaning is appropriate. Tests should be observed over a sufficient period of time so that both the immediate and the long range effects are known to enable selection of the gentlest method possible.
- Cleaning masonry surfaces with the gentlest method possible, such as low pressure water and detergents, using natural bristle brushes.
- Inspecting painted masonry surfaces to determine whether repainting is necessary.
- Removing damaged or deteriorated paint only to the next sound layer using the gentlest method possible (e.g., hand scraping) prior to repainting.

- Applying compatible paint coating systems following proper surface preparation.
- Repainting with colors that are historically appropriate to the building and district.
- Evaluating the overall condition of the masonry to determine whether more than protection and maintenance are required, that is, if repairs to the masonry features will be necessary.

Not Recommended…

- Failing to evaluate and treat the various causes of mortar joint deterioration such as leaking roofs or gutters, differential settlement of the building, capillary action, or extreme weather exposure.
- Cleaning masonry surfaces when they are not heavily soiled to create a new appearance, thus needlessly introducing chemicals or moisture into historic materials.
- Cleaning masonry surfaces without testing or without sufficient time for the testing results to be of value.
- Sandblasting brick or stone surfaces using dry or wet grit or other abrasives. These methods of cleaning permanently erode the surface of the material and accelerate deterioration.
- Using a cleaning method that involves water or liquid chemical solutions when there is any possibility of freezing temperatures.
- Cleaning with chemical products that will damage masonry, such as using acid on limestone or marble, or leaving chemicals on masonry surfaces.
- Applying high pressure water cleaning methods that will damage historic masonry and the mortar joints.
- Removing paint that is firmly adhering to, and thus protecting, masonry surfaces.
- Using methods of removing paint which are destructive to masonry, such as sandblasting, application of caustic solutions, or high pressure water blasting.
- Failing to follow manufacturers' product and application instructions when repainting masonry.
- Using new paint colors that are inappropriate to the historic building and district.
- Failing to undertake adequate measures to assure the protection of masonry features.

4.5.2.3 Repair

Recommended…

- Repairing masonry walls and other masonry features by repointing the mortar joints where there is evidence of deterioration such as disintegrating mortar, cracks in mortar joints, loose bricks, damp walls, or damaged plasterwork.
- Removing deteriorated mortar by carefully hand-raking the joints to avoid damaging the masonry.
- Duplicating old mortar in strength, composition, color, and texture.
- Duplicating old mortar joints in width and in joint profile.
- Repairing stucco by removing the damaged material and patching with new stucco that duplicates the old in strength, composition, color, and texture.
- Using mud plaster as a surface coating over unfired, unstabilized adobe because the mud plaster will bond to the adobe.

- Cutting damaged concrete back to remove the source of deterioration (often corrosion on metal reinforcement bars). The new patch must be applied carefully so it will bond satisfactorily with, and match, the historic concrete.
- Repairing masonry features by patching, piecing-in, or consolidating the masonry using recognized preservation methods. Repair may also include the limited replacement in kind--or with compatible substitute material--of those extensively deteriorated or missing parts of masonry features when there are surviving prototypes such as terra cotta brackets or stone balusters.
- Applying new or non-historic surface treatments such as water-repellent coatings to masonry only after repointing and only if masonry repairs have failed to arrest water penetration problems.

Not Recommended…

- Removing nondeteriorated mortar from sound joints, and then repointing the entire building to achieve a uniform appearance.
- Using electric saws and hammers rather than hand tools to remove deteriorated mortar from joints prior to repointing.
- Repointing with mortar of high Portland cement content (unless it is the content of the historic mortar). This can often create a bond that is stronger than the historic material and can cause damage as a result of the differing coefficient of expansion and the differing porosity of the material and the mortar.
- Repointing with a synthetic caulking compound.
- Using a "scrub" coating technique to repoint instead of traditional repointing methods.
- Changing the width or joint profile when repointing.
- Removing sound stucco; or repairing with new stucco that is stronger than the historic material or does not convey the same visual appearance.
- Applying cement stucco to unfired, unstabilized adobe. Because the cement stucco will not bond properly, moisture can become entrapped between materials, resulting in accelerated deterioration of the adobe.
- Patching concrete without removing the source of deterioration.
- Replacing an entire masonry feature such as a cornice or balustrade when repair of the masonry and limited replacement of deteriorated of missing parts is appropriate.
- Using a substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the masonry feature or that is physically or chemically incompatible.
- Applying waterproof, water repellent, or non-historic coatings such as stucco to masonry as a substitute for repointing and masonry repairs. Coatings are frequently unnecessary, expensive, and may change the appearance of historic masonry as well as accelerate its deterioration.

4.5.2.4 Replace

Recommended…

- Replacing in kind an entire masonry feature that is too deteriorated to repair--if the overall form and detailing are still evident--using the physical evidence as a model to reproduce the feature. Examples can include large sections of a wall, a cornice, balustrade, column, or stairway. If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.

Not Recommended…

- Removing a masonry feature that is unrepairable and not replacing it; or replacing it with a new feature that does not convey the same visual appearance.

BRICK: PROBLEMS AND DETERIORATION[5]

U.S. General Services Administration

Historic Preservation Technical Procedures

04211-08

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

Problems may be classified into two broad categories: 1) Natural or inherent problems based on the characteristics of the material and the conditions of the exposure, and 2) Vandalism and human induced problems.

Although there is some overlap between the two categories, the inherent material deterioration problems generally occur gradually over long periods of time, at predictable rates and require appropriate routine or preventive maintenance to control. Conversely, many human induced problems, (especially vandalism), are random in occurrence; can produce catastrophic results; are difficult to prevent, and require emergency action to mitigate. Some human induced problems, however, are predictable and occur routinely.

NATURAL AND INHERENT PROBLEMS

1. Cracking: May be caused by structural movement or settlement of the building, use of too hard of a repointing mortar, or differing rates of expansion and contraction between adjacent materials.

2. Crazing: A pattern of tiny cracks; typical on glazed brick due to the different coefficients of expansion and contraction between the brick and the glaze. This is not usually a serious problem unless the cracks extend into the body of the brick allowing moisture to infiltrate the masonry.

3. Efflorescence: Deposits of soluble salts on the surface of the masonry evident as a white haze. Moisture traveling through the capillaries of masonry may draw excess amounts of soluble salts along with it. As the moisture is drawn to the surface, it evaporates leaving the salt deposits behind. Efflorescence may be an indication that salts are present under the masonry surface called subflorescence, which is a more serious condition.

4. Erosion: The gradual wearing away of stone or masonry caused by combined forces of wind and rain against the surface of the material.

5. Flaking: An early form of peeling or spalling where thin, flat outer layers of the masonry become detached; usually caused by the presence of moisture combined with freeze/thaw cycles. Water-repellent coatings may also cause the surface to flake.

6. Peeling: May result from use of an inferior masonry unit or from weathering (as in flaking above).

7. Rising Damp: The movement of groundwater along with salts up through the base of masonry walls by suction or capillary action; evident as a horizontal wet stain on the interior and/or exterior of the building. The presence of salts can produce efflorescence on the surface in addition to

[5] The following excerpt is from the U.S. General Services Administration (GSA). Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

facilitating other forms of moisture-related deterioration. Rising damp is caused by improper drainage causing ground to become saturated, or a high watertable.

8. Spalling: When the outer layers of the masonry begin to peel or break off unevenly; it is usually caused by the build-up of moisture and salts trapped in the masonry combined with the pressures from freeze\thaw cycles. Spalling may also result from using too hard of a repointing mortar and improper or abrasive cleaning.

9. Subflorescence: A build-up of salt deposits beneath the masonry surface as moisture in the wall evaporates. During freeze/thaw cycles, the moisture and salts expand and build up pressure inside the masonry. This internal pressure can lead to spalling.

10. Weathering: The natural wearing away of stone or masonry due to the combined forces of wind and rain; more commonly found at corners and projecting details.

HUMAN-INDUCED PROBLEMS

1. Chipping: May be caused improper repair work such as using mortar that is too hard; may be caused by accidental damage or vandalism.

2. Bricks under fired: Inferior bricks may crumble easily when exposed to the natural weathering processes.

3. Prolonged saturation with water caused by leaks in pipes and gutters, open joints or ground moisture: The prolonged presence of water in conjunction with natural freeze/thaw cycles can lead to spalling, efflorescence and loosened mortar joints.

4. Inappropriate mortar used for repointing: Mortar for use in repointing older brick should typically contain lime rather than Portland cement. Lime-based mortar is more flexible and can better accommodate the thermal stresses of expansion and contraction that the masonry units undergo, while Portland cement mortar is dense and more impermeable. A mortar that is too hard can put the units under excessive stress. When the units expand, the dense Portland cement does not compact and can force the brick units to spall. When the units contract, the Portland cement mortar may cause cracking between the mortar and the units, allowing water to access the masonry, which can eventually lead to spalling of the brick units.

5. Portland cement mixture used for repointing may contain sulfate impurities and contaminate adjacent brick with salts, which can cause the brick to crumble or exfoliate.

6. Application of paint or water-repellent coating to masonry surface: These coatings can prevent the transmission of water vapor through the masonry wall which can lead to a build-up of moisture in the units themselves. Excessive water retention can cause efflorescence and spalling.

7. Sandblasted brick: Sandblasting removes the hard, outer surface of the brick, exposing the softer, more porous core to the weather, which can increase the rate of deterioration.

END OF SECTION

REMOVING BIOLOGICAL GROWTH FROM EXTERIOR MASONRY AND STUCCO[6]

U.S. General Services Administration

Historic Preservation Technical Procedures

04200-02

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on removing biological growth such as lichens, algae, mold, and mildew from masonry and stucco.

B. Biological growths such as lichens, algae, moss, and fungi growing on masonry walls are usually an indication that there is excess moisture in or around the masonry. These growths should be removed, as they attract moisture to the masonry surface and hold it there, which can lead to more serious problems. Lichens and mosses in particular, produce oxalic acid which can damage certain types of historic masonry.

C. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:

1. Safety Precautions
2. Historic Structures Precautions
3. Submittals
4. Quality Assurance
5. Delivery, Storage and Handling
6. Project/Site Conditions
7. Sequencing and Scheduling
8. General Protection (Surface and Surrounding)

These guidelines should be reviewed prior to performing this procedure and should be followed, when applicable, along with recommendations from the Regional Historic Preservation Officer (RHPO).

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. ProSoCo, Inc.
P.O. Box 1578
Kansas City, KS 66117
913/281-2700

[6] The following excerpt is from the U.S. General Services Administration (GSA). Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

2.02 MATERIALS

A. For Removing Mold and Mildew:

1. Non-sudsing ammonia or one of the following bleaches:

CAUTION: DO NOT MIX AMMONIA WITH CHLORINE BLEACHES, A POISONOUS GAS WILL RESULT! DO NOT USE BLEACH ON BIRD DROPPINGS.

Sodium Hypochlorite (NaOCl):

a. An unstable salt produced usually in aqueous solution and used as a bleaching and disinfecting agent.
b. Other chemical or common names include Bleaching solution*; Household bleach*; Laundry bleach*; Solution of chlorinated soda*.
c. Potential Hazards: CORROSIVE TO FLESH.
d. Available from chemical supply house, grocery store or supermarket, hardware store or janitorial supply distributor.

-OR-

Hydrogen Peroxide (H202):

a. An unstable compound used especially as an oxidizing and bleaching agent, an antiseptic, and a propellant.
b. Other chemical or common names include Peroxide of hydrogen*; Solution of hydrogen dioxide*; Superoxol*; (hydrogen peroxide is commonly sold as a 3% solution; Superoxol is a 30% solution; Superoxol causes flesh burns; 3% hydrogen peroxide does not).
c. Potential Hazards: TOXIC (when concentrated); CORROSIVE TO FLESH; FLAMMABLE (in high concentration).
d. Available from chemical supply house, drugstore, pharmaceutical supply distributor, or hardware store.

-OR-

Calcium Hypochlorite (CaCl2O2):

a. A white powder used especially as a bleaching agent and disinfectant.
b. Other chemical or common names include Chlorinated calcium oxide; Bleaching powder*; Calcium oxymuriate*; Chloride of lime*; Chlorinated lime*; Hypochlorite of lime*; Oxymuriate of lime*.
c. Potential Hazards: CORROSIVE TO FLESH; FLAMMABLE (WHEN IN CONTACT WITH ORGANIC SOLVENTS).
d. Available from chemical supply house, dry cleaning supply distributor, drugstore or pharmaceutical supply distributor, janitorial supply distributor, swimming pool supply distributor, or water and sanitation supply distributor.

-OR-

Chloramine-T: Chloramine is any of various compounds containing nitrogen and chlorine.

2. Trisodium Phosphate:

NOTE: THIS CHEMICAL IS BANNED IN SOME STATES SUCH AS CALIFORNIA. REGULATORY INFORMATION AS WELL AS ALTERNATIVE OR EQUIVALENT CHEMICALS

MAY BE REQUESTED FROM THE ENVIRONMENTAL PROTECTION AGENCY (EPA) REGIONAL OFFICE AND/OR THE STATE OFFICE OF ENVIRONMENTAL QUALITY.

a. Strong base-type powdered cleaning material sold under brand names.
b. Other chemical or common names include Sodium Orthophosphate; Tribasic sodium phosphate; Trisodium orthophosphate; TSP*; Phosphate of soda*; (also sold under brand names such as).
c. Potential Hazards: CORROSIVE TO FLESH.
d. Available from chemical supply house, grocery store or supermarket or hardware store.

3. Powdered detergent such as "Tide" or approved equal.

B. Proprietary cleaner such as "Limestone Restorer" (ProSoCo, Inc.), or approved equal.
C. Clean, potable water

2.03 EQUIPMENT

A. Garden hose and nozzle
B. Rubber or polyethylene bucket (DO NOT USE A METAL BUCKET AS IT MAY REACT WITH THE CHEMICAL CLEANER AND PRODUCE TOXIC FUMES)
C. Glass or ceramic mixing bowl
D. Knife blade
E. Stiff, natural bristle brushes (non-metallic)
F. Tampico brush, roller or low pressure (50 psi maximum) spray such as pneumatic garden sprayer
G. Rubber gloves
H. Safety glasses

PART 3---EXECUTION

3.01 EXAMINATION

A. Determine the source of excessive moisture, i.e. leaky downspout, standing water, roof overhang, vegetation, etc., and make any necessary repairs before continuing with this task.
B. Determine the type of stain, i.e. algae and lichens, or mold and mildew.

3.02 PREPARATION

A. Protection:
1. Provide adequate wash solutions (i.e. water, soap, and towels) before starting the job.
2. Do not spray in the immediate vicinity of unprotected people and animals.

3.03 ERECTION, INSTALLATION, APPLICATION

NOTE: DO NOT TRY MORE THAN ONE TREATMENT ON A GIVEN AREA UNLESS THE CHEMICALS USED FROM PRIOR TREATMENT HAVE BEEN WASHED AWAY.

A. Removing Lichens and Algae (ONLY):
1. Remove as much plant growth as possible using a knife blade and stiff bristle brush.
2. Water rinse the surface to remove most of the plant material.
a. If the substrate is sound and dense, use low to medium water pressure (100-400 psi).
b. If the masonry is softer, use standard water pressure from the spigot.
3. Allow water to soak plant growth for approximately 30 minutes.
4. Gently scrub the surface with a stiff, natural bristle brush.
5. Thoroughly rinse the surface again with clean, clear water at low pressure from a garden hose.

NOTE: DO NOT USE ANY CHEMICALS WITHOUT FIRST CONSULTING WITH RHPO.

B. Removing Mold and Mildew (ONLY):

CAUTION: DO NOT MIX AMMONIA WITH CHLORINE BLEACHES, A POISONOUS GAS WILL RESULT!

1. Mix the following:
   3 oz. (2/3 cup) trisodium phosphate (TSP) cleaner
   1 oz. (1/3 cup) powdered detergent (i.e. Tide)
   1 qt. 5% sodium hypochlorite bleach (laundry bleach)
   3 qts. warm water

-OR-

   1 part ammonia with 3 parts water

2. Apply the solution to the affected area and scrub with a medium-hard natural bristle brush. Keep the surface saturated until the stain is bleached,

CAUTION: BE SURE TO WEAR RUBBER GLOVES AND SAFETY GLASSES WHEN APPLYING THE SOLUTION.

3. Thoroughly rinse the surface with clean, clear water from a garden hose and allow to dry.
4. Repeat the process as necessary to achieve the desired level of cleanliness.

-OR-

C. For treating any of the above (lichens, algae, mold or mildew), try using a proprietary cleaner such as Limestone Restorer (ProSoCo, Inc.), or approved equal.
   1. Add 1 part Limestone Restorer to 3 parts water and mix in a rubber or polyethylene bucket.
   2. Apply a flood coat of this mixture to the masonry using a low pressure spray (approximately 50 psi).

CAUTION: DO NOT USE A HIGH PRESSURE SPRAY WHEN APPLYING THIS SOLUTION AS THIS MAY CAUSE THE SOLUTION TO BE DRIVEN DEEPER INTO THE PORES OF THE MASONRY, MAKING REMOVAL OF THE SOLUTION DIFFICULT.

a. Begin spraying at the top of the vertical surface and move across horizontally. Allow 100mm rundown.
b. Continue the next horizontal pass across the previous run down.
c. Allow the solution to remain on the surface approximately 5-30 minutes depending upon the thickness of the growth.
d. Gently scrub the surface with a stiff, natural bristle brush. Thoroughly rinse the treated area using pressure-applied water (approximately 400 to 1500 psi) with a 40-60 degree fan spray or garden hose with nozzle adjusted to a tight stream. Rinse from the bottom of the treated area to the top.
e. Allow the surface to dry a minimum of 24 hours.

END OF SECTION

REPOINTING MASONRY USING LIME MORTAR[7]

U.S. General Services Administration

Historic Preservation Technical Procedures

04520-02

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on repointing stone masonry using lime mortar.

B. Repointing is the process of removing deteriorated mortar from a masonry joint and replacing old mortar with new, sound mortar.

C. This process is sometimes referred to as "tuck pointing", though "tuck pointing", is actually a decorative treatment rather than a method of repair. True tuck pointing is the process of adding a finish layer of mortar, occasionally tinted, to the outer portion of a newly laid joint.

D. Major reasons for mortar joint failures include:
   1. Weathering action,
   2. Settling,
   3. Temperature cycles,
   4. Poor original design and materials, and
   5. Lack of exterior maintenance.

E. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:
   1. Safety Precautions
   2. Historic Structures Precautions
   3. Submittals
   4. Quality Assurance
   5. Delivery, Storage and Handling
   6. Project/Site Conditions
   7. Sequencing and Scheduling
   8. General Protection (Surface and Surrounding)

F. For guidance on preparing lime mortar, see 04100-03-S.

1.02 SUBMITTALS

A. Manufacturers' literature describing packaged items.

B. Source and screen analysis of bulk aggregate.

C. Mortar sample: Submit, for verification and approval, a sample of each type of mortar used, in form of 6" long by 1/2" wide sample strips of mortar set in aluminum or plastic channels.
   1. Provide record of mortar mix, composition, and field procedures to be followed.

[7] The following excerpt is from the U.S. General Services Administration (GSA). Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

1.03 QUALITY ASSURANCE

A. Mock-ups: Raking and Repointing Sample Work:
   1. Test/Sample Area and THE CULTURAL RESOURCES POC Approval:
      a. Initially perform sample joint raking and repointing on each of a 100 sq. ft. test of stone, brick, and terra cotta areas as approved by THE CULTURAL RESOURCES POC.
      b. Demonstrate proficiency with joint raking tools and ability to not damage masonry units with either hand or power tools.
      c. Mix and cure test batch of repointing mortar and place in joints; repeat test mix until mortar color is approved. Test mortar should be matched, dried, and approved before placing in joints.
      d. Demonstrate workmanship of repointing procedures and joint finishing.
      e. Gain written approval from THE CULTURAL RESOURCES POC for test area before proceeding with remaining work.
   2. Joint Raking Method: Rake joints by hand ONLY using special joint cleaning chisels and hammer.
   3. Repointing Method: Repoint joints by hand ONLY using approved pointing trowels. NO "BAGGING" OR CAULKING GUN POINTING METHODS APPROVED.

1.04 PROJECT/SITE CONDITIONS

A. Environmental Conditions: Perform repointing only when the temperature is between 40º Fahrenheit and 80º Fahrenheit. If the temperature is below 40º the mortar sets too slowly, and there is a good chance of freezing before it fully sets. If the temperature is above 80º, the mortar will set too quickly, and there is a strong chance of excessive loss of water prior to adequate setting.

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. Repointing Tools: Available from good hardware stores, building material suppliers or mail-order catalogues.
   1. The Stanley Gold-blatt Tool Co.
      511 Osage Ave.
      Kansas City, KS 66105-2198
      913/621-3010

   2. Marshalltown Trowel Co.
      P.O. Box 738
      Marshalltown, IA 50158
      515/753-5999

   3. Masonry Specialty Co.
      4430 Gibsonia Rd.
      Gibsonia, PA 15044
      412/443-7080

2.02 MATERIALS

A. Lime mortar (See 04100-03-S for materials and procedures in preparing lime mortar)

B. Clean, potable water

2.03 EQUIPMENT

A. Trowels: range in length from 10-12 inches

B. Chisels:
   1. Joint chisels or a standard mason's chisel with a 1-1/2” blade and a long narrow handle
   2. Floor chisels

C. Hammers:
   1. 5# stone dressing hammer
   2. 2# striking hammer
   3. "No-Bounce" hammer
   4. Full size and one half size brick hammers

D. Joint Tools: (see 2.01 MANUFACTURERS above)
   1. 3/8"-1/4" raised beaded tool
   2. 3/8"-1/4" beaded striking tool
   3. 1/2" raised beaded tool with offset handle
   4. 1/2" flat joint iron
   5. Pointing tool should be about 1/16" narrower than the joint being filled to achieve good compaction

E. Hawks: Plywood or steel hawk (mortar board)

F. Brushes:
   1. Natural bristle brushes
   2. Stiff bristle brushes (no wire)

G. Spray bottle

2.03 MIXES

A. See 04100-03-S for lime mortar mixes

PART 3---EXECUTION

3.01 EXAMINATION

A. Examine all existing exterior mortar joints. If the answer to any of the following questions is yes, then the building's joints are deteriorated and need repointing:
   1. Are mortar joints eroded back more than 1/4" from the masonry face?
   2. Are there cracks running vertically or horizontally through the mortar?
   3. Are mortar bonds broken or pulled away from the masonry?
   4. Has mortar fallen out of joints?
   5. Is mortar excessively soft, powdery, or crumbling?
   6. Is pointing badly-stained?

B. Typical exterior damage due to mortar deterioration includes open joints, efflorescence, spalling and loosened masonry units.

C. Typical interior damage due to mortar deterioration includes failing plaster and stained wall paper.

D. A professional pointer experienced in old masonry is required for any of the following areas or conditions:
   1. Chimneys need repointing
   2. Window lintels must be rebuilt
   3. Masonry is loose or missing
   4. Work must be done from scaffolds or extension ladders
   5. The original mortar joints were "beaded"-tooled with a raised, round-profiled joint that projects out from the wall

3.02 PREPARATION

A. Preparing the Joints:
   1. Clean area of loose dirt and debris using a stiff bristle brush and remove all extraneous fastenings and devices.
   2. Install necessary protection of adjacent building materials, property, and persons from joint cleaning work and dirt.
   3. Control dust and dirt from raking work; dampen area being worked; and use curtains to limit spread of dust from joint raking and cutting operations.

B. Joint Cutting and Raking:
   1. Cut and rake old mortar from existing joints by hand using a hammer and chisel.

   NOTE: POWER CHISELS AND POWER SAWS SHOULD NOT BE USED.

   2. Place the chisel in the center of the joint and pound it with a striking hammer or "No-Bounce" hammer until the mortar disintegrates.
   3. Rake out the loose material to a depth of about 1 inch and never to a depth less than their width. Leave a clean, square face at the back of the joint to provide optimum contact with the new mortar.

CAUTION: AVOID OVER CUTTING ENDS OF VERTICAL JOINTS, WIDENING JOINTS OR CUTTING INTO BEDDING FACES OF MASONRY UNITS.

   4. While raking out joints, remove all metal fittings such as nails, brackets, and clips on both horizontal and vertical surfaces.
   5. Carefully clean out the prepared face with a soft or stiff bristle brush, or blow the joints clean with low-pressure compressed air (40-60 psi).
   6. Thoroughly flush out joint with clean, clear water.

3.03 ERECTION, INSTALLATION, APPLICATION

A. Filling Joints:
   1. Dampen masonry surfaces and joints to control suction and evaporation before placing repointing mortars.

NOTE: There should be no free water present which may cause voids in the mortar.

   2. Using a pointing tool, push the mortar into the joint from a board and iron with the maximum possible pressure; The mortar should be applied in layers, each to a maximum thickness of 3/8".

NOTE: The pointing tool should be about 1/16” narrower than the joint being filled to achieve good compaction. In some cases, the joints will be so thin that a standard pointing tool will need to be ground down to fit the joint.

   3. Thoroughly compact each layer of mortar and allow to set until thumb-print hard before applying the next layer of mortar.
   4. Fill the joints so that they are slightly recessed from the masonry face. Avoid leaving a joint which is visually wider than the actual historical appearance.
   5. Continuously keep all excess and spilled mortar brushed off the faces of masonry units, ledges and other surfaces before it sets or stains the work.

B. Joint Finishing:
   1. Begin when mortar attains "thumb print" hardness.
   2. Tool the joint to match the old mortar.

NOTE: It is important to tool the joint at the right stage; if the joint is too soft, the color will be lighter than expected and hairline shrinkage cracks are likely to occur; if the joint is too hard when tooled, dark streaks may appear (tool burning) and good closure of the mortar against the masonry will not be achieved. Excessive tooling may bring lime and fine aggregates to the surface, creating a visual change in texture and a surface subject to early deterioration.

3. To produce a roughened texture, lightly spray the mortar with water after the initial set, stipple the mortar with a stiff bristle brush, or dab the mortar with coarse sacking.
4. Protect finished work from direct sun and rain until the face has dried and hardened.

3.04 ADJUSTING/CLEANING

A. Cleaning Up:
   1. Use masking and drop cloths to prevent mortar stains on adjacent work and ledges.
   2. Keep work areas clean and free from mortar drips, spills, and residue of waste mortars or wash-off.
   3. Clean off excess mortar as work proceeds using masonry brushes before mortar sets.
   4. Wash completed repointing work when finished mortar joints are set with clean water and masonry brushes, scrubbing only as required to clean mortar stains off masonry without scouring the units and joint faces.
   5. Do not use acid or detergent cleaning agent to aid mortar removal and clean-up without written approval from THE CULTURAL RESOURCES POC.

B. Curing:
   1. Schedule work only when moderate weather is forecast.
   2. Protect completed work from adverse weather, heavy rainfall, freezing, and drying by direct sunlight and winds until cured.
   3. Sprinkle or mist repointed work as required to achieve cure in mortar joints for a minimum of 72 hours after completion.
   4. Lime Mortar: Cures by drying and crystallization, not by hydration; and can be washed out of joints if not protected before it cures.

C. Final Cleaning:
   1. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter using stiff nylon or bristle brushes and clean water spray applied at low pressure.

NOTE: Use of metal scrapers or brushes is not permitted. Use of acid or alkali cleansing agents is not permitted.

D. Some efflorescence, called new construction "bloom," occasionally appears on the surface within the first few months following a repointing project. These deposits normally are harmless and are removed by the natural washing of the rain. If not removed by natural weathering, they can be removed with dry brushing with a bristle brush. The use of chemical cleaners to remove this type of efflorescence normally is not necessary; AVOID USING ACIDS, PARTICULARLY MURIATIC ACID.

END OF SECTION

PREPARING LIME MORTARS FOR REPOINTING MASONRY[8]

U.S. General Services Administration

Historic Preservation Technical Procedures

04100-03

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

PART 1---GENERAL

1.01 SUMMARY

A. This standard includes guidance on preparing lime mortars for repointing masonry.

B. Lime mortars are preferable to portland cement mortars for repointing historic masonry:
   1. Lime mortars are more permeable by water. Water passing through lime mortar will dissolve a small portion of the lime and then will deposit it in hairline cracks as the water evaporates.
   2. Lime mortars expand slightly during setting, and resists shrinkage which causes cracking.
   3. Lime mortars are more durable than generally recognized.

C. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:
   1. Safety Precautions
   2. Historic Structures Precautions
   3. Submittals
   4. Quality Assurance
   5. Delivery, Storage, and Handling
   6. Project/Site Conditions
   7. Sequencing and Scheduling
   8. General Protection (Surface and Surrounding)

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM), 100 Barr Drive, West Conshohocken, PA 19428, (610) 832-9585 or FAX (610) 832-9555.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Lime and cement must be protected from rainwater and ground moisture, as water vapor in the air can begin the setting process. Other materials also should be protected from contamination.

[8] The following excerpt is from the U.S. General Services Administration (GSA). Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

PART 2---PRODUCTS

2.01 MATERIALS

NOTE: The use of standard specifications for materials, such as those developed by the ASTM, provides an easily referenced level of quality.

A. Lime: Should conform to ASTM C207, Type S, high plasticity, Hydrated Lime for Masonry Purposes.
    1. Lime which meets this standard will "work" well, resists drying during curing, and is sufficiently strong for the purpose of repointing.
    2. Lime expands as it hydrates, making high lime mortars more resistant to crack formation.

B. Cement: Should conform to ASTM C150, Type I, White. It should not have more than 0.60% alkali or more than 0.15% water soluble alkali. Use gray portland cement ONLY if a dark mortar is to be matched.
    1. Cement meeting this standard should increase the workability of the mortar, accelerate the setting time, and slightly increase the strength of the mortar.
    2. The low alkali content will prevent efflorescence.

C. Sand: Free of impurities and conforming to ASTM C144.
    1. Sand color, size, and texture should match the original as closely as possible. Provide a sample of the sand for comparison to the original, and have it approved by THE CULTURAL RESOURCES POC before beginning repointing work.
    2. When possible, use bar sand or beach sand rather than crushed sand for the repointing mortar.
        a. Crushed sand has sharp edges, which makes it more "sticky" and difficult to work into the joints.
        b. Bar sand, on the other hand, has rounded edges and flows easily during the mortar application.
        c. The working characteristics of mortar made with crushed sand may be improved by adding a slight amount of portland cement. The amount of cement should be determined by experimentation, but should not exceed 20% of the total lime/cement binder. 20% OR LESS OF CEMENT HAS MINIMAL EFFECT ON THE HARDNESS OF THE MORTAR. CEMENT CONTENT ABOVE 20% WILL MAKE THE MORTAR TOO HARD.

NOTE: Bar sand or beach sand should be washed to remove the salts before using.

D. Clean, potable water: If the water must be transported or stored in a container, the container must not impart any chemicals to the water.

E. Stone dust finely ground from the same stone as that to be repointed.

F. Additives: NO antifreeze compounds or other admixture shall be used.

NOTE: Do not use anti-freeze compounds. These compounds are designed for use with cement mortars, and their effectiveness with high lime mortars is questionable. Furthermore, the compounds contain salts which can lead to serious problems in the masonry at a later time.

NOTE: Air entraining agents are not recommended. These agents are designed for use with cement rather than lime, and they result in decreased bonding of the mortar and the masonry. Air entraining is not necessary with high lime mortars because of the natural ability of these mortars to flex with temperature changes.

2.02 EQUIPMENT

A. Surface temperature thermometer - can be either mechanical (less expensive but must be calibrated often) or digital electronic

B. Wooden mortar boxes

C. Hoe

D. Mesh screen

E. Hawks: Plywood or steel hawk (mortar board)

2.03 MIXES

A. Some factors to consider when mixing lime mortar include durability, color and texture, and workability.
    1. Durability: Repointing mortar should be softer than the masonry units and the original mortar to reduce stresses at the edge of the masonry and, in the case of lime mortar, to reduce shrinkage which can cause cracks in the mortar.
        a. If the new mortar is harder than the masonry or the original mortar, it can cause serious stresses within the wall during thermal expansion and contraction, which can lead to deterioration of the masonry units rather than the mortar.

        b. If the mortar is softer, any deterioration which occurs will take place in the mortar, which is easier to replace than the units themselves.

    2. The repointing mortar should allow the passage of water, both liquid and vapor. If the mortar does not allow water to pass freely through it, the water can become trapped inside the wall, freeze, and cause serious deterioration to the masonry.

    3. Color and texture: The repointing mortar should match the original mortar in color, texture, and physical characteristics.
        a. Obtaining an accurate color match is best achieved by selecting an appropriate sand.
            1. Use sand which is similar to the original in color and gradation. Sand from more than one source may be required.
            2. For repointing of natural stones, use finely ground stone "dust" in the mortar to match the joints as closely as possible to the stone.

        b. If the original mortar was tinted, or if it is impossible to obtain a color match through the use of sand, it may be necessary to use a special mortar pigment.

CAUTION: PIGMENTS MAY REACT WITH OTHER INGREDIENTS IN THE MORTAR TO FORM EFFLORESCENCE. THEY MAY ALSO WEATHER AT A DIFFERENT RATE THAN NATURAL COLORING AND CAUSE A COLOR VARIATION IN THE MORTAR.

NOTE: If pigments must be used, pure mineral oxides should be used because they do not fade or leach out of the mortar. Amount of pigment should not exceed 2% of the mortar mix by the weight.

        c. Many mortars used before the twentieth century have small lumps of incompletely burned or ground lime, or other impurities. To match the original appearance of the masonry, these impurities must be included in the new repointing mortar. Use identical materials, such as ground oyster shells (obtained at feed stores) or lumps of lime, to duplicate original lumps.
    4. Workability: The workability or plasticity of the mortar is a direct result of the selection of materials.

B. Mortar Mix:

1. Have the existing mortar completely analyzed to insure that the repointing mortar will not be less permeable/harder than the masonry units or the original mortar. IT IS BETTER TO HAVE MORTAR THAT IS MORE PERMEABLE THAN LESS.
2. Measure all ingredients by cubic volume using a pre-established uniform measure, such as a small bucket, rather than a less uniform measure such as a shovel.
3. For historic masonry set in lime mortar, use the following mortar mix:

   1 part portland cement
   3 parts lime
   8-12 parts sand (To match existing mortar as closely as possible.)

NOTE: The exact mix required will relate to the grain size and sharpness of the sand and will vary depending on the supply.

-OR-

For historic masonry set in standard mortar, use the following mortar mix (ASTM C270 Type "0") as a starting point:

1 part portland cement
2 parts lime or lime putty
6 to 9 parts sand and stone dust (To match existing mortar as closely as possible.)

-OR-

For Limestone (ASTM C270 Type "N"):

1 part portland cement
1 parts lime
4-6 parts aggregate
Enough water to form a workable consistency

-OR-

For Granite (ASTM C270 Type "S"):

2 parts portland cement
1 part lime
7-9 parts aggregate
Enough water to form a workable consistency

NOTE: For deteriorated granite walls or granite walls indicating movement, use ASTM C270 type “N” as listed above for limestone.

4. Mix a final "job-size" batch once the correct sand color, cement content, etc. have been determined through small tests to ensure the on-site mixing conditions will result in the same final product.

PART 3---EXECUTION

3.01 ERECTION, INSTALLATION, APPLICATION

A. Mix Hydrated Lime:
   1. Add dry bagged hydrated lime to water. Stir and hoe the mass to form a thick cream.
   2. Allow to stand at least 24 hours before use.

B. Prepare Roughage Premix (for later use):
   1. Accurately proportion the sand and lime using measuring boxes constructed to contain the exact volume of each ingredient required to make on batch.
   2. Mix sand and lime thoroughly for about ten minutes. Store in plastic-lined drums and seal until required.

NOTE: This compound may be stored indefinitely if kept sealed from air and kept from freezing.

   3. When required for use, add and mix the correct portion of gauging cement as specified and use immediately. ACCURATE PORTIONING IS VERY IMPORTANT.

C. Add cements to lime and aggregate mixes immediately before the use of the mortar.
   1. Perform all batching with wooden boxes or plastic pails of known volume to ensure standardization and conformity of measurement; SHOVEL MEASUREMENT OF MATERIALS IS NOT PERMITTED.
   2. Use box sizes that are sufficient for producing a batch size equal to one mixer load.

NOTE: Mix dry ingredients thoroughly before adding any water (approximately five minutes.

D. Add a small amount of water so that the mortar is just wet enough to hang on a trowel.

NOTE: Excess water will cause shrinkage and too little water will retard carbonation. Record the amount of water added so that it may be used as a guide for future batches.

E. Mix mortars at least 10 minutes before using to improve workability and ensure thorough mixing.

NOTE: Automatic mixers should have rubber blades. Clean mixing boards and mixing machines thoroughly after each use to prevent hardened lumps of mortar from containing the next batch of mortar.

   1. Repointing mortars may sit 1-2 hours after initial mixing and then may be remixed to a workable consistency. This is done to reduce shrinkage.
   2. Test the mix by holding a trowel with mortar on it upside down and shaking it once.
      a. If the mortar falls off without shaking, it has too much sand.
      b. If more than one shake is required, the mortar is too sticky or "plastic" and the lime content must be decreased.

F. Coloring Mortars:
   1. Take samples of freshly-broken mortar from the original masonry pointing. Note color of aggregate for color-matching. DO NOT TRY TO MATCH THE COLOR OF THE BINDER.

NOTE: Use unweathered, unsoiled samples only.

   2. Prepare test patties of mortar approximating the inner color of the sample and set aside to dry for at least 72 hours. Drying time may be accelerated by placing the patty sample in an oven or over a hot-plate.
   3. Break the sample test patties and compare the inner portions to the original.
   4. See Section 2.03 above for additional information on coloring mortars.

G. Use repointing mortar within approximately 1-2 hours of final mixing. Retemper the mortar as necessary to maintain workability.

NOTE: Retempering is permitted to maintain workability. Remixing is not permitted. Add water at the mortar-board using a spray bottle to replace only water lost through evaporation.

NOTE: Use all mortar within two hours of gauging; throw out left over mortar; do not re-temper or remix mortars after this time has elapsed.

NOTE: This time limit may vary depending upon the outside temperature (longer on cooler days and shorter on warmer days.)

H. For guidance on repointing, see 04520-02-R.

END OF SECTION

4.6 METAL

4.6.1 Metal Element

4.6.1.1 Metal—Hardware

NR Rating: 366

Description:

Metal hardware includes operation handles for windows, doorknobs, and locks for both windows and doors. Over time, the door hardware has been altered or replaced in most areas. The hardware is generally in fair condition. It is missing or broken in areas and the finish has worn off in others. In most areas the hardware is rusting and should be cleaned thoroughly.

The doorknob has delaminated and should be replaced with one similar to the original character of the building. The door knob in the second image is missing its handle and should also be replaced with one similar to those used in the original construction of this building.

Treatment Rating 6: SPECIFIED TREATMENT IS NOT REQUIRED

IF ANY WORK IS DONE ON THIS ELEMENT IT SHOULD BE SYMPATHETIC TO THE SIGNIFICANT QUALITIES OF THE HISTORIC PROPERTY.

Statement of Importance:

- The hardware is not original in the design of the Rolling Heath School and has no historic value.

Condition: ***Poor – Replace***

Fair to good - Preserve

Poor - Replace

Inventory Quantity and Condition

The hardware is evaluated as Poor when:

- there is a door handle missing/ broken on the east facade of the building, and
- the hardware is rusting and will need to be cleaned, and
- the hardware on the doors and windows is generally intact and operable, and
- the hardware shows signs of daily use and wear as the finishes are wearing, and
- the hardware needs to be maintained on a yearly basis in order to insure that it will continue to function properly.

Minor deficiency of the hardware exists where:

- Clean rusty hinges and door hardware, and
- replace the door knobs on the east and south facades with hardware that is similar in appearance to those that were used in the original construction, and
- replace hinges and connectors that are beyond surface cleaning, and
- maintain hardware so that it remains in correct working condition, and
- standard preventive maintenance practices and building conservation methods have not been followed.

Minor deficiencies can include, but are not limited to: rusting surfaces, broken handles, and wearing finishes.

4.6.1.2 Metal—Railing

NR Rating: 314

Description:

There are two metal railings, one on the south facade and another on the east; both of which lead to entrances to the building. The railing on the east facade is generally in good condition, but the railing on the south facade is rusting and as a result is staining the proximate concrete stoop. These elements are in good condition, but will need to be cleaned and if they are beyond surface cleaning they will need to be replaced in kind. They will also need to be painted or sealed in some manner in order to prevent their further deterioration.

Metal railing is rusting and should be cleaned and repainted to prevent further deterioration.

Treatment Rating 4: PRESERVE WHERE THERE IS NO COMPELLING REASON FOR REMOVAL

UNDERTAKE ALL NECESSARY ALTERATION WORK AS SENSITIVELY AS POSSIBLE, INCLUDING ANY DEMOLITION WORK.

Statement of Importance:

- The metal railings do not date to the World War II period of significance of the building. They are a later, sensitive repair, but do not represent a substantial amount of historic fabric, are not distinctive, nor do they make any measurable contribution to the building's historic appearance or system of construction.

Condition: ***Good– Preserve***

Fair to good - Preserve

Poor – Replace

Inventory Quantity and Condition

The railings are evaluated as Good when:

- the railing on the south facade is rusting over 80% of its surface and the railing on the east facade is rusting over less than 5% of its surface, and
- the concrete on the south stoop is becoming stained as a direct result of this elements deterioration, and
- the railings generally are in good condition and only need minor routine maintenance.

Minor deficiency of the railing exists where:

- Railings should be cleaned and sealed to prevent further deterioration, and
- if the railings are beyond surface cleaning they should be replaced in kind, and
- maintain railings so that they remain in correct working condition, and
- standard preventive maintenance practices and building conservation methods have not been followed, and/or
- there is a reduced life expectancy of affected or related building materials and/or systems, and/or
- there is a condition with long-term impact beyond 5 years.

Minor deficiencies can include, but are not limited to: rusting surfaces.

4.6.2 Maintenance / Management Guidelines for Metal

According to *The Secretary of Interior's Standards for Rehabilitation*, the proper procedure is to respect the significance of the original materials and features, repair and retain them wherever possible, and replace them only when absolutely necessary.

The following recommendations for care of the historic metal are to be thoroughly read and understood before a treatment is specified. *The Secretary of the Interior's Standards for Rehabilitation* should also be consulted to determine the appropriateness of any treatment.

The following is an excerpt from *The Secretary of the Interior's Standards for Rehabilitation.* Full documentation can be found at http://www2.cr.nps.gov/tps/tax/rhb/stand.htm

4.6.2.1 Identify, Retain, and Preserve

Recommended…

- Identifying, retaining, and preserving architectural metal features such as columns, capitals, window hoods, or stairways that are important in defining the overall historic character of the building; and their finishes and colors. Identification is also critical to differentiate between metals prior to work. Each metal has unique properties and thus requires different treatments.

Not Recommended…

- Removing or radically changing architectural metal features, which are important in defining the overall historic character of the building so that, as a result, the character is diminished.
- Removing a major portion of the historic architectural metal from a facade instead of repairing or replacing only the deteriorated metal, then reconstructing the facade with new material in order to create a uniform or "improved" appearance.
- Radically changing the type of finish or its historic color or accent scheme.

4.6.2.2 Protect and Maintain

Recommended…

- Protecting and maintaining architectural metals from corrosion by providing proper drainage so that water does not stand on flat, horizontal surfaces or accumulate in curved, decorative features.
- Cleaning architectural metals, when appropriate, to remove corrosion prior to repainting or applying other appropriate protective coatings.
- Identifying the particular type of metal prior to any cleaning procedure and then testing to assure that the gentlest cleaning method possible is selected or determining that cleaning is inappropriate for the particular metal.
- Cleaning soft metals such as lead, tin, copper, terneplate, and zinc with appropriate chemical methods because their finishes can be easily abraded by blasting methods.
- Using the gentlest cleaning methods for cast iron, wrought iron, and steel--hard metals--in order to remove paint buildup and corrosion. If hand scraping and wire brushing have proven ineffective, low pressure grit blasting may be used as long as it does not abrade or damage the surface.
- Applying appropriate paint or other coating systems after cleaning in order to decrease the corrosion rate of metals or alloys.
- Repainting with colors that are appropriate to the historic building or district.
- Applying an appropriate protective coating, such as lacquer to an architectural metal feature subject to heavy pedestrian use, such as a bronze door.
- Evaluating the overall condition of the architectural metals to determine whether more than protection and maintenance are required, that is, if repairs to features will be necessary.

Not Recommended…

- Failing to identify, evaluate, and treat the causes of corrosion, such as moisture from leaking roofs or gutters.
- Placing incompatible metals together without providing a reliable separation material. Such incompatibility can result in galvanic corrosion of the less noble metal, e.g., copper will corrode cast iron, steel, tin, and aluminum.
- Exposing metals, which were intended to be protected from the environment.
- Applying paint or other coatings to metals such as copper, bronze, or stainless steel that were meant to be exposed.
- Removing the patina of historic metal. The patina may be a protective coating on some metals, such as bronze or copper, as well as a significant historic finish.
- Cleaning soft metals such as lead, tin, copper, terneplate, and zinc with grit blasting which will abrade the surface of the metal.
- Using cleaning methods, which alter or damage the historic color, texture, and finish of the metal, or cleaning when it is inappropriate for the metal.
- Failing to employ gentler methods prior to abrasively cleaning cast iron, wrought iron, or steel; or using high pressure grit blasting.

- Failing to re-apply protective coating systems to metals or alloys that require them after cleaning so that accelerated corrosion occurs.
- Using new colors that are inappropriate to the historic building or district.
- Failing to assess pedestrian use or new access patterns so that architectural metal features are subject to damage by use or inappropriate maintenance such as salting adjacent sidewalks.
- Failing to undertake adequate measures to assure the protection of architectural metal features.

4.6.2.3 Repair

Recommended…

- Repairing architectural metal features by patching, splicing, or otherwise reinforcing the metal following recognized preservation methods.
- Repairs may also include the limited replacement in kind--or with a compatible substitute material--of those extensively deteriorated or missing parts of features when there are surviving prototypes such as porch balusters, column capitals or bases; or porch cresting.

Not Recommended…

- Replacing an entire architectural metal feature such as a column or a balustrade when repair of the metal and limited replacement of deteriorated or missing parts are appropriate.
- Using a substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the architectural metal feature or that is physically or chemically incompatible.

4.6.2.4 Replace

Recommended…

- Replacing in kind an entire architectural metal feature that is too deteriorated to repair--if the overall form and detailing are still evident--using the physical evidence as a model to reproduce the feature.
- Examples could include cast iron porch steps or steel sash windows.
- If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.

Not Recommended…

- Removing an architectural metal feature that is irreparable and not replacing it; or replacing it with a new architectural metal feature that does not convey the same visual appearance.

PRIMERS AND PAINTS FOR WROUGHT IRON, CAST IRON, AND STEEL[9]

U.S. General Services Administration
Historic Preservation Technical Procedures

05010-13

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

This standard includes general information on primers and paints to be used on interior and exterior wrought iron, cast iron, and steel surfaces.

THE SELECTION OF A SUITABLE PRIMER AND PAINT FOR METALS DEPENDS ON MANY FACTORS INCLUDING THE TYPE OF METAL TO BE COATED, THE TYPE OF SURFACE PREPARATION TO BE USED, ENVIRONMENTAL AND SURFACE CONDITIONS, DESIRED APPEARANCE, AND PERFORMANCE REQUIREMENTS, METHOD OF APPLICATION, AND TYPE AND LEVEL OF EXPOSURE. CONSULT A PAINT MANUFACTURER ALONG WITH THE DIRECTORATE OF ENVIRONMENTAL COMPLIANCE AND MANAGEMENT BEFORE MAKING THE FINAL SELECTION.

The primary purpose of paint is to protect the metal from deterioration. To do so, paint manufacturers have developed paint systems, which are made to work together to protect the metal substrate. These systems include primers and appropriate, compatible topcoats, which can vary depending on the substrate, environmental conditions, and can, vary between manufacturers. As a result, appropriate primers and compatible topcoats, both from the same manufacturer should be used.

For information on paint removal from metal, surface preparation, and application procedures see the following:

For guidance on paint removal from iron and steel, see:
- 05010-05-R "Cleaning/Removing Paint From Wrought Iron, Cast Iron and Steel Using Mechanical/Abrasive Methods
- 05010-16-R "Removing Paint From Wrought Iron, Cast Iron and Steel Using Thermal Methods"
- 05010-17-R "Removing Paint From Wrought Iron, Cast Iron and Steel Using Chemical Methods"

For additional information on the history, properties and uses of paint, see 09900-01-S. See 09900-07-S for general guidelines on painting interior and exterior surfaces.

PRIMERS FOR WROUGHT IRON, CAST IRON, AND STEEL

Characteristics
- Primary function is adhesion.
- Must bond well to substrate and intermediate coat. Should have enough chemical and weather resistance to protect the substrate before application of next coat.

[9] The following excerpt is from the U.S. General Services Administration (GSA). Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

- Should be compatible with intermediate and topcoats.
- Should be compatible with paint/rust removal methods.

Types

A. Oil/Alkyd Primers:

Advantages:

1. Bond well to most surfaces even if surface preparation is substandard; and
2. Compatible with oil finish coats.

Limitations:

1. NOT compatible with finish coats of vinyl, epoxy or other synthetic polymer. Solvents in these systems attack and soften these primers; and
2. Limited corrosion resistance

B. Mixed Resin Primers:

Advantages:

1. Bond well to most surfaces, though adequate surface preparation is important; nd
2. Compatible with most finish coats; and
3. Good alkali resistance; and
4. Some corrosion resistance.

Limitations:

1. It is only compatible with a specific range of topcoats.

C. Resin Same as Topcoats:

Advantages:

1. Effective when surface is properly prepared; and
2. Some corrosion resistance.

D. Inorganic Zinc:

Advantages:

1. Outstanding bonding characteristics when surface is cleaned and roughened; and
2. Compatible with most finish coats; and
3. Effectively resists disbanding; and
4. Excellent resistance to underfilm corrosion; and
5. Effective in protecting the metal without the help of a finish coat.

Limitations:

1. It is NOT acid or alkali-resistant.

E. Wash Primers: Suitable for use on steel, aluminum, zinc, cadmium, chromium, tinplate, and terneplate.

Advantages:

1. Provides a smooth, durable, uniform base for finish coat application; and
2. Compatible with the following topcoats: vinyl, phenolics, alkyds, nitrocellulose, and oil-type products.

Limitations:

1. It is NOT recommended for surfaces subject to temperatures above 150 degrees F (66 degrees C).

F. Conversion Coatings: Oxidizing solution Used on zinc, iron, aluminum, and magnesium (formulation will vary depending on type of metal). This type of coating is usually factory-applied.

Advantages:

1. Excellent corrosion resistance; and
2. Good adhesion to subsequent paint coats.

Limitations:
1. It is subject to deterioration if overheated.

G. Zinc Chromate: Used on aluminum, magnesium, and ferrous metals.
Advantages:
1. It has good corrosion resistance.

Limitations:
1. It is not suited to highly acidic environments.

H. Zinc-rich Coatings:
Advantages:
1. It has good corrosion resistance.

PAINTS FOR WROUGHT IRON, CAST IRON, AND STEEL

Characteristics
Should be compatible with primer
- Intermediate coat should uniformly bond the primer with the topcoat.
- Intermediate coat should have enough chemical and weather resistance to protect the primer and substrate.

Types
A. Oil-based/Alkyd Enamel:
Advantages:
1. For normal to severe weather conditions, provides good abrasion and dirt resistance; and
2. Suitable for both exterior and interior uses; and
3. Good bonding characteristics.

Limitations:
1. Alkyds are not good in a continuously damp or chemically corrosive environment, nor are they solvent resistant; and
2. Limited alkali resistance.

B. Baked Phenolic:
Advantages:
1. Excellent resistance to acidic environments; and
2. Excellent resistance to water; and
3. Excellent resistance to strong solvents; and
4. Low material cost.

Limitations:
1. Low alkali resistance; and
2. High labor cost for application.

C. Epoxies:
Advantages:
1. Good adhesion, and
2. Good chemical resistance, and
3. Good abrasion resistance, and
4. Good alkali resistance.

Limitations:
1. Sensitive to chalking under exterior exposure, and
2. Sensitive to color fading, and
3. Weak in acid.

D. Acrylics: (thermoplastic and thermosetting coatings)
Advantages:
1. Moderate cost; and
2. Good resistance to degradation from ultraviolet light; and
3. Suitable for both interior and exterior use.

E. Vinyl: Used primarily as intermediate coats
Advantages:
1. Good alkali and acid resistance, and
2. Excellent water resistance, and
3. Low chalking rate.

Limitations
1. Limited solvent and heat resistance, and
2. Inferior to alkyd and epoxy coatings - lower adhesive strength, and
3. Sensitive to intercoat contamination.

F. Inorganic Zinc:
Advantages:
1. Excellent weather and solvent resistance, and
2. Excellent resistance to underfilm corrosion, and
3. Resistant to petroleum products.

Limitations:
1. Limited chemical resistance, and
2. Not suitable for strong acid or strong alkali environments.

G. Organic Zinc:
Advantages:
1. It protects against corrosion.

H. Furan:
Advantages:
1. It is one of the most versatile and resistant of organic films.

Limitations:
1. Poor adhesion to steel and any primed surface; and
2. The film gets very hard after curing, making it extremely difficult to maintain them.

I. Urethanes:
Advantages:
1. Excellent gloss and color retention; and
2. Preferable to epoxy protective coatings or primers; and
3. Available in a wide variety of formulations for different surface types and conditions.

Limitations:
1. Comparable to epoxies and vinyl in resistance to corrosion; and
2. Some tend to yellow when exposed to sunlight; and
3. It is expensive.

J. Silicones:
Advantages:
1. Excellent heat resistance; and
2. Excellent color and gloss retention; and
3. Available in pure or modified form (a mixture of 2 coating types).

Limitations:
1. It is expensive.

END OF SECTION

4.7 ROOFING

4.7.1 Roofing Elements

4.7.1.1 Roofing—Galvanized Metal Roof

NR Rating: 314

Description:

The roof is constructed of galvanized metal sheet panels which are generally they are in good condition. It is not original to the structure, but does not detract from the original appearance of the building.

Galvanized metal roof should be cleaned and sealed to prevent further deterioration.

Treatment Rating 4: PRESERVE WHERE THERE IS NO COMPELLING REASON FOR REMOVAL

UNDERTAKE ALL NECESSARY ALTERATION WORK AS SENSITIVELY AS POSSIBLE, INCLUDING ANY DEMOLITION WORK.

Statement of Importance:

- The galvanized metal sheet roof dates to the World War II period; however, it does not represent a substantial amount of historic fabric, is not distinctive, and it does not contribute to the significance of the Rolling Heath School House.

Condition: ***Good– Preserve***

Fair to good - Preserve

Poor – Replace

Inventory Quantity and Condition

The metal sheet roof is evaluated as Good when:

- the roof is structurally and architecturally sound and performing its intended purpose, and
- there are few or no cosmetic imperfections, and
- the roofing should be inspected yearly for signs of wearing or failure, and
- sheets should be cleaned and replaced in areas where the deterioration is beyond repair.

Minor deficiency of the sheet roof exists where:

- The metal sheets should be inspected yearly for wear and localized failure, and
- sheets should be replaced where they no longer functioning to maximum capacity, and
- if inspection reveals globalized damage, then entire roof should be replaced.

4.7.2 Maintenance / Management Guidelines

According to *The Secretary of Interior's Standards for Rehabilitation*, the proper procedure is to respect the significance of the original materials and features, repair and retain them wherever possible, and replace them only when absolutely necessary.

The following recommendations for care of the historic roofing are to be thoroughly read and understood before a treatment is specified. *The Secretary of the Interior's Standards for Rehabilitation* should also be consulted to determine the appropriateness of any treatment.

The following is an excerpt from *The Secretary of the Interior's Standards for Rehabilitation*. Full documentation can be found at http://www2.cr.nps.gov/tps/tax/rhb/stand.htm

4.7.2.1 Identify, Retain, and Preserve

Recommended…

- Identifying, retaining, and preserving roofs--and their functional and decorative features--that is important in defining the overall historic character of the building.
- This includes the roof's shape, such as hipped, gambrel, and mansard; decorative features, such as cupolas, cresting chimneys, and weathervanes; and roofing material such as slate, wood, clay tile, and metal, as well as its size, color, and patterning.

Not Recommended…

- Radically changing, damaging, or destroying roofs, which are important in defining the overall historic character of the building so that, as a result, the character is diminished.
- Removing a major portion of the roof or roofing material that is repairable, and then reconstructing it with new material in order to create a uniform or "improved" appearance.
- Changing the configuration of a roof by adding new features such as dormer windows, vents, or skylights so that the historic character is diminished.
- Stripping the roof of sound historic material such as slate, clay tile, wood, and architectural metal.
- Applying paint or other coatings to roofing material, which has been historically uncoated.

4.7.2.2 Protect and Maintain

Recommended…

- Protecting and maintaining a roof by cleaning the gutters and downspouts and replacing deteriorated flashing. Roof sheathing should also be checked for proper venting to prevent moisture condensation and water penetration; and to insure that materials are free from insect infestation.
- Providing adequate anchorage for roofing material to guard against wind damage and moisture penetration.
- Protecting a leaking roof with plywood and building paper until it can be properly repaired.

Not Recommended…

- Failing to clean and maintain gutters and downspouts properly so that water and debris collect and cause damage to roof fasteners, sheathing, and the underlying structure.
- Allowing roof fasteners, such as nails and clips to corrode so that roofing material is subject to accelerated deterioration.
- Permitting a leaking roof to remain unprotected so that accelerated deterioration of historic building materials—masonry, wood, plaster, paint, and structural members—occurs.

4.7.2.3 Repair

Recommended…

- Repairing a roof by reinforcing the historic materials, which comprise roof features.
- Repairs will also generally include the limited replacement in kind--or with compatible substitute material--of those extensively deteriorated or missing parts of features when there are surviving prototypes such as cupola louvers, dentils, dormer roofing; or slates, tiles, or wood shingles on a main roof.

Not Recommended…

- Replacing an entire roof feature such as a cupola or dormer when repair of the historic materials and limited replacement of deteriorated or missing parts are appropriate.
- Failing to reuse intact slate or tile when only the roofing substrate needs replacement.
- Using a substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the roof or that is physically or chemically incompatible.

4.7.2.4 Replace

Recommended…

- Replacing in kind an entire feature of the roof that is too deteriorated to repair--if the overall form and detailing are still evident--using the physical evidence as a model to reproduce the feature. Examples can include a large section of roofing, or a dormer or chimney.
- If using the same kind of material is not technically or economically feasible, then a compatible substitute material may be considered.

Not Recommended…

- Removing a feature of the roof that is irreparable, such as a chimney or dormer, and not replacing it; or replacing it with a new feature that does not convey the same visual appearance.

Repairing Holes in a Sheetmetal Roof[10]

U.S. General Services Administration

Historic Preservation Technical Procedures

07610-05

The Cultural Resources POC, DPW will review all proposed work, in addition these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on patching holes in sheet metal roof by brazing and welting. **GENERALLY, THIS WORK SHOULD BE ACCOMPLISHED BY AN EXPERIENCED ROOFING CONTRACTOR**.

NOTE: DO NOT USE ASPHALT ROOFING COMPOUND OR ALUMINUM-BASED ROOF COATINGS TO MAKE THE PATCHES. THE REPAIRS SELDOM LAST, AND ARE HARD TO UNDO, AND ARE POTENTIALLY DAMAGING TO THE EXISTING ROOF.

B. Falling masonry, scaffold poles, and other objects are responsible for inflicting damage to many roofs at some time during their life. Damage is mostly of a minor and localized nature, and in the case of a fully supported, traditional metal roof is usually no more than a shallow indentation in the metal and supporting boards, with perhaps a small rupture in the covering at the base of the depression.

C. Safety Precautions:

1. Wear rubber-soled shoes that have non-slip or grid type tread (preferably sneakers with a high top for good ankle support). Avoid wearing loose clothing.

2. Wear a safety belt or harness and secure it to a substantial chimney or to a window on the opposite side of the house. Leave only enough slack so you can work comfortably in one area, and adjust the slack as you work on other sections of the roof.

3. Be sure the roof is clear of debris and water.

4. Do not work on wet snow covered roofs. Work on cleated walkboards.

5. Steep roofs: On roof slopes greater than 4 inches rise per foot, special consideration must be given to both footing and materials handling.

   a. Secure chicken ladders or cleats at the top for adequate footing.
   b. Hang and secure approved safety lines with manila rope.
   c. Carry a limited number of materials so that balance and footing are not impaired.

[10] The following excerpt is from the U.S. General Services Administration (GSA) Technical Procedures. Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

d. Use scaffolding, ladders, and working platforms as required to execute the work. Ladders shall not be supported on hanging gutters. They may be distorted which can affect the slope to drain.

D. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:

1. Safety Precautions
2. Historic Structures Precautions
3. Submittals
4. Quality Assurance
5. Delivery, Storage and Handling
6. Project/Site Conditions
7. Sequencing and Scheduling
8. General Protection (Surface and Surrounding)

These guidelines should be reviewed prior to performing this procedure and should be followed, when applicable, along with recommendations from the Regional Historic Preservation Officer (RHPO).

1.02 DEFINITIONS

A. Anneal--the operation of heating and cooling the metal to soften it and make it less brittle.

B. Brazing--to solder with a non-ferrous metal that melts at a lower temperature than that of the metals being joined.

C. Cleats or clips--metal strips, cut to lengths to suit roll or seam, placed at intervals and securely fixed to the roof base, the ends being welted in with the edges of the sheets to hold the roofing in position, made from same material as roofing.

D. Solder--metal or metallic alloy of tin and lead used when melted to join metallic surfaces.

E. Standing seam--a double welted joint formed between the sides of adjacent bays and left standing.

F. Welting--joining copper sheets at their edges by folding together. Welting may by single or double folds, such joints being termed single or double welts respectively.

1.03 QUALITY ASSURANCE

A. Qualifications: Steel, aluminum and copper systems should be applied by qualified sheet metal mechanics using methods devised or approved by the manufacturer of the metal. Details may vary depending on the properties of the metal, local custom, and architectural effect required.

1.04 MAINTENANCE

A. The amount of maintenance required will depend on the kind of roofing used and the exposure hazards. It will also depend on the degree of waterproofing quality and exterior appearance that is acceptable.

1. Small pieces of metal with exposed fasteners and simple laps may require more maintenance than full-length zipped panels.

2. Factory enamel coatings and concealed fasteners add immeasurably to the appearance and life of a metal roof, and reduce the maintenance cost to the minimum.

B. Keep the roof clear of debris, and trim all overhanging branches that might cause mechanical damage.

C. In addition to scheduled inspections, inspect after each exposure to unusually severe weather conditions such as strong winds, hail, or long continuous rains.

D. Never use any black goop (asphaltic roofing compound) or caulk to seal joints on a metal roof. Asphalt attacks metal roofing, and no caulk lasts long enough for this application.

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. Follansbee Steel
State St.
Follansbee, WV 26037
800/624-6906.

Standing-seam and batten-seam metal roofing sold through distributors. Free brochure.

B. Met-Tile, Inc.
1745 Monticello Ct.
Ontario, CA 91761
714/947-0311

Tile facsimile metal panel roofing system of galvanized metal. Free literature.

C. Metal Sales Mfg. Corp.
Deer Lake Industrial Park
P.O. Box 158
Orwigsburg, PA 17961
717/366-2020

Large, diversified manufacturer of flat metal roofing panels, also barrel type tiles. Free literature.

2.02 MATERIALS

NOTE: Chemical products are sometimes sold under a common name. This usually means that the substance is not as pure as the same chemical sold under its chemical name. The grade of purity of common name substances, however, is usually adequate for stain removal work, and these products should be purchased when available, as they tend to be less expensive. Common names are indicated below by an asterisk (*).

A. Nails of metal appropriate for metal used:

1. For terne or terne-coated stainless steel: Use galvanized nails
2. For copper: Use copper nails or brass screws

B. Cleats, same material as roof

C. Sheetmetal to match remainder of roof

D. Solder

E. Soldering flux

F. Rosin Paper

G. Muriatic acid*: (generally available in 18 degree and 20 degree Baume solutions)

1. A strong corrosive irritating acid.

2. Other chemical or common names include Chlorhydric acid; Hydrochloric Acid; Hydrogen chloride; Marine acid*; Spirit of salt*; Spirit of sea salt*.

3. Potential Hazards: TOXIC, CORROSIVE TO FLESH; CORROSIVE TO CONCRETE, STEEL, WOOD, OR GLASS, FLAMMABLE.

4. Available from chemical supply house, drugstore or pharmaceutical supply distributor, or hardware store.

H. Clean, soft cloths

2.03 EQUIPMENT

A. Chicken ladder, safety belt or harness

B. Snips for cutting sheet metal

C. Soldering copper, soldering iron

D. Handy tongs for bending the edges of the solder

E. Metal seamer

F. Stiff bristle brushes

PART 3---EXECUTION

3.01 EXAMINATION

A. Whenever possible, make inspection from ground, or from above if possible.

B. Inspect roof parts for signs of warped, cracked, split, or out of place sheets, pulled fastenings, broken joints and seams, excessive weathering, or metal punctures.

C. Inspect the underside of the roof deck from the attic to detect leaks. Flashings are the most vulnerable points. Therefore, inspect the underside carefully at all flashing points for evidence of leakage such as water stains.

3.02 PREPARATION

A. Surface Preparation:

1. Carefully examine, measure, and record existing sheetmetal patterns at edges, hips, ridges, and other special conditions.

2. For safety of the personnel, keep the deck clear of waste material as the work proceeds.

3. For installation of new material, verify the type, thickness, weight/gauge prior to installation.

4. Prior to installation, remove all oil, dirt, and other debris from the surface. All surfaces shall be dry and free from frost.

3.03 EXECUTION, INSTALLATION, APPLICATION

A. For Small Repairs:

1. Thoroughly clean the area to be patched of all rust and/or roofing cement. When finished, the metal should be bare and shiny.

2. Cut a metal patch, using the same material as the roof, to the required size and shape. Fold the edges under 1/2 inch and snip off the corners (this makes the patch stronger and takes off easily damaged sharp corners).

3. Place a weight, such as a brick, over the patch to hold it firmly to the metal. If the patch is on a steep slope or vertical surface, clamp or tack-solder it in place.

4. Soft solder the patch over the defect. For guidance on soldering, see 05010-07-R "Procedures for Soldering Metal".

B. For Medium-Sized Repairs:

1. Brazing:

NOTE: SILVER BRAZING REQUIRES EXTREMELY HIGH TEMPERATURES, SO THE METHOD CAN ONLY BE USED WHERE THE METAL CAN BE RAISED FROM THE DECKING ALLOWING A FIRE-RESISTANT INSULATION SHEET OR PAD TO BE PLACED BETWEEN THE TWO. THIS WILL REQUIRE A NEARBY SEAM TO BE UNFOLDED.

a. Carefully remove the damaged piece of metal sheeting.
b. Level the indentation in the decking with a suitable wood filler.
c. Silver braze the new metal to the existing bay using a "dog tooth" joint to hold the edges together and prevent undue distortion.

2. Welting: If fire precautions make it impractical to use brazing, try welting:

a. Welt a new square of sheet metal into the existing damaged bay. Make sure the metal patch is the same material as the existing roof.
b. Replace rosin paper underlayment as required.
c. Seal the welt by flowing soft solder under the final fold and into the mitered corners using a large copper bit.
d. Pre-tin the edges of the new and existing metal and dress the welt tight to create a capillary soldered joint for maximum strength.

C. For Large Repairs:

1. Remove the damaged sheets carefully.
2. Repair the decking.
3. Replace the rosin paper underlayment.
4. Close the covering with new metal, matching original seam type, pan size, metal type, etc. Install new clips or cleats as required.

3.04 PROTECTION

A. At the end of each work day, provide building protection for any exterior roofing element removed for repair or replacement.

B. Work only on a quantity of roofing which may be repaired on that same day. At the end of the day, use 15 pound roofing felt or polyethylene sheeting to drape over missing roofing and insert under roof unit laps or temporarily secure areas of existing roofing and roof as required to make roof watertight and windproof.

END OF SECTION

4.8 DOORS AND WINDOWS

4.8.1 Doors and Windows Elements

4.8.1.1 Doors and Windows—Wood Doors

NR Rating: 366

Description:

The south facade of building 10230 is symmetrical with a centered six-paneled door. The other door is located on the north end of the east facade symmetrical with three double-hung windows. The wood doors should be maintained in order to protect them from deterioration. When these new doors and windows were installed, there was no seal on the wood (which is in contact with the CMU wall.) Because it was not sealed, the wood will deteriorate more rapidly as it allows water to penetrate, expand, and contract the wood fibers. This element will have to be replaced at some point in the next 5 years. When this happens, the windows and doors should be replaced with materials similar in appearance and properties to the original construction of this building.

The doors and windows will need to be replaced within the next 5 years due to improper installation. The wood which is in direct contact with the CMU walls is not sealed.

Treatment Rating 6: SPECIFIED TREATMENT IS NOT REQUIRED

IF ANY WORK IS DONE ON THIS ELEMENT IT SHOULD BE SYMPATHETIC TO THE SIGNIFICANT QUALITIES OF THE HISTORIC PROPERTY.

Statement of Importance:

- The doors are not original in the design of the Rolling Heath School and have no historic value.

Condition: ***Good– Preserve***

Fair to good - Preserve

Poor – Replace

Inventory Quantity and Condition

The doors are evaluated as Good when:

- the doors are structurally intact and performing their intended purpose, and
- due to improper installation (no seal on the wood which is in direct contact with the CMU wall), the doors lifespan is limited as they will begin to deteriorate rapidly, and
- when these doors are replaced, they must be first sealed and secondly installed properly and cleanly unlike the recent installation as seen in the above images, and
- doors, thresholds, and trim should be cleaned in order to maintain.

Minor deficiency of the door exists where:

- Any repairs to the wood should be made after cleaning the surface gently if necessary, and
- standard preventive maintenance practices and building conservation methods have not been followed, or
- there is a reduced life expectancy of affected or related building materials and/or systems, or
- there is a condition with long-term impact beyond 5 years.

Minor deficiencies can include, but are not limited to: improper wood seal where wood is in contact with CMU walls which will promote the advanced deterioration of this element.

4.8.1.2 Doors and Windows—Wood Windows

NR Rating: 366

Description:

The west facade of building 10230 is symmetrical with four evenly spaced double-hung windows. There are three windows and a door evenly spaced on the east facade. The wood windows should be maintained in order to protect them from deterioration. When these new doors and windows were installed, there was no seal on the wood where it is in contact with the CMU wall. This will be to the detriment of this element. Because it was not sealed, the wood will deteriorate more rapidly as it allows water to penetrate, expand, and contract the wood fibers. This element will have to be replaced at some point in the next 5 years. When this happens, the windows and doors should be replaced with materials similar in appearance and properties to the original construction of this building.

Windows and their frames are in good condition and should be maintained for now. The doors and windows will need to be replaced within the next 5 years due to improper installation. The wood which is in direct contact with the CMU walls is not sealed. This will allow water to penetrate easily, expand, contract, freeze, thaw, which will promote the advanced deterioration of these elements. Upon their eventual replacement, ensure they are both sealed and installed properly unlike this first image. This is a poorly executed infill job which can be easily avoided with care.

Treatment Rating 6: SPECIFIED TREATMENT IS NOT REQUIRED

IF ANY WORK IS DONE ON THIS ELEMENT IT SHOULD BE SYMPATHETIC TO THE SIGNIFICANT QUALITIES OF THE HISTORIC PROPERTY.

Statement of Importance:

- The windows are not original in the design of the Rolling Heath School and have no historic value.

Condition: ***Good– Preserve***

Fair to good - Preserve

Poor – Replace

Inventory Quantity and Condition

The windows are evaluated as Good when:

- The windows are structurally intact and performing their intended purpose, and
- due to improper installation (no seal on the wood which is in direct contact with the CMU wall), the windows lifespan is limited as they will begin to deteriorate rapidly, and
- when these windows are replaced, they must be first sealed, secondly installed properly and cleanly unlike the recent installation as seen in the above images and thirdly they must be truer to the original 1912 construction, and
- windows and trim should be cleaned in order to maintain.

Minor deficiency of the windows exists where:

- Any repairs to the wood should be made after cleaning the surface gently if necessary, and
- standard preventive maintenance practices and building conservation methods have not been followed, or
- there is a reduced life expectancy of affected or related building materials and/or systems, or
- there is a condition with long-term impact beyond 5 years.

Minor deficiencies can include, but are not limited to: improper wood seal where wood is in contact with CMU walls which will promote the advanced deterioration of this element.

4.8.2 Maintenance / Management Guidelines

According to *The Secretary of Interior's Standards for Rehabilitation*, the proper procedure is to respect the significance of the original materials and features, repair and retain them wherever possible, and replace them only when absolutely necessary.

The following recommendations for care of the historic roofing are to be thoroughly read and understood before a treatment is specified. *The Secretary of the Interior's Standards for Rehabilitation* should also be consulted to determine the appropriateness of any treatment.

The following is an excerpt from *The Secretary of the Interior's Standards for Rehabilitation*. Full documentation can be found at http://www2.cr.nps.gov/tps/tax/rhb/stand.htm

4.8.2.1 Identify, Retain, and Preserve

Recommended…

- Identifying, retaining, and preserving windows--and their functional and decorative features--those are important in defining the overall historic character of the building.
- Such features can include frames, sash, muntins, glazing, sills, heads, hoodmolds, paneled or decorated jambs and moldings, and interior and exterior shutters and blinds.
- Conducting an in-depth survey of the conditions of existing windows early in rehabilitation planning so that repair and upgrading methods and possible replacement options can be fully explored.

Not Recommended…

- Removing or radically changing windows which are important in defining the historic character of the building so that, as a result, the character is diminished.
- Changing the number, location, size, or glazing pattern of windows, through cutting new openings, blocking-in windows, and installing replacement sash that do not fit the historic window opening.
- Changing the historic appearance of windows through the use of inappropriate designs, materials, finishes, or colors which noticeably change the sash, depth of reveal, and muntin configuration; the reflectivity and color of the glazing; or the appearance of the frame.
- Obscuring historic window trim with metal or other material.
- Stripping windows of historic material such as wood, cast iron, and bronze.
- Replacing windows solely because of peeling paint, broken glass, stuck sash, and high air infiltration. These conditions, in themselves, are no indication that windows are beyond repair.

4.8.2.2 Protect and Maintain

Recommended…

- Protecting and maintaining the wood and architectural metal which comprise the window frame, sash, muntins, and surrounds through appropriate surface treatments such as cleaning, rust removal, limited paint removal, and re-application of protective coating systems.
- Providing adequate anchorage for roofing material to guard against wind damage and moisture penetration.
- Evaluating the overall condition of materials to determine whether more than protection and maintenance are required, i.e. if repairs to windows and window features will be required.

Not Recommended…

- Failing to provide adequate protection of materials on a cyclical basis so that deterioration of the window material is accelerated.
- Retrofitting or replacing windows rather than maintaining the sash, frame, and glazing.
- Failing to undertake adequate measures to assure the protection of historic windows.

4.8.2.3 Repair

Recommended…

- Repairing window frames and sash by patching, splicing, consolidating or otherwise reinforcing. Such repair may also include replacement in kind--or with compatible substitute material--of those parts that are either extensively deteriorated or are missing when there are surviving prototypes such as architrave, hoodmolds, ash, sills, and interior or exterior shutters and blinds.

Not Recommended…

- Replacing an entire window when repair of materials and limited replacement of deteriorated or missing parts are appropriate.
- Failing to reuse serviceable window hardware such as brass sash lifts and sash locks.
- Using substitute material for the replacement part that does not convey the visual appearance of the surviving parts of the window or that is physically or chemically incompatible.

4.8.2.4 Replace

Recommended…

- Replacing in kind an entire window that is too deteriorated to repair using the same sash and pane configuration and other design details. If using the same kind of material is not technically or economically feasible when replacing windows deteriorated beyond repair, then a compatible substitute material may be considered.

Not Recommended…

- Removing a character-defining window that is irreparable and blocking it in, or replacing it with a new window that does not convey the same visual appearance.

REPAIR OF BOWS OR UNDULATIONS IN A WOOD DOOR FRAME[11]

U.S. General Services Administration
Historic Preservation Technical Procedures

08210-02

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on realigning a bowed wood doorframe.

B. A wood doorframe that bows or undulates may result from warping in the frame, building settlement, or pressure in the wall behind the frame.

C. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:
   1. Safety Precautions
   2. Historic Structures Precautions
   3. Submittals
   4. Quality Assurance
   5. Delivery, Storage, and Handling
   6. Project/Site Conditions
   7. Sequencing and Scheduling
   8. General Protection (Surface and Surrounding)

PART 2---PRODUCTS

2.01 MATERIAL

A. Wooden shims and blocking
B. 6d and 8d finish nails

2.02 EQUIPMENT

A. Wide blade putty knife and prybar
B. Hack saw
C. Hammer and chisel

PART 3---EXECUTION

3.01 EXAMINATION

A. To discern door problem, observe the door open and close a few times. Note the location of any binding or rubbing. Note also if door binds inconsistently from top to bottom or hinge side to latch side.

3.02 ERECTION, INSTALLATION, APPLICATION

A. Check if jamb is secured to framing by carefully twisting and pushing it.

[11] The following excerpt is from the U.S. General Services Administration (GSA). Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

B. Push back high spots where jamb is loose and secure by nailing. Use 8d finish nails for securing the jamb into the frame and 6d finish nails for securing the trim into the jamb.

C. If jamb cannot be forced back into position, it must be freed from casing and realigned.
   1. Carefully loosen casing on less conspicuous side, with a wide blade putty knife and pry bar; insert putty knife blade first and then insert pry bar on top of knife blade, allowing the knife blade to protect the casing.
   2. Loosen casing on side that is more noticeable just enough to insert hacksaw and cut nails, which hold the casing to the jamb.
   3. Shim out low spots with solid wood wedges or blocking nailed into place through jamb. If necessary nails can be hidden by first removing door stops, nailing blocking into place and renailing stops.
   4. Cut down high spots by removing any existing shims and/or chiseling away at any blocking.
   5. When jamb is plumb and straight, resecure casing, filling nail holes as necessary.

END OF SECTION

UNSTICKING A WOOD DOUBLE-HUNG WINDOW SASH[12]

U.S. General Services Administration
Historic Preservation Technical Procedures

08610-03

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance and procedures required to inspect and loosen a wood sash.

B. A wood window sash can bind or stick for many reasons including: window nailed shut; accumulation of paint and/or dirt; humidity causing wood expansion; bowed members; weather-stripping too tight; or building settlement. NOTE: Some sash were fixed, installed without operable parts such as single hung sash.

C. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:
   1. Safety Precautions
   2. Historic Structures Precautions
   3. Submittals
   4. Quality Assurance
   5. Delivery, Storage, and Handling
   6. Project/Site Conditions
   7. Sequencing and Scheduling
   8. General Protection (Surface and Surrounding)

1.02 SYSTEM DESCRIPTION

A. A window sash in proper working order is freely sliding, has balancing and moving apparatus in working order, and has operable sash lock(s) to deter air infiltration. In addition, operable sash often have weather-stripping and adjustable interior stops to allow for seasonal swelling and shrinkage.

PART 2---PRODUCTS

2.01 MATERIALS

A. Replacement stock is available for stop and parting beads. Be sure replacement is an exact duplicate of the original. Milling a new piece may be required.

2.02 EQUIPMENT

A. A device for cutting paint seals such as "Window zipper" (Red Devil), or approved equal; available at hardware stores.
B. A rubber mallet and block of wood for jamb and stop straightening.

[12] The following excerpt is from the U.S. General Services Administration (GSA). Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

C. Utility knife for cutting paint seals
D. Paint scraper
E. Wide putty knife or "window zipper" to break paint seal
F. Screwdriver and screws to tighten jamb into place
G. Hand soap or household paraffin for waxing the stop and parting beads
H. Flat steel pry bar to loosen sash from outside
I. Carpenter's nippers to remove nails
J. 1" chisel to scrape paint in channel
K. Sandpaper
L. Planer
M. Nail to secure sash cord/chain
N. Soap and water

PART 3---EXECUTION

3.01 EXAMINATION

A. Determine if sash is an operable design and not fixed.

3.02 ERECTION, INSTALLATION, APPLICATION

A. The sash may be nailed shut:
    1. Check around general area of sash for the presence of any nails.
    2. If sash is nailed shut with finish nails, drive them completely through with nail set.
    3. If large headed nails were used, pull them out with carpenter's nippers being careful not to damage wood.

B. The sash may be painted shut:
    1. Break the paint seal between the stops and the sash.
    2. Use a "window zipper" or a wide putty knife with a rubber mallet.
    3. Do this on the inside and outside of the window.
    4. CAREFULLY insert a heavy screwdriver between the sash rail and jamb at groove for sash cord. TAKE CARE NOT TO MAR OR DAMAGE FINISH AND/OR SASH.
    5. Work at both sides of jambs to loosen sash.
    6. If window still will not open, use a pry bar on the outside of the sash. TAKE CARE TO PROTECT THE SASH AND SILL FROM DENTS WITH A WIDE PUTTY KNIFE OR WOOD BLOCKING. INTENSE PRESSURE ON A SMALL AREA SUCH AS THAT FROM A SMALL SCREWDRIVER OR FLAT PRYBAR CAN GOUGE OR DENT THE WOOD.

C. If the window has been opened but is difficult to move:
    1. Remove any dirt from the channel, stops, weather-stripping, and parting bead.
    2. Remove any globs of dried paint from the stops and parting bead with a 1" chisel and sand edges after paint is removed.
    3. Lubricate stops and parting bead with hand soap or household paraffin.

D. If sash still binds, determine the point of friction:
    1. If the friction occurs along the jamb; with a hammer, tap a wood block approximately 6" long 5 or 6 times against the back of channel to force the jamb back into place. If this allows the sash to move more freely, screw the jamb into the jack stud behind at 3" intervals around the point of friction.
    2. If the friction occurs with the stop, use the same procedure as above, but with less force and do not drive screws into the stop.

E. Problems such as humidity, paint build-up, or weather-stripping applied too tightly require more aggressive repair:

1. If the window is easily operable during dry times of the year but will not work properly during humid times, then humidity is to blame. Repair should not be attempted until the time of year with highest humidity. See section 1.02 A; If the window has adjustable interior stops, it may be desirable to refurbish and restore them to use.
    a. The sash must be carefully planed and should be done only once.
    b. Take off as little of the sash surface as possible to make the window operable during all times of the year.
    c. Remove the sash as described below with the problem of paint build-up.

2. If the sash binds because of the build-up of layers of paint, remove the paint. To remove the paint properly, first remove the sash:
    a. Remove the stop; break the paint seal between the inside stop and the window frame. Pry the stop away from the frame with a stiff putty knife, small pry bar, or wide chisel.
    b. Pull one side of sash out to expose the sash cord/chain.
    c. Remove cord/chain from both sides of sash. Temporarily secure the end of cord/chain with a nail through the cord/chain and across the pulley hole so that it will not fall into the pocket. Lift out the sash.
    d. Remove loose paint from all members by sanding, and repaint.
    e. Reinstall parting bead and sash.
    f. When reinstalling inner stop, check position in relation to the sash one nail at a time so that sash will fit snugly in place and will not bind or rattle.
    g. To remove the upper sash - lower the sash; remove the parting bead from the top down; at midpoint, raise the sash and continue. Follow the same procedure as above.

3. If weather-stripping applied too tightly is suspected to be the problem, removal and reinstallation of weather-stripping will be required.

END OF SECTION

THE REPAIR OF HISTORIC WOODEN WINDOWS
PRESERVATION BRIEFS: 9[13]

U.S. General Services Administration
Historic Preservation Technical Procedures

08610-01

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

John H. Myers

This standard includes the bulk of information contained in the original Preservation Brief developed by the National Park Service. To obtain a complete copy of this brief, including figures and illustrations, please contact:

Superintendent of Documents
P.O. Box 371954
Pittsburgh, PA 15250-7954

GPO #024-005-01026-2
Available ONLY in package sets
Briefs 1-14 - $13.00

Please call the Publication Order Information Desk at 202/783-3238 or FAX 202/512-2250 to verify price and availability.

INTRODUCTION

The windows on many historic buildings are an important aspect of the architectural character of those buildings. Their design, craftsmanship, or other qualities may make them worthy of preservation. This is self-evident for ornamental windows, but it can be equally true for warehouses or factories where the windows may be the most dominant visual element of an otherwise plain building. Evaluating the significance of these windows and planning for their repair or replacement can be a complex process involving both objective and subjective considerations. The Secretary of the Interior's Standards for Rehabilitation and the accompanying guidelines call for respecting the significance of original materials and features, repairing and retaining them wherever possible and when necessary, replacing them in kind. This Brief is based on the issues of significance and repair, which are implicit in the standards, but the primary emphasis is on the technical issues of planning for the repair of windows including evaluation of their physical condition, techniques of repair, and design considerations when replacement is necessary. Much of the technical section presents repair techniques as an instructional guide for the do-it-yourselfer. The information will be useful, however, for the architect, contractor, or developer on large-scale projects. It presents a methodology for approaching the evaluation and repair of existing windows and considerations for replacement, from which the professional can develop alternatives and specify appropriate materials and procedures.

[13] The following excerpt is from the U.S. General Services Administration (GSA). Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

ARCHITECTURAL OR HISTORICAL SIGNIFICANCE

Evaluating the architectural or historical significance of windows is the first step in planning for window treatments, and a general understanding of the function and history of windows is vital to making a proper evaluation. As a part of this evaluation, one must consider four basic window functions: admitting light to the interior spaces, providing fresh air and ventilation to the interior, providing a visual link to the outside world, and enhancing the appearance of a building. No single factor can be disregarded when planning window treatments; for example, attempting to conserve energy by closing up or reducing the size of window openings may result in the use of more energy by increasing electric lighting loads and decreasing passive solar heat gains.

Historically the first windows in early American houses were casement windows; that is, they were hinged at the side and opened outward. In the beginning of the eighteenth century, single and double-hung windows were introduced. Subsequently many styles of these vertical sliding sash windows have come to be associated with specific building periods or architectural styles, and this is an important consideration in determining the significance of windows, especially on a local or regional basis. Site specific, regionally oriented architectural comparisons should be made to determine the significance of windows in question. Although such comparisons may focus on specific window types and their details, the ultimate determination of significance should be made within the context of the whole building, wherein the windows are one architectural element.

After all of the factors have been evaluated, windows should be considered significant to a building if they: 1) are original, 2) reflect the original design intent for the building, 3) reflect period or regional styles or building practices, 4) reflect changes to the building resulting from major periods or events, or 5) are examples of exceptional craftsmanship or design. Once this evaluation of significance has been completed, it is possible to proceed with planning appropriate treatments, beginning with an investigation of the physical condition of the windows.

PHYSICAL EVALUATION

The key to successful planning for window treatments is a careful evaluation of existing physical conditions on a unit-by-unit basis. A graphic or photographic system may be devised to record existing conditions and illustrate the scope of any necessary repairs. Another effective tool is a window schedule, which lists all of the parts of each window unit. Spaces by each part allow notes on existing conditions and repair instructions. When such a schedule is completed, it indicates the precise tasks to be performed in the repair of each unit and becomes a part of the specifications. In any evaluation, one should note at a minimum, 1) window location, 2) condition of the paint, 3) condition of the frame and sill, 4) condition of the sash (rails, stiles and muntins), 5) glazing problems, 6) hardware, and 7) the overall condition of the window (excellent, fair, poor, and so forth).

Many factors such as poor design, moisture, vandalism, insect attack, and lack of maintenance can contribute to window deterioration, but moisture is the primary contributing factor in wooden window decay. All window units should be inspected to see if water is entering around the edges of the frame and, if so, the joints or seams should be caulked to eliminate this danger. The glazing putty should be checked for cracked, loose, or missing sections, which allow water to saturate the wood, especially at the joints. The back putty on the interior side of the pane should also be inspected, because it creates a seal, which prevents condensation from running down into the joinery. The sill should be examined to ensure that it slopes downward away from the building and allows water to drain off. In addition, it may be advisable to cut a drip line along the underside of the sill. This almost invisible treatment will ensure 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 identify points of water penetration, moisture saturation, and potential deterioration. Failure of the paint should not, however, be mistakenly interpreted as a sign that the wood is in poor condition and hence, irreparable. Wood is frequently in sound physical condition beneath unsightly paint.

After noting areas of paint failure, the next step is to inspect the condition of the wood, particularly at the points identified during the paint examination.

Each window should be examined for operational soundness beginning with the lower portions of the frame and sash. Exterior rainwater and interior condensation can flow downward along the window, entering and collecting at points where the flow is blocked. The sill, joints between the sill and jamb, corners of the bottom rails, and muntin joints are typical points where water collects and deterioration begins. The operation of the window (continuous opening and closing over the years and seasonal temperature changes) weakens the joints, causing movement and slight separation. This process makes the joints more vulnerable to water, which is readily absorbed into the end-grain of the wood. If severe deterioration exists in these areas, it will usually be apparent on visual inspection, but other less severely deteriorated areas of the wood may be tested by two traditional methods using a small ice pick.

An ice pick or an awl may be used to test wood for soundness. The technique is simply to jab the pick into a wetted wood surface at an angle and pry up a small section of the wood. Sound wood will separate in long fibrous splinters, but decayed wood will lift up in short irregular pieces due to the breakdown of fiber strength.

Another method of testing for soundness consists of pushing a sharp object into the wood, perpendicular to the surface. If deterioration has begun from the hidden side of a member and the core is badly decayed, the visible surface may appear to be sound wood. Pressure on the probe can force it through an apparently sound skin to penetrate deeply into decayed wood. This technique is especially useful for checking sills where visual access to the underside is restricted.

Following the inspection and analysis of the results, the scope of the necessary repairs will be evident and a plan for the rehabilitation can be formulated. Generally the actions necessary to return a window to "like new" condition will fall into three broad categories: 1) routine maintenance procedures, 2) structural stabilization, and 3) parts replacement. These categories will be discussed in the following sections and will be referred to respectively as Repair Class I, Repair Class II, and Repair Class III. Each successive repair class represents an increasing level of difficulty, expense, and work time. Note that most of the points mentioned in Repair Class I are routine maintenance items and should be provided in a regular maintenance program for any building. The neglect of these routine items can contribute too many common window problems.

Before undertaking any of the repairs mentioned in the following sections all sources of moisture penetration should be identified and eliminated, and all existing decay fungi destroyed in order to arrest the deterioration process. Many commercially available fungicides and wood preservatives are toxic, so it is extremely important to follow the manufacturer's recommendations for application, and store all chemical materials away from children and animals. After fungicidal and preservative treatment the windows may be stabilized, retained, and restored with every expectation for a long service life.

REPAIR CLASS I: ROUTINE MAINTENANCE REPAIRS

Repairs to wooden windows are usually labor intensive and relatively uncomplicated. On small-scale projects, this allows the do-it-yourselfer to save money by repairing all or part of the windows. On larger projects, it presents the opportunity for time and money, which might otherwise be spent on the removal and replacement of existing windows, to be spent on repairs, subsequently saving all or part of the material cost of new window units. Regardless of the actual costs, or who performs the work, the

evaluation process described earlier will provide the knowledge from which to specify an appropriate work program, establish the work element priorities, and identify the level of skill needed by the labor force.

The routine maintenance required to upgrade a window to "like new" condition normally includes the following steps: 1) some degree of interior and exterior paint removal, 2) removal and repair of sash (including reglazing where necessary), 3) repairs to the frame, 4) weather-stripping and reinstallation of the sash, and 5) repainting. Historic windows have usually acquired many layers of paint over time. Removal of excess layers or peeling and flaking paint will facilitate operation of the window and restore the clarity of the original detailing. Some degree of paint removal is also necessary as a first step in the proper surface preparation for subsequent refinishing (if paint color analysis is desired, it should be conducted prior to the onset of the paint removal). There are several safe and effective techniques for removing paint from wood, depending on the amount of paint to be removed. 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 09910-01-S).

Paint removal should begin on the interior frames, being careful to remove the paint from the interior stop and the parting bead, particularly along the seam where these stops meet the, jamb. This can be accomplished by running a utility knife along the length of the seam, breaking the paint bond. It will then be much easier to remove the stop, the parting bead, and the sash. The interior stop may be initially loosened from the sash side to avoid visible scarring of the wood and then gradually pried loose using a pair of putty knives, working up and down the stop in small increments. With the stop removed, the lower or interior sash may be withdrawn. The sash cords should be detached from the sides of the sash and their ends may be pinned with a nail or tied in a knot to prevent them from falling into the weight pocket.

Removal of the upper sash on double-hung units is similar but the parting bead, which holds it in place, is set into a groove in the center of the stile and is thinner and more delicate than the interior stop. After removing any paint along the seam, the parting bead should be carefully pried out and worked free in the same manner as the interior stop. The upper sash can be removed in the same manner as the lower one and both sash taken to a convenient work area (in order to remove the sash the interior stop and parting bead need only be removed from one side of the window). Window openings can be covered with polyethylene sheets or plywood sheathing while the sash are out for repair.

The sash can be stripped of paint using appropriate techniques, but if any heat treatment is used, the glass should be removed or protected from the sudden temperature change, which can cause breakage. An overlay of aluminum foil on gypsum board or asbestos can protect the glass from such rapid temperature change. It is important to protect the glass because it may be historic and often adds character to the window. Deteriorated putty should be removed manually, taking care not to damage the wood along the rabbet. If the glass is to be removed, the glazing points, which hold the glass in place, can be extracted and the panes numbered and removed for cleaning and reuse in the same openings. With the glass panes out, the remaining putty can be removed and the sash can be sanded, patched, and primed with a preservative primer. Hardened putty in the rabbets may be softened by heating with a soldering iron at the point of removal. Putty remaining on the glass may be softened by soaking the panes in linseed oil, and then removed with less risk of breaking the glass. Before reinstalling the glass, a bead of glazing compound or linseed oil putty should be laid around the rabbet to cushion and seal the glass. Glazing compound should only be used on wood which has been brushed with linseed oil and primed with an oil based primer or paint. The pane is then pressed into place and the glazing points are pushed into the wood around the perimeter of the pane. The final glazing compound or putty is applied and beveled to complete the seal. The sash can be refinished as desired on the inside and painted on the outside as soon as a "skin" has formed on the putty, usually in 2 or 3 days. Exterior paint should cover the beveled glazing compound or putty and lap over onto the glass slightly to complete a weather tight seal. After the proper curing times have elapsed for paint and putty, the sash will be ready for reinstallation.

While the sash are out of the frame, the condition of the wood in the jamb and sill can be evaluated. Repair and refinishing of the frame may proceed concurrently with repairs to the sash, taking advantage of the curing times for the paints and putty used on the sash. One of the most common work items is the replacement of the sash cords with new rope cords or with chains. The weight pocket is frequently accessible through a door on the face of the frame near the sill, but if no door exists, the trim on the

interior face may be removed for access. Sash weights may be increased for easier window operation by elderly or handicapped persons.
Additional repairs to the frame and sash may include consolidation or replacement of deteriorated wood. Techniques for these repairs are discussed in the following sections.

The operations just discussed summarize the efforts necessary to restore a window with minor deterioration to "like new" condition. The techniques can be applied by an unskilled person with minimal training and experience. To demonstrate the practicality of this approach, and photograph it, a Technical Preservation Services staff member repaired a wooden double-hung, two over two windows, which had been in service over ninety years. The wood was structurally sound but the window had one broken pane, many layers of paint, broken sash cords, and inadequate, worn-out weather-stripping. The staff member found that the frame could be stripped of paint and the sash removed quite easily. Paint, putty, and glass removal required about one hour for each sash, and the reglazing of both sashes was accomplished in about one hour. Weather-stripping of the sash and frame, replacement of the sash cords and reinstallation of the sash, parting bead, and stop required an hour and a half. These times refer only to individual operations; the entire process took several days due to the drying and curing times for putty, primer, and paint, however, work on other window units could have been in progress during these lag times.

REPAIR CLASS II: STABILIZATION

The preceding description of a window repair job focused on a unit, which was operationally sound. Many windows will show some additional degree of physical deterioration, especially in the vulnerable areas mentioned earlier, but even badly damaged windows can be repaired using simple processes. Partially decayed wood can be waterproofed, patched, built-up, or consolidated and then painted to achieve a sound condition, good appearance, and greatly extended life. Three techniques for repairing partially decayed or weathered wood are discussed in this section, and all three can be accomplished using products available at most hardware stores.

One established technique for repairing wood which is split, checked or shows signs of rot, is to: 1) dry the wood, 2) treat decayed areas with a fungicide, 3) waterproof with two or three applications of boiled linseed oil (applications every 24 hours), 4) fill cracks and holes with putty, and 5) after a "skin" forms on the putty, paint the surface. Care should be taken with the use of fungicide, which is toxic. Follow the manufacturers' directions and use only on areas, which will be painted. When using any technique of building up or patching a flat surface, the finished surface should be sloped slightly to carry water away from the window and not allow it to puddle. Caulking of the joints between the sill and the jamb will help reduce further water penetration.

When sills or other members exhibit surface weathering they may also be built-up using wood putties or homemade mixtures such as sawdust and resorcinol glue, or whiting and varnish. These mixtures can be built up in successive layers, then sanded, primed, and painted. The same caution about proper slope for flat surfaces applies to this technique.

Wood may also be strengthened and stabilized by consolidation; using semi-rigid epoxies which saturate the porous decayed wood and then harden. The surface of the consolidated wood can then be filled with a semi-rigid epoxy-patching compound, sanded, and painted. Epoxy patching compounds can be used to build up missing sections of decayed ends of members. Profiles can be duplicated using hand molds, which are created by pressing a ball of patching compound over a sound section of the profile, which has been rubbed with butcher's wax. This can be a very efficient technique where there are many typical repairs to be done. Technical Preservation Services has published “Epoxies for Wood Repairs in Historic Buildings” by Morgan Phillips and Judith Selwyn (1978), which discusses the theory and techniques of epoxy repairs. The process has been widely used and proven in marine applications and proprietary products are available at hardware and marine supply stores. Although epoxy materials may be comparatively expensive, they hold the promise of being among the most durable and long lasting materials available for wood repair.

Any of the three techniques discussed can stabilize and restore the appearance of the window unit. There are times, however, when the degree of deterioration is so advanced that stabilization is impractical, and the only way to retain some of the original fabric is to replace damaged parts.

REPAIR CLASS III: SPLICES AND PARTS REPLACEMENT

When parts of the frame or sash are so badly deteriorated that they cannot be stabilized, there are methods, which permit the retention of some of the existing or original fabric. These methods involve replacing the deteriorated parts with new matching pieces, or splicing new wood into existing members. The techniques require more skill and are more expensive than any of the previously discussed alternatives. It is necessary to remove the sash and/or the affected parts of the frame and have a carpenter or woodworking mill reproduce the damaged or missing parts. Most millwork firms can duplicate parts, such as muntins, bottom rails, or sills, which can then be incorporated into the existing window, but it may be necessary to shop around because there are several factors controlling the practicality of this approach. Some woodworking mills do not like to repair old sash because nails or other foreign objects in the sash can damage expensive knives (which cost far more than their profits on small repair jobs); others do not have cutting knives to duplicate muntin profiles. Some firms prefer to concentrate on larger jobs with more profit potential and some may not have a craftsman who can duplicate the parts. A little searching should locate a firm which will do the job, and at a reasonable price. If such a firm does not exist locally, there are firms, which undertake this kind of repair and ship nationwide. It is possible, however, for the advanced do-it-yourselfer or craftsman with a table saw to duplicate molding profiles using techniques discussed by Gordie Whittington in “Simplified Methods for Reproducing Wood Mouldings,” Bulletin of the Association for Preservation Technology, Vol. III, No. 4, 1971, or illustrated more recently in The Old House, Time-Life Books, Alexandria, Virginia, 1979.

The repairs discussed in this section involve window frames, which may be in much deteriorated condition, possibly requiring removal; therefore, caution is in order. The actual construction of wooden window frames and sash is not complicated. Pegged mortise and tenon units can be disassembled easily, if the units are out of the building. The installation or connection of some frames to the surrounding structure, especially masonry walls, can complicate the work immeasurably, and may even require dismantling of the wall. It may be useful, therefore, to take the following approach to frame repair: 1) conduct regular maintenance of sound frames to achieve the longest life possible, 2) make necessary repairs in place wherever possible, using stabilization and splicing techniques, and 3) if removal is necessary, thoroughly investigate the structural detailing and seek appropriate professional consultation.

Another alternative may be considered if parts replacement is required, and that is sash replacement. If extensive replacement of parts is necessary and the job becomes prohibitively expensive, it may be more practical to purchase new sash, which can be installed into the existing frames. Such sash are available as exact custom reproductions, reasonable facsimiles (custom windows with similar profiles), and contemporary wooden sash, which are similar in appearance. There are companies, which still manufacture high quality wooden sash, which would duplicate most historic sash. A few calls to local building suppliers may provide a source of appropriate replacement sash, but if not, check with local historical associations, the state historic preservation office, or preservation related magazines and supply catalogs for information. If a rehabilitation project has a large number of windows such as a commercial building or an industrial complex, there may be less of a problem arriving at a solution. Once the evaluation of the windows is completed and the scope of the work is known, there may be a potential economy of scale. Woodworking mills may be interested in the work from a large project; new sash in volume may be considerably less expensive per unit; crews can be assembled and trained on site to perform all of the window repairs; and a few extensive repairs can be absorbed (without undue burden) into the total budget for a large number of sound windows. While it may be expensive for the average historic homeowner to pay seventy dollars or more for a mill to grind a custom knife to duplicate four or five bad muntins, that cost becomes negligible on large commercial projects, which may have several hundred windows.

Most windows should not require the extensive repairs discussed in this section. The ones, which do, are usually in buildings, which have been abandoned for long periods or have totally lacked maintenance for

years. It is necessary to thoroughly investigate the alternatives for windows, which do require extensive repairs to arrive at a solution, retain historic significance, and which are economically feasible. Even for projects requiring repairs identified in this section, if the percentage of parts replacement per window is low, or the number of windows requiring repair is small, repair can still be a cost effective solution.

WEATHERIZATION

A window that is repaired should be made as energy efficient as possible by the use of appropriate weather-stripping to reduce air infiltration. A wide variety of products are available to assist in this task. Felt may be fastened to the top, bottom, and meeting rails, but may have the disadvantage of absorbing and holding moisture, particularly at the bottom rail. Rolled vinyl strips may also be tacked into place in appropriate locations to reduce infiltration. Metal strips or new plastic spring strips may be used on the rails and, if space permits, in the channels between the sash and jamb. Weather-stripping is an historic treatment, but old weather-stripping (felt) is not likely to perform very satisfactorily. Appropriate contemporary weather-stripping should be considered an integral part of the repair process for windows. The use of sash locks installed on the meeting rail will ensure that the sash are kept tightly closed so that the weather-stripping will function more effectively to reduce infiltration. Although such locks will not always be historically accurate, they will usually be viewed as an acceptable contemporary modification in the interest of improved thermal performance.

Many styles of storm windows are available to improve the thermal performance of existing windows. The use of exterior storm windows should be investigated whenever feasible because they are thermally efficient, cost-effective, reversible, and allow the retention of original windows (see 01100-04-S "Preservation Briefs: 3 Conserving Energy in Historic Buildings"). Storm window frames may be made of wood, aluminum, vinyl, or plastic; however, the use of unfinished aluminum storms should be avoided. The visual impact of storms may be minimized by selecting colors that match existing trim color. Arched top storms are available for windows with special shapes. Although interior storm windows appear to offer an attractive option for achieving double-glazing with minimal visual impact, the potential for damaging condensation problems must be addressed. Moisture, which becomes trapped between the layers of glazing, can condense on the colder, outer prime window, potentially leading to deterioration. The correct approach to using interior storms is to create a seal on the interior storm while allowing some ventilation around the prime window. In actual practice, the creation of such a durable, airtight seal is difficult.

WINDOW REPLACEMENT

Although the retention of original or existing windows is always desirable and this Brief is intended to encourage that goal, there is a point when the condition of a window may clearly indicate replacement. The decision process for selecting replacement windows should not begin with a survey of contemporary window products, which are available as replacements, but should begin with a look at the windows, which are being replaced. Attempt to understand the contribution of the window(s) to the appearance of the facade including: 1) the pattern of the openings and their size; 2) proportions of the frame and sash; 3) configuration of window panes; 4) muntin profiles; 5) type of wood; 6) paint color; 7) characteristics of the glass; and 8) associated details such as arched tops, hoods, or other decorative elements. Develop an understanding of how the window reflects the period, style, or regional characteristics of the building, or represents technological development.

Armed with an awareness of the significance of the existing window, begin to search for a replacement, which retains as much of the character of the historic window as possible. There are many sources of suitable new windows. Continue looking until an acceptable replacement can be found. Check building supply firms, local woodworking mills, carpenters, preservation oriented magazines, or catalogs or suppliers of old building materials, for product information. Local historical associations and state historic preservation offices may be good sources of information on products, which have been used successfully in preservation projects.

Consider energy efficiency as one of the factors for replacements, but do not let it dominate the issue. Energy conservation is no excuse for the wholesale destruction of historic windows, which can be made thermally efficient by historically, and aesthetically acceptable means. In fact, an historic wooden window with a high quality storm window added should thermally outperform a new double glazed metal window that 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, in addition, many historic windows have high ratios of wood to glass, thus reducing the area of highest heat transfer. One measure of heat transfer is the U-value, the number of Btu's per hour transferred through a square foot of material. When comparing thermal performance, the lower the U-value the better the performance. According to ASHRAE 1977 Fundamentals, the U-values for single glazed wooden windows range from 0.88 to 0.99. The addition of a storm window should reduce these figures to a range of 0.44 to .049. A non-thermal break, double-glazed metal window has a U-value of about 0.6.

CONCLUSION

Technical Preservation Services recommends the retention and repair of original windows whenever possible. We believe that the repair and weatherization of existing wooden windows is more practical than most people realize, and that many windows are unfortunately replaced because of a lack of awareness of techniques for evaluation, repair, and weatherization. Wooden windows, which are repaired and properly maintained, will have greatly extended service lives while contributing to the historic character of the building. Thus, an important element of a building's significance will have been preserved for the future.

END OF SECTION

SEALING LEAKY WOOD DOUBLE-HUNG WINDOWS[14]

U.S. General Services Administration
Historic Preservation Technical Procedures

08611-01

The Cultural Resources POC, DPW will review all proposed work; in addition, these guidelines must be reviewed and followed by all personnel prior to performing this procedure.

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on sealing leaky windows and includes caulking gaps between the wall and the frame, filling cracks in the wood, repainting and replacing loose window putty.

B. Peeling paint, the absence of putty, and open sash joints are signs of moisture infiltration into the window sash. The wood should be properly sealed against moisture to prevent deterioration in wood.

C. See 01100-07-S for general project guidelines to be reviewed along with this procedure. These guidelines cover the following sections:
   1. Safety Precautions
   2. Historic Structures Precautions
   3. Submittals
   4. Quality Assurance
   5. Delivery, Storage, and Handling
   6. Project/Site Conditions
   7. Sequencing and Scheduling
   8. General Protection (Surface and Surrounding)

PART 2---PRODUCTS

2.01 MATERIALS

A. Caulking Compound (in order of recommended usage):
   1. Polyurethanes - easily workable; paintable; 15-20 year life span; limited availability.
   2. Polysulfides - slow drying; can be sanded and painted; highly elastic; limited availability.
   3. Butyls - paintable but cannot be sanded; 7-10 year life span.
   4. Silicones - some can be painted but generally not sanded.
   5. Acrylic Latex - for exterior work, their use is best left to tight, narrow joints; short life span especially when compared to polysulfides and polyurethanes.

B. Polyethylene foam backer rod such as "Ethafoam" SB brand backer rod (available at builder's supply houses or concrete materials suppliers), or approved equal.

C. Linseed oil

D. Wood filler (there are four basic types):

[14] The following excerpt is from the U.S. General Services Administration (GSA). Full documentation can be found at: http://w3.gsa.gov/web/p/hptp.nsf

1. Water-mix Wood Putty: Easy to tint and fairly resilient, but has poor moisture resistance.
2. Solvent-based Wood Filler: Not tintable, but has many color choices. A solvent is needed to clean any excess or spills. It is difficult to sand, but has good adhesion and moisture resistance. It also has a problem with shrinkage.
3. Acrylic Latex Wood Filler: Better than water-based in adhesion, moisture resistance, and flexibility. Apply the filler in layers to avoid shrinkage.
4. Two-part Polyester Filler: Similar to auto body filler. It has excellent adherence and moisture resistance with minimal shrinkage. It stains easily, but is time consuming to prepare.

E. Wood water-repellent preservative (see 06310-01-P, Section 2.02 Materials, and 06310-01-S)

F. Paint (see 06300-01-S)

G. Linseed oil putty

H. Clean, potable water

2.02 EQUIPMENT

A. Wire brush

B. Natural bristle brushes for oil-based paints: Precondition by soaking in raw linseed oil for 24 hours. Use nylon bristle brushes for water-based paint. Do not use the same brush for both types of paint.

C. Putty knife

D. Caulking gun

PART 3---EXECUTION

3.01 EXAMINATION

A. Inspect windows periodically, at least yearly. Check for ease of operation, presence, and operation of all hardware, and cracked or missing putty and glazing.

3.02 ERECTION, INSTALLATION, APPLICATION

A. Recaulking Gaps Between Window Frame and Wall:
   1. Re-nail any loose boards in the window frame.
   2. Using a wire brush and putty knife, remove any loose dirt and debris that may have collected in the gap.
   3. For gaps 3/8 inches or wider, insert a closed-cell polyurethane backer rod.
   4. Push the backer rod into the joint to fill up the space behind the caulking.
   5. Fill gap with a flexible caulking or sealant. Apply with a caulking gun until flush with the surface.
   6. If an oil-based caulk is used, allow the caulk to dry for at least 48 hours and then paint. Paint will extend the life of oil-based paint.

B. Fill holes and cracks with linseed oil and fill with putty (see 06440-04-R for guidance).

C. Examine condition of paint.
   1. If paint has minor cracking or peeling, remove loose paint with a wire brush and putty knife and repaint.
   2. If paint deterioration is extensive:

a. Remove all paint from window (see 06400-07-R and 06400-09-R for guidance).
b. Liberally apply a wood preservative to the wood (see 06310-01-P for guidance). This acts as a primer for the paint.
c. Allow to dry for 24 hours.
d. Apply 2 thin coats of paint and allow to dry (see 06300-01-S, 06300-02-R, and 09900-07-S for guidance).

D. Replace Window Putty:
1. Remove loose or cracked putty using a putty knife.
2. Using a wire brush, remove loose dirt and debris from within the putty channel.
3. Brush exposed areas with linseed oil. This will be absorbed into the wood and prevent the new putty from drying too quickly and cracking.
4. Apply fresh window putty and smooth out with a putty knife.

END OF SECTION

5.0 MAINTENANCE LOG

DATE	CONTRACTOR INFORMATION	WORK PERFORMED	WEATHER CONDITIONS	PROBLEMS OR COMPLICATIONS	SUPERVISOR SIGNATURE

DATE	CONTRACTOR INFORMATION	WORK PERFORMED	WEATHER CONDITIONS	PROBLEMS OR COMPLICATIONS	SUPERVISOR SIGNATURE

DATE	CONTRACTOR INFORMATION	WORK PERFORMED	WEATHER CONDITIONS	PROBLEMS OR COMPLICATIONS	SUPERVISOR SIGNATURE

DATE	CONTRACTOR INFORMATION	WORK PERFORMED	WEATHER CONDITIONS	PROBLEMS OR COMPLICATIONS	SUPERVISOR SIGNATURE

DATE	CONTRACTOR INFORMATION	WORK PERFORMED	WEATHER CONDITIONS	PROBLEMS OR COMPLICATIONS	SUPERVISOR SIGNATURE

DATE	CONTRACTOR INFORMATION	WORK PERFORMED	WEATHER CONDITIONS	PROBLEMS OR COMPLICATIONS	SUPERVISOR SIGNATURE

DATE	CONTRACTOR INFORMATION	WORK PERFORMED	WEATHER CONDITIONS	PROBLEMS OR COMPLICATIONS	SUPERVISOR SIGNATURE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (From - To)
06-2005	Final	

4. TITLE AND SUBTITLE
Fort Leonard Wood Maintenance and Repair Manual:
Rolling Heath School House

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Adam Smith, Marcia Harris, and Sunny Stone

5d. PROJECT NUMBER
MIPR

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Engineer Research and Development Center (ERDC)
Construction Engineering Research Laboratory (CERL)
PO Box 9005
Champaign, IL 61826-9005

8. PERFORMING ORGANIZATION REPORT NUMBER
ERDC/CERL SR-05-43

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Dept. of the Army, Installation Management Agency
HQ U.S. Army Garrison Fort Leonard Wood
320 MANSCEN Loop, Suite 120
Fort Leonard Wood, MO 65473-8929

10. SPONSOR/MONITOR'S ACRONYM(S)
AFZF-PW-ENV-NR

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
Copies are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

14. ABSTRACT

This report is a record of all maintenance proposed for the Fort Leonard Wood Rolling Heath School House (Bldg 10230). Each individual element section contains further details. The maintenance and management guidelines and procedures follow for site, masonry, metal, wood, roofing, doors and windows, and furnishings. Recommendations for maintenance and management of each particular element should be strictly followed, and work should be logged in the back of this manual (date, weather conditions, supervisor signature, contractor information, work performed, and problems).

15. SUBJECT TERMS
Ft. Leonard Wood, MO
maintenance and repair
facility management
building management

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Adam Smith
Unclassified	Unclassified	Unclassified	SAR	117	19b. TELEPHONE NUMBER (include area code) (217) 373-5897