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USMMA Historic District Property Maintenance and Repair Manual

Volume 1 – Overview

Sunny E. Adams and Adam D. Smith

June 2018

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Cover Photo (*counterclockwise from upper left*): Compilation of elements depicting concrete, brick, metal, stucco, and light fixtures as examples of some of the historic materials covered in the eight-volume series of maintenance manuals for the USMMA (ERDC-CERL, 2015).

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Volume 1 - Overview

Sunny E. Adams and Adam D. Smith

*Construction Engineering Research Laboratory
U.S. Army Engineer Research and Development Center
2902 Newmark Drive
Champaign, IL 61822*

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Abstract

The U.S. Merchant Marine Academy is located in Kings Point, New York. The Academy is listed on the National Register of Historic Places (#14000538). The historic district contains contributing mansions constructed during the Gold Coast Era and the Academy buildings constructed in 1942 to 1969. All buildings require regular planned maintenance and repair. The most notable cause of historic building element failure and/or decay is not because the historic building is old, but rather it is caused by an incorrect or inappropriate repair and/or basic neglect of the historic building fabric. This document is a maintenance manual compiled with as-is conditions of building materials at the Academy. The *Secretary of the Interior's Standards for the Treatment of Historic Properties on Preservation, Rehabilitation, and Repair* are discussed per material. This 8-volume report includes an overview volume plus volumes on each of the following elements: concrete, wood, brick, metal, roofing, stucco, and mechanical systems. All mentioned repair procedures are from the U.S. General Services Administration (GSA): Historic Preservation Technical Procedures and/or the National Park Service's series of Preservation Briefs. This report satisfies Section 110 of the National Historic Preservation Act (NHPA) of 1966, as amended.

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Preface

This study was conducted for the U.S. Department of Transportation Maritime Administration (MARAD) under Project Number 450153, “Historic Preservation Plan for U.S. Merchant Marine Academy.” The technical monitor was Barbara Voulgaris, Federal Preservation Officer, U.S. Department of Transportation, MARAD.

The work was performed by the Land and Heritage Conservation Branch (CNC) of the Installations Division (CN), U.S. Army Engineer Research and Development Center – Construction Engineering Research Laboratory (ERDC-CERL). At the time of publication, Dr. Michael Hargrave was Chief, CEERD-CNC; and Ms. Michelle Hanson was Chief, CEERD-CN. The Deputy Director of ERDC-CERL was Dr. Kirankumar Topudurti, and the Director was Dr. Lance D. Hansen.

COL Bryan S. Green was the Commander of ERDC, and Dr. David W. Pittman was the Director.

Foreword

ERDC-CERL's efforts to put together a guide to proper maintenance and repair of the historic elements at the U.S. Merchant Marine Academy (USMMA) have been divided into multiple volumes for ease of use by installation personnel.

This is Volume 1 of 8, and it provides an overview of the project and the USMMA's historic context, an explanation of the Secretary of the Interior's Standards and their application, and overviews and lists of immediate concerns for the USMMA's historic exteriors and interiors.

The following historic elements are covered in subsequently numbered volumes of this report: concrete (vol. 2), wood (vol. 3), brick (vol. 4), metal (vol. 5), roofing (vol. 6), stucco (vol. 7), and mechanical systems (vol. 8).

ADAM D. SMITH

Project Manager

Unit Conversion Factors

Multiply	By	To Obtain
acres	4,046.873	square meters
feet	0.3048	meters
inches	0.0254	meters
miles (U.S. statute)	1,609.347	meters
square feet	0.09290304	square meters
yards	0.9144	meters

Abbreviations

Term	Meaning
CRM	cultural resource manager
ERDC-CERL	Engineer Research and Development Center-Construction Engineering Research Laboratory
GSA	General Services Administration
MARAD	Maritime Administration
NHPA	National Historic Preservation Act
NPS	National Park Service
NRHP	National Register of Historic Places
NY	New York
SHPO	State Historic Preservation Office
USMMA	United States Merchant Marine Academy
USMMAHD	United States Merchant Marine Academy Historic District

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1 Methodology

1.1 Background

Congress codified the National Historic Preservation Act of 1966 (NHPA), the nation's most effective cultural resources legislation to date, to provide guidelines and requirements for preserving tangible elements of our past. This was done primarily through the creation of the National Register of Historic Places (NRHP) in 1966. Contained within the NHPA (Sections 106 and 110) are requirements for federal agencies to address their cultural resources, which are defined as any prehistoric or historic district, site, building, structure, or object. Section 110 requires federal agencies to inventory and evaluate their cultural resources. Section 106 requires determination of the effects of federal undertakings on properties deemed eligible or potentially eligible for the NRHP.

1.1.1 Federal guidelines

The Secretary of the Interior's Standards for the Treatment of Historic Properties (Grimmer 2017), puts forth a set of federal guidelines and provides various levels of treatments that can be applied to historic structures and landscapes, such as reconstruction, restoration, preservation, and rehabilitation. There are guidelines that address issues such as protecting, maintaining, and repairing features. These Standards and Guidelines will provide a strong basis for developing maintenance requirements.

1.1.2 Maintenance of historic materials

Historic structures are usually made of materials that are natural, hand-crafted and were not the product of a manufacturer. Many of these same materials (wood, stone, brick, metal, etc.) are used in construction today, however, they may be of a different quality, durability or process of manufacture and the procedures for maintenance and repair can be quite different. For example, 18th century hand-made brick is quite different than 20th or 21st century machine-made brick. Maintenance procedures, products, techniques and schedules that are developed or recommended by manufacturers of modern materials should not automatically be applied to similar materials on historic structures. A series of Preservation Briefs,

published by the U.S. National Park Service (NPS),¹ are one source of technical information about the treatment of historic materials. The briefs address many types of materials and applications, and contain information directly applicable to the development of correct maintenance procedures regarding historic properties. Another historic preservation resource can be found in the U.S. General Services Administration (GSA) Technical Guidelines.²

1.2 Objective

All buildings require regular planned maintenance and repair. The most notable cause of historic building element failure and/or decay is not because the historic building is old, but rather because of incorrect or inappropriate repair and/or basic neglect of the historic building fabric.

The process of developing a maintenance manual is quite different for historic structures than for modern structures. Most modern structures are a set of manufactured parts that are assembled mostly in the field with standard construction details that are well documented through as-built contract documents. Much of the maintenance information is readily available from product manufacturers and typically assembled by construction contractors. Historic structures will usually require research, testing, physical inspection, and specialized knowledge and skills to assemble and prepare customized information to meet a structure's preservation needs while maintaining its operating use (Loveland 2016).

This report satisfies Section 110 of the NHPA of 1966 as amended, and it will help the U.S. Merchant Marine Academy (USMMA) cultural resource manager (CRM) in managing these historic buildings by prioritizing appropriate maintenance and repair that will help to:

- reduce the cost of maintenance in the long run;
- increase the life of the building and its elements;
- use the building and its elements efficiently;

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¹ <https://www.nps.gov/tps/how-to-preserve/briefs.htm>

² GSA's illustrated *Technical Guidelines* profile innovative preservation design solutions developed for GSA historic projects. Guidelines can be downloaded from: <https://www.gsa.gov/real-estate/historic-preservation/historic-preservation-policy-tools/preservation-tools-resources/technical-guidelines>.

- increase safety and security; and
- comply with federal historic preservation regulations.

1.3 Approach

1.3.1 Project funding

Under an Interagency Agreement, the U.S. Department of Transportation, Maritime Administration (MARAD) retained the Land and Heritage Conservation Branch of the Engineer Research and Development Center-Construction Engineering Research Laboratory (ERDC-CERL).

1.3.2 Source material

The USMMA has performed five other architectural inventories and evaluations of buildings at the USMMA per Section 110 of the NHPA.

In 2005, the Louis Berger Group wrote a cultural resources survey report (Louis Berger 2005).

The second report was a character-defining features report for the USMMA written by ERDC-CERL (Smith et al. 2014a).

The third report expanded the boundaries of the Historic District in an NRHP nomination prepared by ERDC-CERL (Smith et al. 2014b). This work determined that the USMMA Historic District has two periods of significance: 1912–1941 (Gold Coast Era) and 1942–1969 (USMMA Design and Development). The 42-acre district consists of a contributing landscape and 38 contributing buildings, structures, and objects. The district is historically significant on a national level under National Register Criterion A as a reminder of the Golden Age period of the late nineteenth and early twentieth centuries. Criterion C is met through the design of the buildings that survive on the district's grounds (NPS 1997). The district was listed by the NRHP on 29 August 2014 as #14000538.

While the William Barstow Mansion is not a part of the USMMA Historic District (USMMAHD), the fourth report was prepared by ERDC-CERL for the former Barstow property that is on the USMMA grounds and now serves as the American Merchant Marine Museum. This report summarized the mansion property's nomination and listing to the NRHP (Smith

et al. 2014c). The William Barstow Mansion was listed on 29 August 2014 as NRHP #14000539.

In 2018, ERDC-CERL prepared a fifth report, which a landscape management plan to aid USMMA in preservation of its historic district. It identifies contributing landscapes and offers treatment recommendations for preservation and rehabilitation as needed (Tooker and Smith 1982).

1.3.3 Site visits

The researchers conducted two site visits to inventory and assess buildings and structures at the USMMA. The site visits occurred in May 2015 and April 2017.

In addition, some photos were drawn from a 2013 project's work.

1.4 Authors

The research team included Adam D. Smith, Master of Architecture, as project manager with 18 years of experience in military architectural history and Sunny E. Adams, Master of Architecture, as architectural historian with 14 years of experience.

1.5 U.S. Merchant Marine Academy Historic District – background

The USMMAHD (see Figure 1 for the district's location and boundary) encompasses a group of buildings of various property types (administrative, academic, residential, religious, and athletic/recreational) that form a defined space in which the individual elements are similar in materials, architectural details, and physical proportions, and that collectively, they exhibit a unity of exterior design that creates a cohesive visual environment. The Classical Revival-style buildings of the academy were designed with an emphasis on balance and symmetry. This cohesion and repetition of architectural elements was a conscious decision on the part of Alfred Hopkins & Associates, who designed the buildings and gave the space a campus-like feeling. The centerpiece of the district is Wiley Hall, the former Bendel-Chrysler mansion designed by architect Henry Otis Chapman, Sr., which was located on the property when the government purchased it in 1942 (building #1 on Figure 1). The clockwise completion of residence halls and academic buildings around Wiley Hall created a quadrangle that

became the heart of the new academy. The new buildings, all of which were completed between 1942 and 1943, were designed in a Classical Revival inspired vocabulary that echoed the Beaux Arts Classical Style of Wiley Hall, thus creating a unified architectural complex. The USMMA incorporated a series of preexisting Gold Coast-era mansions, houses, and support buildings to the south of the original Bendel/Chrysler estate. Their construction dates range from 1912 to the 1920s. A chapel, which was designed by Eggers & Higgins, was added on the USMMA's waterfront in 1961, and a library (also designed by Eggers & Higgins) was added to the center of campus in 1969.

Figure 1. Sketch map of USAMA Historic District, with numbered properties shown within bold outline of the district (USMMA DPW with modifications by ERDC-CERL).

1.6 U.S. Merchant Marine Academy Historic District – general information

LOCATION: The USMMA is located in Kings Point, New York. The Academy is listed on the National Register of Historic Places (#14000538). The historic district contains contributing mansions constructed during the Gold Coast Era and the Academy buildings constructed from 1942 to 1969. All buildings require regular planned maintenance and repair.

PRESENT OWNER: U.S. Department of Transportation, MARAD

ORIGINAL USE: Residential and education

PRESENT USE: Education

DATE OF CONSTRUCTION: 1942–1969

SIGNIFICANCE: As the former site of a mansion and estate belonging first to Henri W. Bendel and then to Walter P. and Della Chrysler, as well as the site of former estates belonging to other prominent wealthy Americans, the USMMAHD is nationally significant as a reminder of the “Golden Age” of the late nineteenth and early twentieth centuries. This was a period when financial, industrial, and entertainment leaders were nationally known and the recipients of vast amounts of wealth, either earned or inherited. In and around the New York City area, this affluent cohort sought the “country life” in Long Island for their second (or third, or fourth) homes. Like those of Newport, Rhode Island, these estates were often called “cottages” or given other diminutive terms that belied their often-palatial dimensions and decorations. The owners of these estates were at the pinnacle of the New York social scene, and their entertainments and other extravagances during the “Jazz Age” were fodder to the news outlets of the time, with magazines and newspapers recounting every party, event, real estate transaction, new construction, and civic institution with which these “celebrities” were involved. With a period of significance from 1915-1941, the USMMAHD retains its integrity and meets National Register Criteria A and C at a national level. Criterion A is met through the association of the remaining structures from this period with the history of the Long Island “Gold Coast” estates. Criterion C is met through the design of the estate buildings surviving on USMMAHD grounds.

The USMMAHD is also significant nationally as the nation's only federally-owned educational facility for the advanced training of merchant mariners, and is one of five federal service academies (others are: U.S. Military Academy, U.S. Naval Academy, U.S. Air Force Academy, and U.S. Coast Guard Academy). The merchant marine officers serve the U.S. merchant fleet, including commercial and military transport. The USMMA was established in 1942, with the acquisition of the Walter P. Chrysler estate at King's Point, New York, followed quickly by adding other estates and grounds.

The USMMAHD has a period of significance that extends from its beginning in 1942 through 1969, when the last remaining building in the central campus plan was constructed. USMMAHD retains its integrity and meets, at a national level, National Register Criteria A and C, and Criteria Consideration G. Criterion A is met through the association of the campus buildings with the historical trends of merchant marine training and the development of a professional merchant marine for the nation; Criterion A is also met for buildings associated with the development of Kings Point as a summer resort for Manhattanites in the early twentieth century. Criterion C is met through the design of the campus buildings, both those remaining from the previous estates and those constructed specifically for the USMMA. Criteria Consideration G is met through the inclusion of one building that is less than 50 years old as an integral part of the historic district.

NATIONAL REGISTER: Listed.

HABS/HAER: None.

DESCRIPTION: The architectural resources included in the USMMAHD were either reconstructed specifically for or were converted for use by USMMA during its initial establishment in 1942 and 1943.³ These buildings represent the academic, administrative, and residential support provided to cadet-midshipmen during their ashore training at USMMA. The USMMAHD, consisting of 49 contributing resources and 10 noncontributing resources, meets National Register Criterion C as an excellent example of a significant concentration of buildings that are linked historically and that are physically and spatially interrelated. The centerpiece of the district is Wiley Hall, which was a preexisting mansion on the property when the government purchased it. The clockwise completion of Fulton, Bowditch, Barry, Jones, Cleveland, Rogers, Delano, Murphy, and Palmer Halls around Wiley Hall created a quadrangle that became the heart of the new academy. The new buildings, all of which were completed between 1942 and 1944, were designed in a classically inspired vocabulary that echoed the Beaux Arts classicism of Wiley Hall, thus creating a unified architectural complex. With the exception of Wiley Hall, which is masonry and stucco, all buildings are of buff-colored concrete masonry units with cast stone (concrete) accents, and the buildings display a generally consistent cornice line, which adds to the visual cohesiveness of the area. The Classical Revival-style buildings are designed with an emphasis on balance and symmetry. The choice of architectural style likely was influenced by the architecture of the Bendel-Chrysler house. This cohesion and repetition of architectural elements was a conscious decision on the part of the architects who designed the buildings and give the space a campus-like feeling.

For all areas of significance claimed for USMMAHD under Criteria A and C, USMMAHD is significant at a national level. The USMMAHD contains all features that contribute to these areas of significance, and it conveys a sense of historic and architectural cohesiveness through its location, design, setting, materials, workmanship, feeling, and association. Refer to Figure 1 on page 5 for a map of the historical district.

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³ This paragraph is extracted from a previous report (The Louis Berger Group, Inc. 2005).

2 Secretary of the Interior's Standards and Guidelines⁴

The *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings*⁵ (Grimmer 2017 [update of Weeks and Grimmer 1995]) is the publication that establishes professional standards and provides guidance on the care of historic properties. The publication offers information for maintaining, repairing, and replacing historic materials, as well as information for designing new additions or making alterations. The Guidelines offer general design and technical recommendations to assist in applying the Standards to a specific property. The *Secretary's Standards and Guidelines* can be applied to historic properties of all types, materials, construction, sizes, and use. They apply to both the structure's exterior and interior, and extend to a property's landscape features, site, environment, and related new construction.

Federal agencies use *The Secretary's Standards and Guidelines* in carrying out their historic preservation responsibilities on properties that they own or manage. Together, the publication's Standards and Guidelines provide a framework and guidance for decision making about work or changes to a historic property.

The Standards offer four distinct approaches to the treatment of historic properties—preservation, rehabilitation, restoration, and reconstruction. The basic philosophy behind the treatments and their related standards is to do the least amount of harm to a historic property or building as possible. The four approaches create a hierarchy of treatment—from the least to the greatest intervention—each of which can be expressed by the following phrases:

- *Maintain rather than Repair*
- *Repair rather than Replace*
- *Preserve rather than Restore*
- *Restore rather than Reconstruct*

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⁴ <https://www.nps.gov/tps/standards.htm>

⁵ Title of this document henceforth shortened to *The Secretary's Standards and Guidelines*.

2.1 Preservation standards and guidelines⁶

Preservation is defined as the act or process of applying measures necessary to sustain the existing form, integrity, and materials of a historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction. New exterior additions are not within the scope of this treatment; however, the limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make the properties functional is appropriate within a preservation project.

2.1.1 Standards for preservation

1. A property will be used as it was historically, or be given a new use that maximizes the retention of distinctive materials, features, spaces, and spatial relationships. Where a treatment and use have not been identified, a property will be protected and, if necessary, stabilized until additional work may be undertaken.
2. The historic character of a property will be retained and preserved. The replacement of intact or repairable historic materials or alteration of features, spaces, and spatial relationships that characterize a property will be avoided.
3. Each property will be recognized as a physical record of its time, place, and use. Work needed to stabilize, consolidate, and conserve existing historic materials and features will be physically and visually compatible, identifiable upon close inspection, and properly documented for future research.
4. Changes to a property that have acquired historic significance in their own right will be retained and preserved.
5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property will be preserved.

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⁶ This text is excerpted from "Preservation as a Treatment," from the NPS Technical Preservation Services website: <https://www.nps.gov/tps/standards/four-treatments/treatment-preservation.htm>.

6. The existing condition of historic features will be evaluated to determine the appropriate level of intervention needed. Where the severity of deterioration requires repair or limited replacement of a distinctive feature, the new material will match the old in composition, design, color, and texture.
7. Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.
8. Archeological resources will be protected and preserved in place. If such a resource must be disturbed, mitigation measures will be undertaken.

2.1.2 Guidelines for preservation

2.1.2.1 Choosing preservation as a treatment

When choosing **preservation** as a treatment, the options for replacement are less extensive than, for example, in a rehabilitation treatment. This limitation occurs because it is assumed at the outset of a Preservation project that building materials and character-defining features are essentially intact (i.e., that more historic fabric has survived, unchanged over time, than has been lost). The expressed goal of the *Standards for Preservation and Guidelines for Preserving Historic Buildings* chapter (Grimmer 2017, 27–74) is retention of the building’s existing form, features, and detailing. This goal may be as simple as basic maintenance of existing materials and features, or it may involve preparing a historic structures report, undertaking laboratory testing and analyses of materials such as paint and mortar, and hiring conservators to perform sensitive work such as reconstituting interior finishes. Protection, maintenance, and repair are emphasized, while replacement is minimized.

2.1.2.2 Identify, retain, and preserve historic materials and features

The guidance for **preservation** treatment begins with recommendations to identify the form and detailing of those architectural materials and features that are important in defining the building’s historic character and which must be retained to preserve that character. Therefore, guidance on *identifying, retaining, and preserving* character-defining features is always given first. The character of a historic building may be defined by

form, and detailing of exterior materials, such as masonry, wood, and metal; exterior features, such as roofs, porches, and windows; interior materials, such as plaster and paint; and interior features, such as moldings and stairways, room configuration and spatial relationships, as well as structural and mechanical systems; and the building's site and setting.

2.1.2.3 Stabilize deteriorated historic materials and features as a preliminary measure.

Deteriorated portions of a historic building may need to be protected thorough preliminary stabilization measures until additional work can be undertaken. **Stabilizing** may include structural reinforcement, weatherization, or correcting unsafe conditions. Temporary stabilization should always be carried out in such a manner that it detracts as little as possible from the historic building's appearance. Although it may not be necessary in every preservation project, stabilization is nonetheless an integral part of preservation treatment; it is equally applicable, if circumstances warrant, for other treatments.

2.1.2.4 Protect and maintain historic materials and features

After identifying those materials and features that are important and must be retained in the process of **preservation** work, then the goals of *protecting and maintaining* them are addressed. Protection generally involves the least degree of intervention and is preparatory to other work. For example, protection includes the maintenance of historic materials through treatments such as rust removal, caulking, limited paint removal, and re-application of protective coatings; the cyclical cleaning of roof gutter systems; or installation of fencing, alarm systems, and other temporary protective measures. Although a historic building will usually require more extensive work, an overall evaluation of its physical condition should always begin at this level.

2.1.2.5 Repair (stabilize, consolidate, and conserve) historic materials and features

Next, when the physical condition of the character-defining materials and features requires additional work, **repairing** by *stabilizing, consolidating, and conserving* is recommended. Preservation strives to retain existing materials and features while employing as little new material as possible. Consequently, guidance for repairing a historic material, such as

masonry, again begins with the least degree of intervention possible such as strengthening fragile materials through consolidation, when appropriate, and repointing with mortar of an appropriate strength. Repairing masonry as well as wood and architectural metal features may also include patching, splicing, or otherwise reinforcing them using recognized preservation methods. Similarly, within the Preservation treatment, portions of a historic structural system could be reinforced using contemporary materials such as steel rods. All work should be physically and visually compatible, identifiable upon close inspection and documented for future research.

2.1.2.6 Limited replacement in-kind of extensively deteriorated portions of historic features

If repair by stabilization, consolidation, and conservation proves inadequate, the next level of intervention involves the **limited replacement in-kind** of extensively deteriorated or missing parts of features when there are surviving prototypes (for example, brackets, dentils, steps, plaster, or portions of slate or tile roofing). The replacement material needs to match the old both physically and visually, i.e., wood with wood, etc. Thus, with the exception of hidden structural reinforcement and new mechanical systems components, substitute materials are not appropriate in **preservation** treatment. Again, it is important that all new material be identified and properly documented for future research. If prominent features are missing, such as an interior staircase, exterior cornice, or a roof dormer, then a rehabilitation or restoration treatment may be more appropriate.

2.1.2.7 Energy efficiency/accessibility considerations and health and safety code considerations

These sections of the **preservation** guidance address work done to meet accessibility requirements and health and life-safety requirements. This work may be an important aspect of preservation projects, and it, too, must be assessed for its potential negative impact on the building's character. For this reason, particular care must be taken not to obscure, damage, or destroy character-defining materials or features in the process of undertaking work to meet code requirements.

2.1.2.8 Sustainability

Sustainability should be addressed as part of a Preservation project. Good preservation practice is often synonymous with sustainability. Existing energy-efficient features should be retained and repaired. New sustainability treatments should generally be limited to updating existing features and systems to have the least impact on the historic character of the building.

The topic of sustainability is addressed in detail in *The Secretary of the Interior's Standards for Rehabilitation & Illustrated Guidelines on Sustainability for Rehabilitating Historic Buildings* (Grimmer et al. 2011).

Although specifically developed for the treatment Rehabilitation, the illustrated Sustainability Guidelines can be used to help guide the other treatments.

2.1.3 Preservation as a treatment

When the property's distinctive materials, features, and spaces are essentially intact and thus convey the historic significance without extensive repair or replacement; when depiction at a particular time period is not appropriate; and when a continuing or new use does not require additions or extensive alterations, **preservation** may be considered as a treatment. Prior to undertaking work, a documentation plan for preservation should be developed.

This report's contents—investigating the maintenance issues, concerns, and needs of the USMMA historic buildings—has been determined to be a preservation maintenance project. By its definition, this includes cyclical maintenance planning. The information gathered from the building survey directs the prioritization process for preservation maintenance work tasks (recommended treatments).

Recommendations in this report address the actual condition of the historic buildings and present recommended treatments to maintain the structure for 5–10 years. Certain treatments will inherently have a service life that will exceed 5–10 years if maintained in good condition.

It is important to maintain a clear understanding of the treatment. The NPS guidance, Cultural Resource Management Guideline (NPS 1998) defines preservation maintenance as follows:

Action to mitigate wear and deterioration of a historic property without altering its historic character by protecting its condition, repairing when its condition warrants with the least degree of intervention including limited replacement in-kind, replacing an entire feature in-kind when the level of deterioration or damage of materials precludes repair, and stabilization to protect damaged materials and features from additional damage.

Types of preservation maintenance are as follows:

- Housekeeping is the removal of undesirable deposits of soil in ways that minimize harm to the surfaces treated, repeated at short intervals so that the gentlest and least radical methods can be used.
- Routine maintenance usually consists of service activities such as tightening, adjusting, oiling, or pruning, etc.
- Cyclic maintenance is maintenance performed less frequently than annually and it usually involves replacement or at least mending of material.
- Stabilization is action to render an unsafe, damaged, or deteriorated property as stable while retaining its present form.

2.2 Rehabilitation standards and guidelines⁷

Rehabilitation is “the process of returning a property to a state of utility, through repair or alteration, which makes possible an efficient contemporary use while preserving those portions and features of the property, which are significant to its historic, architectural, and cultural values.”

2.2.1 Standards for rehabilitation

The Secretary’s Standards for Rehabilitation are widely used to guide federal agencies in carrying out historic preservation responsibilities for properties under federal ownership or control. The standards are listed on the website as follows:

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⁷This text is excerpted from “Rehabilitation as a Treatment,” from the NPS Technical Preservation Services website: <https://www.nps.gov/tps/standards/rehabilitation/rehab/stand.htm>.

1. A property will be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships.
2. The historic character of a property will be retained and preserved. The removal of distinctive materials or alterations of features, spaces, and spatial relationships that characterize a property will be avoided.
3. Each property will be recognized as a physical record of time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other historic properties, will not be undertaken.
4. Changes to a property that have acquired historical significance in their own right will be retained and preserved.
5. Distinctive materials, features, finishes and construction techniques or examples of craftsmanship that characterize a property will be preserved.
6. Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture, and where possible, materials. Replacement of missing features will be substantiated by documentary and physical evidence.
7. Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.
8. Archeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken through consultation with the New York (NY) State Historic Preservation Office (SHPO).
9. New addition, exterior alteration, or related new construction will not destroy historic materials, features, and spatial relationships that characterize the property. The new work shall be differentiated

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

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

2.2.2 Guidelines for rehabilitation

2.2.2.1 Choosing rehabilitation as a treatment

In **Rehabilitation**, historic building materials and character-defining features are protected and maintained as they are in the treatment of Preservation; however, an assumption is made prior to work that existing historic fabric has become damaged or deteriorated over time and, as a result, more repair and replacement will be required. Thus, latitude is given in the guidance chapter, “*Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings*” (Grimmer 2017, 75–162) to replace extensively deteriorated, damaged, or missing features by using either traditional or substitute materials. Of the four treatments, only rehabilitation includes an opportunity to make possible an efficient contemporary use through alterations and additions.

2.2.2.2 Identify, retain, and preserve historic materials and features

Like preservation, guidance for rehabilitation treatment begins with recommendations to identify the form and detailing of those architectural materials and features that are important in defining the building’s historic character and that must be retained to preserve that character. Therefore, guidance on **identifying, retaining, and preserving** character-defining features is always given first. The character of a historic building may be defined by the form and detailing of exterior materials such as masonry, wood, and metal; exterior features such as roofs, porches, and windows; interior materials such as plaster and paint; and interior features, such as moldings and stairways, room configuration, and spatial relationships, as well as structural and mechanical systems.

2.2.2.3 Protect and maintain historic materials and features

After identifying those materials and features that are important and must be retained in the process of rehabilitation work, then **protecting and maintaining** them are addressed. Protection generally involves the least degree of intervention and is preparatory to other work. For example, protection includes the maintenance of historic material through treatments such as rust removal, caulking, limited paint removal, and re-application of protective coatings; the cyclical cleaning of roof gutter systems; or installation of fencing, alarm systems, and other temporary protective measures. Although a historic building will usually require more extensive work, an overall evaluation of its physical condition should always begin at this level.

2.2.2.4 Repair historic materials and features

Next, when the physical condition of character-defining materials and features warrants addition work **repairing** is recommended. Rehabilitation guidance for the repair of historic materials such as masonry, wood, and architectural metals again begins with the least degree of intervention possible such as patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading them according to recognized preservation methods. Repairing also includes the limited replacement in-kind—or with compatible substitute material—of extensively deteriorated or missing parts of features when there are surviving prototypes (for example, brackets, dentils, steps, plaster, or portions of slate or tile roofing). Although using the same kind of material is always the preferred option, substitute material is acceptable if the form and design as well as the substitute material itself conveys the visual appearance of the remaining parts of the feature and finish.

2.2.2.5 Replace deteriorated historic materials and features

Following repair in the hierarchy, rehabilitation guidance is provided for **replacing** an entire character-defining feature with new material because the level of deterioration or damage of materials precludes repair (for example, an exterior cornice; an interior staircase, or a complete porch or storefront). If the essential form and detailing are still evident so that the physical evidence can be used to reestablish the feature as an integral part of the rehabilitation, then its replacement is appropriate. Like the guidance for repair, the preferred option is always replacement of the entire

feature in-kind, that is, with the same material. Because this approach may not always be technically or economically feasible, provisions are made to consider the use of a compatible substitute material. It should be noted that, while the NPS guidelines recommend replacement of an entire character-defining feature that is extensively deteriorated, they never recommend the removal and replacement with new material for a feature that—although damaged or deteriorated—could reasonably be repaired and thus preserved.

2.2.2.6 Design for the replacement of missing historic features

When an entire interior or exterior feature is missing (for example, an entrance or cast iron façade; or a principal staircase), it no longer plays a role in physically defining the historic character of the building unless it can be accurately recovered in form and detailing through the process of carefully documenting the historical appearance. Although accepting the loss is one possibility, where an important architectural feature is missing, its **replacement** is always recommended in the rehabilitation guidelines as the first or preferred course of action. Thus, if adequate historical, pictorial, and physical documentation exists to accurately reproduce the feature and, if it is desirable to re-establish the feature as part of the building's historical appearance, then designing and constructing a new feature based on such information is appropriate. However, a second acceptable option for the replacement feature is a new design that is compatible with the remaining character-defining features of the historic building. The new design should always take into account the size, scale, and material of the historic building itself and, most importantly, should be clearly differentiated so that a false historical appearance is not created.

2.2.2.7 Alterations or additions for a new use

Some exterior and interior alterations to a historic building are generally needed to assure its continued use, but it is most important that such **alterations** do not radically change, obscure, or destroy character-defining spaces, materials, features, or finishes. Alterations may include providing additional parking space on an existing historic building site; cutting new entrances or windows on secondary elevations; inserting an additional floor; installing an entirely new mechanical system; or creating an atrium or light well. Alteration may also include the selective removal of buildings or other features of the environment or building site that are intrusive and therefore detract from the overall historic character. The construction of

an exterior addition to a historic building may seem to be essential for the new use, but the rehabilitation guidelines emphasize that such new additions should be avoided, if possible, and be considered only after it is determined those needs cannot be met by altering secondary (i.e., noncharacter-defining) interior spaces. If, after a thorough evaluation of interior solutions, an exterior addition is still judged to be the only viable alternative, then the addition should be designed and constructed to be clearly differentiated from the historic building so that the character-defining features are not radically changed, obscured, damaged, or destroyed. Additions and alterations to historic buildings are referenced within specific sections of the Standards for Rehabilitation Guidelines such as Site, Roofs, Structural Systems, etc., but are addressed in detail on the NPS website within the section “New Additions to Historic Buildings.”⁸

2.2.2.8 Energy efficiency/accessibility considerations and health and safety code considerations

These sections of the guidance address work done to meet accessibility requirements and health and safety **code requirements or to improve energy efficiency** with retrofitting measures. Although this type of work is quite often an important aspect of rehabilitation projects, it is usually not part of the overall process of protecting or repairing character-defining features; rather, such work is assessed for its potential negative impact on the building’s historic character. For this reason, particular care must be taken not to radically change, obscure, damage, or destroy character-defining materials or features in the process of meeting code and energy requirements.

2.2.3 Rehabilitation as a treatment

When repair and replacement of deteriorated features are necessary, when alterations or additions to the property are planned for a new or continued use, and when its depiction at a particular time is not appropriate, then **Rehabilitation** may be considered as a treatment (Grimmer 2017, 79). Prior to undertaking work, a documentation plan for rehabilitation should be developed.

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⁸ Online <https://www.nps.gov/tps/standards/applying-rehabilitation/successful-rehab/additions.htm>.

2.3 Restoration standards and guidelines⁹

Restoration is defined as the act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time by means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period. The limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a restoration project.

2.3.1 Standards for restoration

1. A property will be used as it was historically or be given a new use that interprets that property and its restoration period.
2. Materials and features from the restoration period will be retained and preserved. The removal of materials or alteration of features, spaces and spatial relationships that characterize the period will not be undertaken.
3. Each property will be recognized as a physical record of its time, place and use. Work needed to stabilize, consolidate and conserve materials and features from the restoration period will be physically and visually compatible, identifiable upon close inspection and properly documented for future research.
4. Materials, features, spaces, and finishes that characterize other historical periods will be documented prior to their alteration or removal.
5. Distinctive materials, features, finishes and construction techniques or examples of craftsmanship that characterize the restoration period will be preserved.
6. Deteriorated features from the restoration period will be repaired rather than replaced. Where the severity of deterioration requires

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⁹ This text is excerpted from "Restoration as a Treatment," from the NPS Technical Preservation Services website: <https://www.nps.gov/tps/standards/four-treatments/treatment-restoration.htm>.

replacement of a distinctive feature, the new feature will match the old in design, color, texture and, where possible, materials.

7. Replacement of missing features from the restoration period will be substantiated by documentary and physical evidence. A false sense of history will not be created by adding conjectural features, features from other properties, or by combining features that never existed together historically.
8. Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.
9. Archeological resources affected by a project will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.
10. Designs that were never executed historically will not be constructed.

2.3.2 Guidelines for restoration

2.3.2.1 Choosing restoration as a treatment

Restoration is the treatment that should be followed when the expressed goal of the project is to make the building appear as it did at a particular—and most significant—time in its history. The guidance provided in the “Restoration” chapter of *Standards for Restoration and Guidelines for Restoring Historic Buildings* (Grimmer 2017, 163–224) says to first *identify* the materials and features from the restoration period. After these materials and features have been identified, they should be maintained, protected, repaired, and replaced, when necessary. Unlike other treatments in which most (if not all) the historic elements are retained, restoration will likely include the removal of features from other periods. Missing features from the restoration period should be *replaced*, based on physical or historic documentation, with either the same or compatible substitute materials. Only those designs that can be documented as having been built should be re-created in a restoration project.

2.3.2.2 Identify, retain, and preserve materials and features from the restoration period

The guidance for a **restoration** treatment begins with recommendations to identify the form and detailing of those architectural materials and features that are significant to the restoration period as established by historical research and documentation. Therefore, guidance on *identifying, retaining, and preserving* features from the restoration period is always given first.

2.3.2.3 Protect and maintain materials and features from the restoration period

After identifying those materials and features from the restoration period that must be retained in the process of **Restoration** work, then *protecting and maintaining* them are addressed. Protection generally involves the least degree of intervention and is preparatory to other work. Protection includes the maintenance of materials and features from the restoration period as well as ensuring that the property is protected before and during restoration work. An overall evaluation of the physical condition of the features from the *restoration period* should always begin at this level.

2.3.2.4 Repair (stabilize, consolidate, and conserve) materials and features from the restoration period

Next, when the physical condition of restoration-period features requires additional work, then repair by *stabilizing, consolidating, and conserving* is recommended. Restoration guidance focuses on the preservation of those materials and features that are significant to the period. In Restoration, repair may include the limited replacement in-kind or with a compatible substitute material of extensively deteriorated or missing components of existing restoration-period features when there are surviving prototypes to use as a model.

2.3.2.5 Replace extensively deteriorated features from the restoration period

In **Restoration**, *replacing* an entire feature from the restoration period that is too deteriorated to repair, such as a porch, may be appropriate. Together with documentary evidence, the form and detailing of the historic feature should be used as a model for the replacement. Using the same kind of material is preferred; however, compatible substitute material may

be considered. New work may have an unobtrusive date added to it to guide future research and treatment.

2.3.2.6 Remove existing features from other historic periods

Most buildings change over time, but the goal in **Restoration** is to depict the building as it appeared at its most significant time in history. Thus, it may involve *removing* or altering existing historic features that do not represent the restoration period. Prior to their alteration or removal, the materials, features, spaces, and finishes that characterize other historical periods should be documented to guide future research and treatment.

2.3.2.7 Re-create missing features from the restoration period

Most **Restoration** projects involve *re-creating* features that were significant to the building during the *restoration period*, such as a porch, but which are now missing. Missing features to be replaced should be substantiated by documentary and physical evidence to ensure the restoration is accurate. Using the same materials to depict lost features is always the preferred approach; however, using compatible substitute material is an acceptable alternative in Restoration because the goal of this treatment is to replicate the *appearance* of the historic building at a particular time.

If documentary and physical evidence are not available to provide an accurate recreation of missing features, then Rehabilitation treatment might be a better overall approach to project work.

2.3.2.8 Code-required work for accessibility and life safety

Sensitive solutions to meeting code requirements in a restoration project are an important part of protecting the building's historic character. Work necessary to meet accessibility and life-safety requirements must be assessed for its potential impact on the historic building as it is restored.

2.3.2.9 Resilience to natural hazards

Resilience to natural hazards should be addressed as part of a restoration project. A historic building may have existing characteristics or features that help to address or minimize the impacts of natural hazards. The se should always be used to best advantage when planning new adaptive treatments that have the least impact on the historic character of the building, its site, and setting.

2.3.2.10 Sustainability

Sustainability should be addressed as part of a **Restoration** project. Good preservation practice is often synonymous with sustainability. Existing energy-efficient features should be retained and repaired. New sustainability treatments should generally be limited to updating existing features and systems to have the least impact on the historic character of the building.

The topic of sustainability is addressed in detail in Grimmer et al. (2011). Although specifically developed for rehabilitation treatment, these Standards and Guidelines can be used to help direct other treatments.

2.3.3 Restoration as a treatment

When the property's design, architectural, or historical significance during a particular time period outweighs the potential loss of extant materials, features, spaces, and finishes that characterize other historical periods, when there is substantial physical and documentary evidence for the work; and when contemporary alterations and additions are not planned, **Restoration** may be considered as a treatment. Prior to undertaking work, a particular time period (i.e., the restoration period) should be selected and justified, and a documentation plan for Restoration should be developed.

2.4 Reconstruction standards and guidelines¹⁰

Reconstruction is defined as the act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object to replicate its appearance at a specific period of time and in its historic location. Reconstruction is different from the other treatments in that it is undertaken where there are no visible historic materials extant or only a foundation remains. The Reconstruction chapter of *Standards for Reconstruction and Guidelines for Reconstructing Historic Buildings* (Grimmer 2017, 225-239) should be followed when it is necessary to re-create a nonsurviving building by using new material. Reconstructing a historic building should only be considered when there is accurate documentation on which to base the reconstruction.

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¹⁰ This text is excerpted from "Reconstruction as a Treatment," from the NPS Technical Preservation Services website: <https://www.nps.gov/tps/standards/four-treatments/treatment-reconstruction.htm>.

2.4.1 Standards for reconstruction

There are six standard for reconstruction, which are listed on the NPS webpage¹¹ as follows:

1. Reconstruction will be used to depict vanished or non-surviving portions of a property when documentary and physical evidence is available to permit accurate reconstruction with minimal conjecture and such reconstruction is essential to the public understanding of the property.
2. Reconstruction of a landscape, building, structure, or object in its historic location will be preceded by a thorough archeological investigation to identify and evaluate those features and artifacts which are essential to an accurate reconstruction. If such resources must be disturbed, mitigation measures will be undertaken.
3. Reconstruction will include measures to preserve any remaining historic materials, features, and spatial relationships.
4. Reconstruction will be based on the accurate duplication of historic features and elements substantiated by documentary or physical evidence rather than on conjectural designs or the availability of different features from other historic properties. A reconstructed property will re-create the appearance of the non-surviving historic property in materials, design, color, and texture.
5. A reconstruction will be clearly identified as a contemporary re-creation.
6. Designs that were never executed historically will not be constructed.

2.4.2 Guidelines for reconstructing historic buildings

Reconstruction is different from the other treatments in that it is undertaken when there are often no visible historic materials extant or only a

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¹¹ This text is excerpted from "Restoration as a Treatment," from the NPS Technical Preservation Services website: <https://www.nps.gov/tps/standards/four-treatments/treatment-reconstruction.htm>.

foundation remains. Whereas Restoration treatment (NPS) provides guidance on restoring historic building features, the section of *Standards for Reconstruction and Guidelines for Reconstructing Historic Buildings* referring to Reconstruction (Grimmer 2017, 225-239) should be followed when it is necessary to recreate a non-surviving building using new material. But, like restoration, reconstruction also involves recreating a historic building which appears as it did at a particular—and at its most significant—time in its history. Because of the potential for historical error in the absence of sound physical evidence, this treatment can be justified only rarely and, thus, is the least frequently undertaken of the four treatments. Reconstructing a historic building should only be considered when there is accurate documentation on which to base it. When only the appearance of the exterior of the building can be documented, it may be appropriate to reconstruct the exterior while designing a very simple, plain interior that does not attempt to appear historic or historically accurate. Signage and interpretative aids should make it clear to visitors that only the exterior of the building is a true reconstruction. Extant historic surface and subsurface materials should also be preserved. Finally, the reconstructed building must be clearly identified as a contemporary re-creation.

2.4.2.1 Research and document historical significance

The guidance for the treatment **Reconstruction** begins with **researching and documenting** the building's historical significance to determine whether its recreation is essential to the public understanding of the property. In some instances, reconstruction may not be necessary if there is historic building still existing on the site or in a setting that can explain the history of the property. Justifying a reconstruction requires detailed physical and documentary evidence to minimize or eliminate conjecture and to ensure that the reconstruction is as accurate as possible. Only one period of significance is generally identified; a building—as it evolved—is rarely recreated. If research does not provide adequate documentation for an accurate reconstruction, other interpretive methods should be considered, such as an explanatory marker.

2.4.2.2 Investigate archeological resources

Investigating archeological resources is the next area of guidance in the treatment **Reconstruction**. The purpose of archeological research is to identify any remaining features of the building, site, and setting that are

essential to an accurate recreation and must be reconstructed. Archeological resources that are not essential to the reconstruction should be left in place. The archeological findings, together with archival documentation, should be used to replicate the design, materials, and plan of the historic building.

2.4.2.3 Identify, protect, and preserve extant historic features

Closely aligned with archeological research, recommendations are given for **identifying, protecting, and preserving** extant features of the historic building. It is never appropriate to base a **Reconstruction** upon conjectural designs or on features from other buildings. Any remaining historic materials and features should be retained and incorporated into the reconstruction when feasible. Both the historic and new materials should be documented to assist in interpretation.

2.4.2.4 Reconstruction of non-surviving building and site

After the research and documentation phases, guidance is given for **Reconstruction** work itself. Exterior and interior features are addressed in general, always emphasizing the need for accurate depiction (i.e., careful duplication of the appearance of historic materials and features for interpretative purposes). While the use of traditional materials and finishes is always preferred, in some instances substitute materials may be used if they are able to convey the same appearance. Where non-visible features of the building are concerned, such as interior structural systems, contemporary materials and technology may be used. Recreating the features of the building site or setting based on archeological findings should also be an integral part of project work.

2.4.2.5 Accessibility and life safety, natural hazards, and sustainability

Whereas preservation, rehabilitation, and restoration treatments usually necessitate retrofitting to meet code requirements and to address other issues (including natural hazards and sustainability), in this treatment it is assumed that the **Reconstructed** building will be essentially new construction. Thus, code-required work treatments to reduce the potential impact of natural hazards, and ensuring that the reconstructed building is as sustainable as possible should be considered during the design phase—when appropriate to the particular Reconstruction project—so as not to negatively impact or detract from the reconstructed appearance of the

building, its site, and setting. The fact that the non-surviving building was located in a floodplain or another area especially vulnerable to the impact of natural hazards is crucial to consider when determining whether the building should be reconstructed.

The topic of sustainability is addressed in detail in *The Secretary of the Interior's Standards for Rehabilitation & illustrated Guidelines on Sustainability for Rehabilitating Historic Buildings*. Although specifically developed for the treatment Rehabilitation, the Guidelines can be used to help guide other treatments.

2.4.3 Reconstruction as a treatment

When a contemporary depiction is required to understand and interpret a property's historic value (including the re-creation of missing components in a historic district or site); when no other property with the same associative value has survived; and when sufficient historical documentation exists to ensure an accurate reproduction, **Reconstruction** may be considered as a treatment. Prior to undertaking work, a documentation plan for Reconstruction should be developed.

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3 Exterior – Overview and Immediate Concerns

The primary purpose of a property's exterior envelope is to provide protection from the weather and other environmental elements; however for historic preservation purposes, those same envelopes typically are what convey the design and age of a building, so they are essential components of the building's character-defining features.

All building materials deteriorate with age and exposure to the weather. Through routine inspection and cyclical maintenance, the useful life span of a building and its historic fabric will be greatly increased. Preventive maintenance involves regular inspection of those parts of the building that are most likely to develop problems. Having a checklist for each USMMA building is advised to help the USMMA CRM and maintenance department identify and keep an accurate record or inventory of the building's problems, to facilitate systematic repair and maintenance. Begin early in project planning to ensure that design scopes, qualifications, and budgets address preservation compliance requirements.

Repair, renovation, and replacement of character-defining features to the contributing features to the USMMA historic district **MUST** be coordinated with the NY SHPO. If a character-defining feature has been previously removed or replaced on the contributing building, prior to this report, and as future renovations occur, these need to be replaced with elements that replicate the original character-defining features of that building. Historic photographs found in *Character-Defining Features of Contributing Buildings and Structures in the United States Merchant Marine Academy Historic District* report (Smith, Enscoe, and Tooker 2014a) will help guide this process, in coordination with the NY SHPO.

Routine maintenance of properties will increase the performance and life span of materials. If maintained, original or historic materials are not likely to require future replacement, which makes sense in both an economic and environmental sense.

NOTE: Maintenance manuals such as those produced as part of this report are a general guide for the historic materials used throughout the USMMA. Do not assume that because a particular building or a particular material on a building is not mentioned in these manuals that the material in need of maintenance or repair does not need to follow the Standards.

3.1 Immediate concerns for exterior features

Common causes of deterioration in historic structures can include: insufficient exterior maintenance; water infiltration; vegetation, animal, bird, or insect infestations; pollution; freeze/thaw period; or foundational/structural issues.

3.1.1 Concrete elements (see Vol. 2)

Deterioration of concrete can be caused by environmental factors, inferior materials, poor workmanship, inherent structural design defects, and inadequate maintenance.

The following points should be noted in the management and preservation of historic concrete elements:

- Environmental factors are a principal source of concrete deterioration. Concrete absorbs moisture readily, and this fact is particularly troublesome in regions of recurrent freeze-thaw cycles. Freezing water produces expansive pressure in the cement paste or in nondurable aggregates.
- The most common cause of deterioration of concrete is improper repair of cracks that then allow water infiltration into the structure of the concrete.
- Improper maintenance of historic buildings can cause long-term deterioration of concrete. Water is a principal source of damage to historic concrete, and prolonged exposure to it can cause serious problems.
- Potential sources of building damage can come from unrepaired roof or plumbing leaks; leaks through exterior cladding; broken or damaged

gutters; damaged, misaligned, or missing downspouts; and unchecked absorption of water from damp earth.

3.1.2 Wood elements (see Vol. 3)

The following points should be noted in the management and preservation of historic wood elements:

- The deterioration of wood is particularly affected by environmental influences such as moisture, humidity, sunlight, wind, insects, vegetation, mold, and lack of maintenance through painting, staining, and crack repair.
- A regular program of repair and maintenance on the wood elements can slow the rate of wood deterioration dramatically. When damage has already occurred, the use of proper rehabilitation techniques can help restore the wood element's integrity and historic character.

3.1.3 Brick elements (see Vol. 4)

The following points should be noted in the management and preservation of historic brick elements:

- The three most common source causes of for deterioration of historic brick masonry are (1) prolonged exposure to water, usually due to improper roof drainage; (2) spalling, due to the use of excessively hard repointing mortars; and (3) exposure to moisture and salts at grade.
- Signs of deterioration include: (a) rust staining from concealed fasteners, (b) white surface staining or build-up due to the mitigation of salts, (c) cracking and spalling of brick due to water or excessively hard mortar installed during previous repointing efforts, (d) pitting of the softer rubbed bricks, and (e) crazing of the glazed brick headers.
- Overall care should be taken to protect the original brick and mortar. Where brick masonry is extremely deteriorated, replacement in-kind must occur. Care must be used to select sound and matching bricks for all repairs. Specialty brick is available from a variety of sources, and efforts to identify matching brick units should be required.

3.1.4 Metal elements (see Vol. 5)

The use of metal features can be an important character-defining feature. If properly maintained, metal features can last for centuries; however, improper maintenance and repair can quickly result in deterioration.

The following points should be noted in the management and preservation of historic metal elements:

- Iron oxidizes (rusts) quickly when exposed to air and moisture. When pollutants are present (as in many urban environments), the amount of moisture in the air required to begin oxidation is lowered, which means that proper care of ironwork is critical in urban environments.
- Where deterioration has already occurred, proper rehabilitation techniques can be used to restore the historic character of the metal.
- Use the gentlest means possible when cleaning metal features to avoid damaging the historic finish.

3.1.5 Roofing elements (see Vol. 6)

Historic roofing materials are distinguishing elements of a building, defining overall style, and reflecting the age and design of the property. As with all historic materials, emphasis should be on retention and repair. However, at USMMA, the majority of the roofs that need the most repair and maintenance attention are the hidden, built-up roofs on the 1940s concrete block buildings. It is of the utmost importance that these roofs be fixed in such a way that water does not infiltrate into the parapet walls and concrete block structure.

The following points should be noted in the management and preservation of historic roofing elements:

- Water penetration, improper installation of gutters and downspouts, and water splashing onto walls from surrounding hard surfaces are causing much of the other historic material failures of these buildings.
- Roofing types on the USMMA historic buildings include clay tile, slate tiles, asphalt shingles, metal, and built-up asphalt roofs. Each element has its own immediate concerns.

- The best course of action for maintaining a roof is periodic inspection and repair.
- Gutter and flashing failure plus lack of proper maintenance is often the culprit in a leaky roof. USMMA maintenance personnel should carefully examine gutters, leaders, valleys, and flashing before determining that wholesale roof replacement is necessary. Any repairs at these areas should be made using materials and techniques to last for the long term and not as a short-term “fix.”

3.1.6 Stucco elements (see Vol. 7)

The following points should be noted in the management and preservation of historic stucco elements:

- Stucco applied to an exterior wall is intended to function as a water-tight surface. Unless maintained, rainwater will penetrate open joints and cracks that may appear over time.
- Stucco is particularly susceptible to water damage, which in turn will cause the stucco to lose its bond and pull away from its substrate.

3.1.7 Mechanical systems elements (see Vol. 8)

The following points should be noted in the management and preservation of historic mechanical systems:

- The unique details of historic exterior lighting embodied in historical architectural features contribute to the overall character of a building.
  - Preserve historic light fixtures in place and maintain them through regular cleaning and repair as needed.
  - Consider rewiring historic fixtures as necessary to extend their life span versus replacing the historic fixture.
- There are several individual air conditioners that are set within windows and through exterior walls of the USMMA historic buildings. This arrangement can be visually as well as physically damaging to the

building. Problems that arise from the units' placement are water infiltration, staining on the historic exterior material, and deterioration of window elements such as sills and sashes.

3.1.8 Landscape vegetation

The landscape of the USMMA is contributing to the historic district (see Tooker and Smith 2018). However, landscape vegetation and its watering needs can be a significant threat to historic building materials.

The following points should be noted in the management and preservation of historic landscape vegetation:

- There should always be spacing of at least one foot between vegetation and building materials to allow proper airflow; this spacing applies to groundcovers, shrubs, and tree branches (Figure 2–Figure 8).
- Unless called out as historic in the USMMA landscape manual (Tooker and Smith 2018), vines and creepers should not be allowed to attach and grow on the buildings (Figure 3–Figure 4 and Figure 6–Figure 8).
- Ensure that water does not hit the historic materials on buildings during irrigation of the landscape.
- Landscape personnel should be instructed to keep lawnmowers and string trimmers at a safe distance from historic materials.

Figure 2. Shrubs are growing too close to the historic concrete block walls at Jones Hall (ERDC-CERL, 2015).

Figure 3. Shrubs that are too close to historic concrete block walls at O'Hara Hall, and Virginia creeper that is growing up the wall needs to be removed (ERDC-CERL, 2015).

Figure 4. Weed trees and English ivy need to be removed from the side of O'Hara Hall (ERDC-CERL, 2015).

Figure 5. Shrubs that are too close to the historic concrete block walls at Barry Hall (ERDC-CERL, 2015).

Figure 6. Ground vegetation growing too close to the base of the historic concrete walls at Delano Hall (ERDC-CERL, 2015).

Figure 7. Vegetation growing too close to the historic stucco walls at Land Hall (ERDC-CERL, 2015).

Figure 8. Shrubs that are growing too close to the historic stucco walls at Melville Hall (ERDC-CERL, 2015).

3.2 Guidelines, briefs, bulletins, and resources for general aspects of historic building exteriors

In addition to the information contained in this manual, the authors have compiled the following federal resource publications (reproduced here for convenience, with links for online access given in References) to inform managers about standards, guidelines, and procedures for understanding architecture and caring for, preserving, and rehabilitating historic buildings with emphasis on historic exterior elements (see subsections 3.2.1–3.2.5).

3.2.1 Maintaining the exterior (Park 2007 – Preservation Brief #47)

Technical Preservation Services

National Park Service
U.S. Department of the Interior

[Home](#) > [How to Preserve](#) > [Preservation Briefs](#) > 47 Maintaining the Exterior

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

PRESERVATION BRIEFS

47

Maintaining the Exterior of Small and Medium Size Historic Buildings

Sharon C. Park, FAIA

[Getting Started](#)

[Maintenance, Schedules and Inspection](#)

[Building Components](#)

[Exterior Walls](#)

[Openings](#)

[Projections](#)

[Foundations and Perimeter Grades](#)

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Preservation is defined as “the act or process of applying measures necessary to sustain the existing form, integrity, and materials of an historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction.”

Maintenance helps preserve the integrity of historic structures. If existing materials are regularly maintained and deterioration is significantly reduced or prevented, the integrity of materials and workmanship of the building is protected. Proper maintenance is the most cost effective method of extending the life of a building. As soon as a building is constructed, restored, or rehabilitated, physical care is needed to slow the natural process of deterioration. An older building has already experienced years of normal weathering and may have suffered from neglect or inappropriate work as well.

Decay is inevitable but deterioration can accelerate when the building envelope is not maintained on a regular basis. Surfaces and parts that were seamlessly joined when the building was constructed may gradually become loose or disconnected; materials that were once sound begin to show signs of weathering. If maintenance is deferred, a typical response is to rush in to fix what has been ignored, creating additional problems. Work done on a crisis level can favor inappropriate treatments that alter or damage historic material.

There are rewards for undertaking certain repetitive tasks consistently according to a set schedule. Routine and preventive care of building materials is the most effective way of slowing the natural process of deterioration. The survival of historic buildings in good condition is primarily due to regular upkeep and the preservation of historic materials.

Well-maintained properties tend to suffer less damage from storms, high winds, and even small earthquakes. Keeping the roof sound, armatures and attachments such as shutters tightened and secured, and having joints and connections functioning well, strengthens the ability of older buildings to withstand natural occurrences.

Over time, the cost of maintenance is substantially less than the replacement of deteriorated historic features and involves considerably less disruption. Stopping decay before it is widespread helps keep the scale and complexity of work manageable for the owner.

This Preservation Brief is designed for those responsible for the care of small and medium size historic buildings, including owners, property administrators, in-house maintenance staff, volunteers, architects, and maintenance contractors. The Brief discusses the benefits of regular inspections, monitoring, and seasonal maintenance work; provides general guidance on maintenance treatments for historic building exteriors; and emphasizes the importance of keeping a written record of completed work.

Getting Started

Understanding how building materials and construction details function will help avoid treatments that are made in an attempt to simplify maintenance but which may also result in long-term damage. It is enticing to read about “maintenance free” products and systems, particularly waterproof sealers, rubberized paints, and synthetic siding, but there is no such thing as maintenance free when it comes to caring for historic buildings. Some approaches that initially seem to reduce maintenance requirements may over time actually accelerate deterioration.

Exterior building components, such as roofs, walls, openings, projections, and foundations, were often constructed with a variety of functional features, such as overhangs, trim pieces, drip edges, ventilated cavities, and painted surfaces, to protect against water infiltration, ultraviolet deterioration, air infiltration, and pest infestation. Construction assemblies and joints between materials allow for expansion and contraction and the diffusion of moisture vapor, while keeping water from penetrating the building envelope. Older buildings use such features effectively and care must be taken to retain them, avoiding the temptation to reduce air infiltration or otherwise alter them.

Monitoring, inspections, and maintenance should all be undertaken with safety in mind. Besides normal safety procedures, it is important to be cognizant of health issues more commonly encountered with older buildings, such as lead-based paint, asbestos, and bird droppings, and to know when it is necessary to seek professional services (see sidebar).

Original building features and examples of special craftsmanship should be afforded extra care. The patina or aging of historic materials is often part of the charm and character of historic buildings. In such cases, maintenance should avoid attempts to make finishes look new by over-cleaning or cladding existing materials. As with any product that has the potential to harm historic materials, the selection of a cleaning procedure should always involve testing in a discreet location on the building to ensure that it will not abrade, fade, streak, or otherwise damage the substrate (Figure 1).

Figure 1. Maintenance involves selecting the proper treatment and protecting adjacent surfaces. Using painter's tape to mask around a brass doorknocker protects the painted door surface from damage when polishing with chemical compounds. On the other hand, hardware with a patinated finish was not intended to be polished and should simply be cleaned with a damp cloth.

Cautions During Maintenance Work

All maintenance work requires attention to safety of the workers and protection of the historic structure. Examples include the following:

- Care should be taken when working with historic materials containing lead-based paint. For example, damp methods may be used for sanding and removal to minimize air-borne particles. Special protection is required for workers and appropriate safety measures should be followed.
- Materials encountered during maintenance work, such as droppings from pigeons and mice, can cause serious illnesses. Appropriate safety precautions need to be followed. Services of a licensed contractor should be obtained to remove large deposits from attics and crawlspaces.
- Heat removal of paint involves several potential safety concerns. First, heating of lead-containing paint requires special safety precautions for workers. Second, even at low temperature levels, heat removal of paint runs the risk of igniting debris in walls. Heat should be used only with great caution with sufficient coverage by smoke detectors in work areas. Work periods need to be timed to allow monitoring after completion of paint removal each day, since debris will most often smolder for a length of time before breaking out into open flame. The use of torches, open flames, or high heat should be avoided.
- Many chemical products are hazardous and volatile organic compounds (VOC) are banned in many areas. If allowed, appropriate respirators and other safety precautions are essential for use.
- Personal protection is important and may require the use of goggles, gloves, mask, closed-toed shoes, and a hard hat.
- Electrical service should be turned off before inspecting a basement after a flood or heavy rain, where there is high standing water.

Cyclical Maintenance Checklist (Figure 2)

Cyclic Building Inspection Checklist: Horse Stable			Inspection date: 04/24/05	
Building Feature	Material(s)	Condition Description	Maintenance Action Required	Work Done
ROOF:				
Covering	Clay tile	Two slipped tiles	Reattach tiles	5/4/05
	Painted metal standing seam	Slight corrosion; blistering paint on metal roof section	Sand and repaint area that is peeling	6/8/05
Flashing	Painted metal	Flashing in good condition	N/A	N/A
Gutters/Downspouts	6" half round galvanized metal	Gutter sagging; downspouts OK	Realign gutter and put on new hanger strap	5/4/05
			Flush out downspouts	5/5/05
Chimneys	No masonry chimney	N/A	N/A	N/A
Attachments/Penetrations	Metal vent stack and weathervane	Vent stack hood has some peeling paint; vane OK	Sand and repaint vent stack	6/8/05

Figure 2. All personnel associated with a historic structure need to become acquainted with how existing building features should appear and during their daily or weekly routines look for changes that may occur. This will help augment the regular maintenance inspection that will occur at specified intervals based on seasonal changes, use, and other factors. A segment of an inspection form showing the roof elements of a horse stable is shown. The inspection report should be kept along with the maintenance plan and other material in notebook, file or electronic form

Maintenance Plan, Schedules and Inspection

Organizing related work into a written set of procedures, or a Maintenance Plan, helps eliminate duplication, makes it easier to coordinate work effort, and creates a system for prioritizing maintenance tasks that takes into account the most vulnerable and character-defining elements.

The first time a property owner or manager establishes a maintenance plan or program, it is advisable to have help from a preservation architect, preservation consultant, and/or experienced contractor. Written procedures should outline step-by-

step approaches that are custom-tailored to a building. No matter how small the property, every historic site should have a written guide for maintenance that can be as simple as:

1. Schedules and checklists for inspections;
2. Forms for recording work, blank base plans and elevations to be filled in during inspections and upon completion of work;
3. A set of base-line photographs to be augmented over time;
4. Current lists of contractors for help with complex issues or in case of emergencies;
5. Written procedures for the appropriate care of specific materials, including housekeeping, routine care, and preventive measures;
6. Record-keeping sections for work completed, costs, warranty cards, sample paint colors, and other pertinent material.

This information can be kept in one or more formats, such as a three-ring binder, file folders, or a computer database. It is important to keep the files current with completed work forms to facilitate long-term evaluations and planning for future work (Figure 2).

Proper maintenance depends on an organized plan with work prescribed in manageable components. Regular maintenance needs to be considered a priority both in terms of time allotted for inspections and for allocation of funding.

Maintenance work scheduling is generally based on a variety of factors, including the seriousness of the problem, type of work involved, seasonal appropriateness, product manufacturer's recommendations, and staff availability. There are other variables as well. For example, building materials and finishes on southern and western exposures will often weather faster than those on northern or eastern exposures. Horizontal surfaces facing skyward usually require greater maintenance than vertical ones; in regions with moderate or heavy rainfall, wood and other materials in prolonged shadow are subject to more rapid decay.

Maintenance costs can be controlled, in part, through careful planning, identification of the amount of labor required, and thoughtful scheduling of work. Maintenance schedules should take into account daily and seasonal activities of the property in order to maximize the uninterrupted time necessary to complete the work. Institutions generally need to budget annually between 2 and 4 percent of the replacement value of the building to underwrite the expense of full building maintenance.³ Use of trained volunteers to undertake maintenance can help reduce costs.

Exterior inspections usually proceed from the roof down to the foundation, working on one elevation at a time, moving around the building in a consistent direction. On the interior, the attic, inside surfaces of exterior walls, and crawlspaces or basements should be examined for signs of potential or existing problems with the building envelope.

The following chart lists suggested inspection frequencies for major features associated with the building's exterior, based on a temperate four-season climate and moderate levels of annual rainfall. For areas of different climate conditions and rainfall, such as in the more arid southwest, the nature of building decay and frequency of inspections will vary. For buildings with certain inherent conditions, heavy use patterns, or locations with more extreme weather conditions, the frequency of inspections should be altered accordingly.

Note: All building features should be inspected after any significant weather event such as a severe rainstorm or unusually high winds.

Survey observations can be recorded on a standardized report form and photographs taken as a visual record. All deficient conditions should be recorded and placed on a written schedule to be corrected or monitored.

INSPECTION FREQUENCY CHART

Feature	Minimum Inspection Frequency	Season
Roof	Annually	Spring or fall; every 5 years by roofer
Chimneys	Annually	Fall, prior to heating season; every 5 years by mason
Roof Drainage	6 months; more frequently as needed	Before and after wet season, during heavy rain
Exterior Walls and Porches	Annually	Spring, prior to summer/fall painting season

Windows	Annually	Spring, prior to summer/fall painting season
Foundation and Grade	Annually	Spring or during wet season
Building Perimeter	Annually	Winter, after leaves have dropped off trees
Entryways	Annually; heavily used entries may merit greater frequency	Spring, prior to summer/fall painting season
Doors	6 months; heavily used entry doors may merit greater frequency	Spring and fall; prior to heating/cooling seasons
Attic	4 months, or after a major storm	Before, during and after wet season
Basement/Crawlspace	4 months, or after a major storm	Before, during and after rain season

Building Components

For purposes of this discussion, the principal exterior surface areas have been divided into five components and are presented in order from the roof down to grade. While guidance for inspection and maintenance is provided for each component, this information is very general in nature and is not indeed to be comprehensive in scope. Examples have been selected to address some typical maintenance needs and to help the reader avoid common mistakes.

Roofs/Chimneys

The roof is designed to keep water out of a building. Thus one of the principal maintenance objectives is to ensure water flows off the roof and into functional gutters and downspouts directly to grade and away from the building—and to prevent water from penetrating the attic, exterior walls, and basement of a building. (Note: Some buildings were designed without gutters and thus assessments must be made as to whether rain water is being properly addressed at the foundation and perimeter grade.) Keeping gutters and downspouts cleared of debris is usually high on the list of regular maintenance activities (Figure 3). Flashing around chimneys, parapets, dormers, and other appendages to the roof also merit regular inspection and appropriate maintenance when needed. The material covering the roof—wood shingles, slate, tile, asphalt, sheet metal, rolled roofing—requires maintenance both to ensure a watertight seal and to lengthen its service life; the type and frequency of maintenance varies with the roofing material. Older chimneys and parapets also require inspection and maintenance. With the exception of cleaning and minor repairs to gutters and downspouts, most roof maintenance work will necessitate use of an outside contractor.

Inspection

The functioning of gutters and downspouts can be safely observed from the ground during rainy weather and when winter ice has collected. Binoculars are a useful tool in helping to identify potential roofing problems from the same safe vantage point. Careful observation from grade helps to identify maintenance needs between close-up inspections by an experienced roofer. Observation from the building interior is also important to identify possible leak locations. When access can be safely gained to the roof, it is important to wear shoes with slip-resistant soles and to use safety ropes. Depending on the nature of the roof, some common conditions of concern to look for are:

- sagging gutters and split downspouts;
- debris accumulating in gutters and valleys;
- overhanging branches rubbing against the roof or gutters
- plant shoots growing out of chimneys;
- slipped, missing, cracked, bucking, delaminating, peeling, or broken roof coverings;
- deteriorated flashing and failing connections at any intersection of roof areas or of roof and adjacent wall;
- bubbled surfaces and moisture ponding on flat or low sloped roofs;
- evidence of water leaks in the attic;
- misaligned or damaged elements, such as decorative cresting, lightning rods, or antennas; and
- cracked masonry or dislodged chimney caps.

Figure 3. Keeping gutters clean of debris can be one of the most important cyclical maintenance activities. On this small one-story addition, a garden hose is being used to flush out the trough to ensure that the gutter and downspouts are unobstructed. Gutters on most small and medium size buildings can be reached with an extension ladder and a garden hose. Photo: Bryan Blundell.

Maintenance

- Remove leaves and other debris from gutters and downspouts. Utilize a ladder with a brace device, if necessary, to keep the ladder from crushing the gutter. Use a garden hose to flush out troughs and downspouts. Patch or repair holes in gutters using products such as fiberglass tape and epoxy adhesive in metal gutters. Avoid asphalt compounds since acidic material can cause further deterioration of metal gutters.
- Correct misaligned gutters and adjust, if necessary, so that water flows to drains and does not pond. If gutter edges sag, consider inserting wooden wedges between the fascia board and the back of the gutter to add support. Seal leaking seams or pinholes in gutters and elbows.
- Broom sweep branch or leaf debris away from shingles, valleys, and crickets, particularly around chimneys and dormers.
- Where mechanical equipment is mounted on flat or low-sloped roofs, ensure that access for maintenance can be provided without damaging the roof. Clean out trapped leaves and debris from around equipment base and consider adding a protective walkway for access.

Figure 4. Damage to roofs often requires immediate attention. As a temporary measure, this damaged roof tile could be replaced with a brown aluminum sheet wedged between the existing tiles. Photo: Chad Randl.

Remove biological growth where it is causing erosion or exfoliation of roofing. Use low-pressure garden hose water and a natural or nylon scrubbing brush to remove such growth, scraping with a plastic putty knife or similar wood or plastic tool as needed on heavier buildup. Most growth is acidic and while there are products designed to kill spores, such as diluted chlorine bleach, they should be avoided. Even fairly weak formulas can still cause unexpected color changes, efflorescence, or oversplash damage to plantings or surfaces below the roof. Where appropriate, trim adjacent tree branches to increase sunlight on the roof since sunlight will deter further biological growth.

Re-secure loose flashing at the dormers, chimneys or parapets. Clean out old mortar, lead, lead wool, or fastening material and make sure that flashing is properly inserted into reglet (slot) joints, taking care not to damage the substrate. Avoid installing new step flashing as a single metal component where multiple pieces are required to provide proper waterproofing. Also avoid attaching step flashing with mastic or sealant. Properly re-bed all step flashing. Use appropriate non-ferrous flashing metal or painted metal if needed. Since cap, step, valley, cricket, and apron

flashings each have specific overlap and extension requirements, replacement flashing should match the existing material unless there has been a proven deficiency.

- Repoint joints in chimneys, parapet, or balustrade capping stones using a hydraulic lime mortar or other suitable mortar where the existing mortar has eroded or cracked, allowing moisture penetration. In general, a mortar that is slightly weaker than the adjacent masonry should be used. This allows trapped moisture in the masonry to migrate out through the mortar and not the masonry. Spalled masonry is often evidence of the previous use of a mortar mix that was too hard.
- Use professional services to repair chimneys and caps. Avoid the use of mortar washes on masonry since they tend to crack, allowing moisture to penetrate and promoting masonry spalling. Repoint masonry with a durable mortar that is slightly weaker than the adjacent masonry. Slope the masonry mortar cap to insure drainage away from the flue. If a chimney rain cap is installed, ensure adequate venting and exhaust.
- As a temporary measure, slip pieces of non-corrosive metal flashing under or between damaged and missing roofing units until new slate, shingles, or tile can be attached. Repair broken, missing or damaged roofing units with ones that match. Follow roofing supplier and industry guidance on inserting and attaching replacement units (Figure 4). Avoid using temporary asphalt patches as it makes a proper repair difficult later on.
- For long-term preservation of wooden shingle roofs coated with a preservative, recoat every few years following the manufacturer's recommendations. Be aware of environmental considerations.
- Scrape and repaint selected areas of coated ferrous metal roofing as needed; repaint on a regularly scheduled basis. Ferrous metal roofs can last a long time if painted regularly. Alkyd coatings are generally used on metal roofs; be sure to wash and properly prepare the area beforehand.

Figure 5. The use of a sealant to close an exposed joint is not always an effective long-term solution. Where this

Environmental regulations may restrict the use of certain types of paints. Apply the coating system in accordance with manufacturer's recommendations. Prepare the surface prior to application to obtain good adhesion with the prime coat. Apply both a prime coat and a topcoat for good bonding and coverage; select primer and topcoat products from the same manufacturer.

- Re-secure loose decorative elements, such as finials and weathervanes. Seek professional advice if decorative elements exhibit considerable corrosion, wood rot, or structural instability. Small surface cracks may benefit from a flexible sealant to keep moisture out; sealants have a limited life and require careful inspection and periodic replacement (Figure 5).

Figure 6. Stucco applied to an exterior wall or foundation was intended to function as a watertight surface. Unless maintained, rainwater will penetrate open joints and cracks that may occur over time. A spalled section of stucco indicates some damage has occurred and a wooden mallet is being used to tap the surface to determine whether the immediate stucco has lost adhesion. Photo: Bryan Blundell.

Exterior Walls

Exterior walls are designed to help prevent water infiltration, control air infiltration, and serve as a barrier for unwanted animals, birds and insects. The primary maintenance objective is to keep walls in sound condition and to prevent water penetration, insect infestation, and needless decay (Figure 6). Depending on the materials and construction methods, walls should have an even appearance, free from unwanted cracks, and should be able to shed excess moisture. Where surfaces are significantly misaligned or where there are bulging wall sections or cracks indicative of potential structural problems, seek professional guidance as to the cause of distress and appropriate corrective measures. Wood-frame construction generally will require more frequent maintenance than buildings constructed of brick, stone, or terra cotta (Figure 7).

Inspections

It is best to inspect walls during dry as well as wet weather. Look for moisture patterns that may appear on the walls after a heavy or sustained rainfall or snow, recording any patterns on elevation drawings or standard recording forms. Monitoring the interior wall for moisture or other potential problems is important as well. Look for movement in cracks, joints, and around windows and doors and try to establish whether movement is seasonal in nature (such as related to shrinkage of wood during dry weather) or signs of an ongoing problem. For moderate size buildings, a ladder or mechanical lift may be necessary, though in some cases the use of binoculars and observations made from windows and other openings will be sufficient. When examining the walls, some common conditions of concern to look for are:

- Misaligned surfaces, bulging wall sections, cracks in masonry units, diagonal cracks in masonry joints, spalling masonry, open joints, and nail popping;
- Evidence of wood rot, insect infestation, and potentially damaging vegetative growth;
- Deficiencies in the attachment of wall mounted lamps, flag pole brackets, signs, and similar items;
- Potential problems with penetrating features such as water spigots, electrical outlets, and vents;
- Excessive damp spots, often accompanied by staining, peeling paint, moss, or mold; and
- General paint problems (Figure 8).

Maintenance

- Trim tree branches away from walls. Remove ivy and tendrils of climbing plants by first cutting at the base of the vine to allow tendrils to die back, and later using a plastic scraper to dislodge debris and an appropriate digging tool to dislodge and remove root systems. Be cautious if using a commercial chemical to accelerate root decay; follow safety directions and avoid contact of chemicals with workers and wall materials.
- Wash exterior wall surfaces if dirt or other deposits are causing damage or hiding deterioration; extend scheduled times for cleaning for cosmetic purposes to reduce frequency (Figure 9). When cleaning, use the gentlest means possible; start with natural bristle brushes and water and only add

decorative wood element connects to the slate roof, the sealant has failed within a short time and a proper metal flashing collar is being fitted instead. Photo: Bryan Blundell.

Figure 7. One of the advantages of wood shingles as a wall covering is that individual shingles that are damaged can easily be replaced. On this highly exposed corner, worn shingles have been selectively replaced to help safeguard against water damage. The new shingles will be stained to match the existing shingles.

a mild phosphate-free detergent if necessary. Use non-abrasive cleaning methods and low-pressure water from a garden hose. For most building materials, such as wood and brick, avoid abrasive methods such as mechanical scrapers and high-pressure water or air and such additives as sand, natural soda, ice crystals, or rubber products. All abrasives remove some portion of the surface and power-washing drives excessive moisture into wall materials and even into wall cavities and interior walls. If using a mild detergent, two people are recommended, one to brush and one to prewet and rinse. When graffiti or stains are present, consult a preservation specialist who may use poultices or mild chemicals to remove the stain. If the entire building needs cleaning other than described above, consult a specialist.

- Repoint masonry in areas where mortar is loose or where masonry units have settled. Resolve cause of cracks or failure before resetting units and repointing. Rake out joints by hand, generally avoiding rotary saws or drills, to a depth of 2 1/2 times the width of the joint (or until sound mortar is encountered), to make sure that fresh mortar will not pop out. Repointing mortar should be lime-rich and formulated to be slightly weaker than the masonry units and to match the historic mortar in color, width, appearance, and tooling. Off-the-shelf pre-mixed cement mortars are not appropriate for most historic buildings. Avoid use of joint sealants in place of mortar on vertical masonry wall surfaces, as they are not breathable and can lead to moisture-related damage of the adjacent masonry (Figure 10).
- Correct areas that trap unwanted moisture. Damaged bricks or stone units can sometimes be removed, turned around, and reset, or replaced with salvaged units. When using traditional or contemporary materials for patching wood, masonry, metal, or other materials, ensure that the materials are compatible with the substrate; evaluate strength, vapor permeability, and thermal expansion, as well as appearance.
- When patching is required, select a compatible patch material. Prepare substrate and install patch material according to manufacturer's recommendations; respect existing joints. Small or shallow surface defects may not require patching; large or deep surface defects may be better addressed by installation of a dutchman unit than by patching.

Figure 8. The paint on the siding of this south-facing wall needs to be scraped, sanded, primed and repainted. Postponing such work will lead to further paint failure, require greater preparatory costs, and could even result in the need to replace some siding. Photo: Charles Fisher.

Figure 9. To help extend a repainting cycle, dirt and spider webs should be removed before permanent staining occurs. In this case, a natural bristle brush and a soft damp cloth are being used to remove insect debris and refresh the surface appearance.

Where a damaged area is too large to patch, consider replacing the section with in-kind material. For stucco and adobe materials, traditional patching formulas are recommended.

When temporarily removing wood siding to repair framing or to tighten corner boards and loose trim, reuse the existing siding where possible. Consider using stainless steel or high strength aluminum nails as appropriate. Putty or fill nail holes flush with siding prior to repainting. Back-prime any installed wood with one coat of primer and coat end grain that might be exposed with two coats of primer.

Prepare, prime, and spot paint areas needing repainting. Remember that preparation is the key to a successful long lasting paint job. Ensure beforehand the compatibility of new and existing paints to avoid premature paint failure. Remove loose paint to a sound substrate; sand or gently rough surface if needed for a good paint bond; wipe clean; and repaint with

appropriate primer and topcoats. Follow manufacturer's recommendations for application of coatings, including temperature parameters for paint application. Use top quality coating materials. Generally paint when sun is not shining directly onto surfaces to be painted.

- Remove deteriorated caulks and sealants, clean, and reapply appropriate caulks and sealants using backer rods as necessary. Follow manufacturer's instructions regarding preparation and installation.
- Correct deficiencies in any wall attachments such as awning and flag pole anchors, improperly installed electrical outlets, or loose water spigots.

Openings

Exterior wall openings primarily consist of doors, windows, storefronts, and passageways. The major maintenance objectives are to retain the functioning nature of the opening and to keep in sound condition the connection between the opening and the wall in order to reduce air and water infiltration.

Inspection

Wall openings are typically inspected from inside as well as out. Examinations should include the overall material condition; a check for unwanted water penetration, insect infiltration, or animal entry; and identification of where openings may not be properly functioning. Frames should be checked to make sure they are not loose and to ascertain whether the intersection between the wall and the frame is properly sealed. Secure connections of glazing to sash and between sash and frames are also important. Particular attention should be placed on exposed horizontal surfaces of storefronts and window frames as they tend to deteriorate much faster than vertical surfaces. Inspections should identify:

- loose frames, doors, sash, shutters, screens, storefront components, and signs that present safety hazards;
- slipped sills and tipped or cupped thresholds;
- poorly fitting units and storm assemblies, misaligned frames, drag marks on thresholds from sagging doors and storm doors;
- loose, open, or decayed joints in door and window frames, doors and sash, shutters, and storefronts;
- loose hardware, broken sash cords/chains, worn sash pulleys, cracked awning, shutter and window hardware, locking difficulties, and deteriorated weatherstripping and flashing;
- broken/cracked glass, loose or missing glazing and putty;
- peeling paint, corrosion or rust stains; and
- window well debris accumulation, heavy bird droppings, and termite and carpenter ant damage.

Maintenance

- Replace broken or missing glass as soon as possible; in some cases cracked glass may be repaired using specialty glues. For historic crown glass and early cylinder glass, a conservation approach should be considered to repair limited cracks. Where panes with a distinct appearance are missing, specialty glass should be obtained to match, with sufficient inventory kept for future needs. Avoid using mechanical devices to remove old putty and match historic putty bevels or details when undertaking work.
- Reputty window glazing where putty is deteriorated or missing. Take care in removing putty so as not to crack or break old glass or damage muntins and sash frames. Re-glaze with either traditionally formulated oil putties or modern synthetic ones, making sure to properly bed the glass and secure with glazing points (Figure 11).
- Clean window glass, door glazing, storefronts, transom prism lights, garage doors, and storm panels using a mild vinegar and water mixture or a non-alkaline commercial window cleaner. Be cautious with compounds that contain ammonia as they may stain brass or bronze hardware elements if not totally removed. When using a squeegee blade or sponge, wipe wet corners with a soft dry cloth. Avoid high-pressure washes.
- Clean handles, locks and similar hardware with a soft, damp cloth. Use mineral spirits or commercial cleaners very sparingly, as repeated use may remove original finishes. Most metal cleaners include ammonia that can streak and stain metal, so it is important to remove all cleaning residue. Polished hardware subject to tarnishing or oxidation, particularly doorknobs, often benefits from a thin coat of paste wax (carnauba), hand buffed to remove extra residue. Avoid lacquer finishes for high use areas, as they require more extensive maintenance. Patinated finishes should not be cleaned with any chemicals, since the subtle aged appearance contributes to the building's character.
- Remove and clean hardware before painting doors and windows; reinstall after the paint has dried.
- Tighten screws in doorframes and lubricate door hinges, awning hardware, garage door mechanisms, window sash chains, and pulleys using a graphite or silicone type lubricant.
- Check weather stripping on doors and windows and adjust or replace as necessary. Use a durable type of weather stripping, such as spring metal or high quality synthetic material, avoiding common brush and bulb or pile weather stripping that require more frequent replacement.

Figure 10. Repointing of masonry should usually be approached as repair rather than maintenance work in part because of the need for a skilled mason familiar with historic mortar. In this case, a moisture condition was not corrected and the use of a waterproof coating and off-the-shelf Portland cement mortar trapped water and resulted in further damage to these 19th century bricks. Photo: NPS files

Figure 11. Glazing putty should be maintained in sound condition to prevent unwanted air infiltration and water damage. New glazing putty should be pulled tight to the glass and edge of the wood, creating a clean bevel that matches the historic glazing

- Adjust steel casement windows as needed for proper alignment and tight fit. Avoid additional weather stripping as this may lead to further misalignment, creating pathways for air and water infiltration.
- Check window sills for proper drainage. Fill cracks in wood sills with a wood filler or epoxy. Follow manufacturer's instructions for preparation and installation. Do not cover over a wood sill with metal panning, as it may trap moisture and promote decay.
- Repair, prime, and repaint windows, doors, frames, and sills when needed. Clean out putty debris and paint chips from windows using a wet paper towel and dispose of debris prior to repair or repainting. Take appropriate additional precautions when removing lead-based paint. Sand and prepare surfaces and use material-specific patching compounds to fill any holes or areas collecting moisture (Figure 12). Avoid leaving exposed wood unpainted for any length of time, as light will degrade the wood surface and lead to premature failure of subsequent paint applications. Immediately prime steel sash after paint is removed and the substrate prepared for repainting.
- Adjust wood sash that bind when operated. Apply beeswax, paraffin, or similar material to tracks or sash runs for ease of movement. If sash are loose, replace worn parting beads. Sash runs traditionally were unpainted between the stop and parting bead; removing subsequent paint applications will often help improve sash operation.
- Correct perimeter cracks around windows and doors to prevent water and air infiltration. Use traditional material or modern sealants as appropriate. If fillers such as lead wool have been used, new wool can be inserted with a thin blade tool, taking care to avoid damage to adjacent trim. Reduce excess air infiltration around windows by repairing and lubricating sash locks so that windows close tightly.
- Remove debris beneath window air conditioning units and ensure that water from units does not drain onto sills or wall surfaces below (Figure 13). Removal of air conditioning units when not in season is recommended.
- Adjust storm panels and clean weep holes; check that weep holes at the bottom of the panels are open so water will not be trapped on the sill. Exterior applied storm windows are best attached using screws and not tightly adhered with sealant. Use of sealant makes storm units difficult to remove for maintenance and can contribute to moisture entrapment if weep holes become clogged.
- Remove weakened or loose shutters and store for later repair. Consider adding a zinc or painted metal top to shutters as a protective cap to cover the wood's exposed end grain. This will extend the life of the shutters.

Figure 12. Good surface preparation is essential for long lasting paint. Scraping loose paint, filling nail holes and cracks, sanding, and wiping with a damp cloth prior to repainting are all important steps whether touching up small areas or repainting an entire feature. Always use a manufacturer's best quality paint. Windows and shutters may need repainting every five to seven years, depending on exposure and climate.

Figure 13. Window air conditioning units can cause damage to surfaces below when condensation drips in an uncontrolled manner. Drip extension tubes can sometimes be added to direct the discharge.

Contracting Maintenance and Repair Work

Many contractors are very proficient in using modern construction methods and materials; however, they may not have the experience or skill required to carry out maintenance on historic buildings. The following are tips to use when selecting a contractor to work on your historic building:

1. Become familiar with work done on similar historic properties in your area so that you can obtain names of possible preservation contractors.

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

Projections

Numerous projections may exist on a historic building, such as porches, dormers, skylights, balconies, fire escapes, and breezeways. They are often composed of several different materials and may include an independent roof. Principal maintenance objectives include directing moisture off these features and keeping weathered surfaces in good condition. Secondary projections may include brackets, lamps, hanging signs, and similar items that tend to be exposed to the elements.

Inspection

In some cases, projections are essentially independent units of a building and so must be evaluated carefully for possible settlement, separation from the main body of the building, and materials deterioration. Some electrical features may require inspection by a electrician or service technician. Common conditions of concern to look for are:

- damaged flashing or tie-in connections of projecting elements;
- misaligned posts and railings;
- deteriorated finishes and materials, including peeling paint, cupped and warped decking, wood deterioration, and hazardous steps;
- evidence of termites, carpenter ants, bees, or animal pests (Figure 14);
- damaged lamps, unsafe electrical outlets or deteriorated seals around connections;
- loose marker plaques, sign, or mail boxes; and
- rust and excessive wear of structural, anchorage, and safety features of balconies and fire escapes.

Maintenance

- Selectively repair or replace damaged roofing units on porches and other projections. Ensure adequate drainage away from the building. Repair flashing connections as needed; clean and seal open joints as appropriate.
- Secure any loose connections, such as on porch rails or fire escapes.
- Maintain ferrous metal components by following manufacturer's recommendation for cleaning and repainting. Remove rust and corrosion from porch handrails, balconies, fire escapes, and other metal features; prepare, prime, and repaint using a corrosion-inhibitive coating system. Apply new primer before new corrosion sets in, followed by new topcoat. Take appropriate safety measures when dealing with existing lead-based paint and in using corrosion-removal products (Figure 15).
- Reattach loose brackets, lamps, or signs.
With electrical boxes for outlets or lighting devices, ensure that cover plates are

Figure 14. When inspecting connections between projections and the main building, look for areas where birds, bees and pests may enter or nest. Birds have been nesting in this porch roof and the area is being cleaned of their debris. Where an opening exists, it may be necessary to cover it with a trim piece, screening, or sealant. Photo: Bryan Blundell

properly sealed. Prime and paint metal elements as needed.

- Keep porch decks and steps free from dust, dirt, leaf debris, and snow as soon as it accumulates using a broom or plastic blade shovel.
- Repair areas of wood decay or other damage to railings, posts, and decorative elements. Repair with wood dutchman, wood putty, or epoxy filler, as appropriate; replace individual elements as needed. Prime and repaint features when necessary and repaint horizontal surfaces on a more frequent basis.
- Sand and repaint porch floorboards to keep weather surfaces protected. The exposed ends of porch floorboards are especially susceptible to decay and may need to be treated every year or two.
- Carefully cut out damaged or buckled porch flooring and replace with wood to match. Back-prime new wood that is being installed; treat end grain with wood preservative and paint primer. Ensure that new wood is adequately kiln or air-dried to avoid shrinkage and problems with paint adherence.
- Repair rotted stair stringers; adjust grade or add stone pavers at stair base to keep wooden elements from coming into direct contact with soil.
- Consider durable hardwoods for replacement material where beading, chamfering, or other decorative work is required in order to match existing features being replaced. Although appropriate for certain applications, pressure treated lumber is hard to tool and may inhibit paint adherence if not allowed to weather prior to coating application.
- Clean out any debris from carpenter bees, ants, termites, and rodents, particularly from under porches. Replace damaged wood and add screening or lattice to discourage rodents. Consider treating above ground features with a borate solution to deter termites and wood rot and repaint exposed surfaces.

Figure 15. Metal projecting elements on a building, such as sign armatures and railings, are easily subject to rust and decay. Proper surface preparation to remove rust is essential. Special metal primers and topcoats should be use

Foundations and Perimeter Grades

The foundation walls that penetrate into the ground, the piers that support raised structures, and the ground immediately around a foundation (known as grade) serve important structural functions. To help sustain these functions, it is important that there is good drainage around and away from the building. The maintenance goal is to prevent moisture from entering foundations and crawl spaces and damaging materials close to the grade, and to provide ventilation in damp areas.

Inspection

Inspections at the foundation should be done in conjunction with the inspection of the downspouts to ensure that water is being discharged a sufficient distance from the building perimeter to avoid excessive dampness in basements or crawl spaces. In addition, crawl spaces should be adequately vented to deter mold and decay and should be screened or otherwise secured against animals. Look for:

- depressions or grade sloping toward the foundation; standing water after a storm;
- material deterioration at or near the foundation, including loss of mortar in masonry, rotting wood clapboards, or settlement cracks in the lower sections of wall;
- evidence of animal or pest infestation;
- vegetation growing close to the foundation, including trees, shrubs and planting beds;
- evidence of moisture damage from lawn and garden in-ground sprinkler systems;
- evidence of moss or mold from damp conditions or poorly situated downspout splash blocks (Figure 16); and
- blocked downspout drainage boots or clogged areaway grates.

Maintenance

- Remove leaves and other debris from drains to prevent accumulation. Detach drain grates from paved areas and extract clogged debris. Flush with a hose to ensure that there is no blockage. Use a professional drain service to clear obstructions if necessary.
- Conduct annual termite inspections. Promptly address termite and other insect infestations. Use only licensed company for treatment where needed.
- Keep the grade around the foundation sloping away from the building. Add soil to fill depressions particularly around downspouts and splash blocks. Make sure that soil does not come too close to wooden or metal elements. A 6" separation between wooden siding and the grade is usually recommended.
- Avoid use of mulching material immediately around foundations as such material may promote termite infestation, retain moisture or change existing grade slope.
- Reset splash blocks at the end of downspouts or add extender tubes to the end of downspouts as necessary (Figure 17).
- Lubricate operable foundation vent grilles to facilitate seasonal use; paint as needed.
- Manage vegetation around foundations to allow sufficient air movement for wall surfaces to dry out during damp periods. Trim plantings and remove weeds and climbing vine roots. Be careful not to scar foundations or porch piers with grass or weed cutting equipment. If tree roots appear to be damaging a foundation wall, consult an engineer as well as a tree company.
- Wash off discoloration on foundations caused by splash-back, algae, or mildew. Use plain water and a soft natural or nylon bristle brush. Unless thoroughly researched and tested beforehand on a discreet area of the wall, avoid chemical products that may discolor certain types of stone. If cleaning products are used, test beforehand in a discreet area; and avoid over splash to plantings and adjacent building materials.
- Selectively repoint unit masonry as needed. Follow guidance under the wall section in regard to compatible mix, appearance, and texture for pointing mortar.
- Avoid using salts for de-icing and fertilizers with a high acid or petro-chemical content around foundations, as these materials can cause salt contamination of masonry. Use sand or organic materials without chloride additives that can damage masonry. Where salt is used on icy walks, distribute it sparingly and sweep up residual salt after walks have dried.
- Use snow shovels and brooms to clean snow from historic paths and walkways. Avoid blade-type snow removers as they may chip or abrade cobblestones, brick, or stone paving. Note that use of steel snow removal tools in areas where salt-containing snow melters are used may result in rust staining from steel fragments left on the paving.

Figure 16. This chronically wet area has a mildew bloom brought on by heat generated from the air-conditioning condenser unit. The dampness could be caused by a clogged roof gutter, improper grading, or a leaking hose bibb.

Sealants and Caulks

Using sealants and caulks has become a familiar part of exterior maintenance today. As the use of precision joinery and certain traditional materials to render joints more weathertight has waned in recent years, caulks and more often elastomeric sealants are used to seal cracks and joints to keep out moisture and reduce air infiltration. Where cracks and failing joints are indicators of a serious problem, sealants and caulks may be used as a temporary measure. In some cases they may actually exacerbate the existing problem, such as by trapping moisture in adjacent masonry, and lead to more costly repairs.

Manufacturer's recommendations provide instructions on the proper application of caulks and sealants. Special attention should be placed on ensuring that the subsurface or joint is properly prepared and cleaned. Backer rods may be necessary for joints or cracks. Tooling of the caulk or sealant is usually necessary to ensure contact with all edge surfaces and for a clean and consistent appearance.

Caulks generally refer to older oil resin-based products, which have relatively limited life span and limited flexibility. Contemporary elastomeric sealants are composed of polymer synthetics. Elastomeric sealants are more durable than caulks and have greater flexibility and wider application. Caulks and sealants can become maintenance problems, as they tend to deteriorate faster than their substrates and must be replaced periodically as a part of cyclical maintenance of the structure.

The selection criteria for caulks and sealants include type of substrate, adhesion properties, size and configuration of joint, intended appearance/color and paintability, movement characteristics, and service life. Both one-part and two-part sealants are available; the latter require mixing as part of the application process. Sealants are commonly used for a variety of places on the exterior of a building such as around windows and doors, at interfaces between masonry and wood, between various wood features or elements, and at attachments to or through walls or roofs, such as with lamps, signs, or exterior plumbing fixtures. Their effectiveness depends on numerous factors including proper surface preparation and application. Applications of sealants and caulks should be examined as part of routine maintenance inspection, irrespective of their projected life expectancy.

Installation of caulks and sealants often can be undertaken by site personnel. For large and more complex projects, a contractor experienced in sealant installation may be needed. In either case, the sealant manufacturer should be consulted on proper sealant selection, preparation, and installation procedures.

Summary and References

Maintenance is the most important preservation treatment for extending the life of a historic property. It is also the most cost effective. Understanding the construction techniques of the original builders and the performance qualities of older building materials, using traditional maintenance and repair methods, and selecting in-kind materials where replacements are needed will help preserve the building and its historic character.

Maintenance can be managed in small distinct components, coordinated with other work, and scheduled over many years to ensure that materials are properly cared for and their life span maximized. A written maintenance plan is the most effective way to organize, schedule, and guide the work necessary to properly care for a historic building. The maintenance plan should include a description of the materials and methods required for each task, as well as a schedule for work required for maintenance of different building materials and components.

Historic house journals, maintenance guides for older buildings, preservation consultants, and preservation maintenance firms can assist with writing appropriate procedures for specific properties. Priorities should be established for intervening when unexpected damage occurs such as from broken water pipes or high winds. Worker safety should always be paramount. When work is beyond the capabilities of in-house personnel and must be contracted, special efforts should be made to ensure that a contractor is both experienced in working with historic buildings and utilizes appropriate preservation treatments.

A well-maintained property is a more valuable property and one that will survive as a legacy for generations to come.

Endnotes

1. *The Secretary of the Interior's Standards for the Treatment of Historic Properties*. Washington, D.C.: U.S. Department of the Interior, National Park Service, 1995.
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Acknowledgements

Sharon C. Park FAIA, is the former Chief of Technical Preservation Services, Heritage Preservation Services, National Park Service, in Washington, D.C. and currently is the Associate Director for Architectural History and Historic Preservation, Smithsonian Institution.

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Figure 17. Extending downspouts at their base is one of the basic steps to reduce dampness in basements, crawl spaces and around foundations. Extensions should be buried, if possible, for aesthetics, ease of lawn care, and to avoid creating a tripping hazard. Photo: NPS files.

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This publication has been prepared pursuant to the National Historic Preservation Act, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Comments about this publication should be made to: Charles Fisher, Technical Publications Program Manager, Technical Preservation Services-2255, National Park Service, 1849 C Street, NW, Washington, D.C. 20240. This publication is not copyrighted and can be reproduced without penalty. Normal procedures for credit to the author and the National Park Service are appreciated. Unless otherwise noted, photographs in this Brief are by Sharon C. Park, FAIA. Except for the author's photos, the photographs used in this publication may not be used to illustrate other publications without permission of the owner.

June 2007

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3.2.2 Identifying architectural character and visual aspects (Nelson 1988, Preservation Brief #17)

Technical Preservation Services

National Park Service
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PRESERVATION BRIEFS

17

Architectural Character—Identifying the Visual Aspects of Historic Buildings as an Aid to Preserving their Character

Lee H. Nelson, FAIA

[Three-Step Process to Identify the Visual Character](#)

[Step 1: Overall Visual Aspects](#)

[Step 2: Visual Character at Close Range](#)

[Step 3: Interior Spaces, Features and Finishes](#)

[The Architectural Character Checklist/Questionnaire](#)

[Summary and References](#)

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Close-up of stone wall, showing craftsmanship. Photo: NPS files.

The Secretary of the Interior's Standards for the Treatment of Historic Properties embody two important goals: 1) the preservation of historic materials and, 2) the preservation of a building's distinguishing character. Every old building is unique, with its own identity and its own distinctive character. Character refers to all those visual aspects and physical features that comprise the appearance of every historic building. Character-defining elements include the overall shape of the building, its materials, craftsmanship, decorative details, interior spaces and features, as well as the various aspects of its site and environment.

The purpose of this Brief is to help the owner or the architect identify those features or elements that give the building its visual character and that should be taken into account in order to preserve them to the maximum extent possible.

There are different ways of understanding old buildings. They can be seen as examples of specific building types, which are usually related to a building's function, such as schools, courthouses or churches.

Buildings can be studied as examples of using specific materials such as concrete, wood, steel, or limestone. They can also be considered as examples of an historical period, which is often related to a specific architectural style, such as Gothic Revival farmhouses, one-story bungalows, or Art Deco apartment buildings.

There are many other facets of an historic building besides its functional type, its materials or construction or style that contribute to its historic qualities or significance. Some of these qualities are feelings conveyed by the sense of time and place or in buildings associated with events or people. A complete understanding of any property may require documentary research about its style, construction, function, its furnishings or contents; knowledge about the original builder, owners, and later occupants; and knowledge about the evolutionary history of the building. Even though buildings may be of historic, rather than architectural significance, it is their tangible elements that embody its significance for association with specific events or persons and it is those tangible elements both on the exterior and interior that should be preserved.

Therefore, the approach taken in this Brief is limited to **identifying those visual and tangible aspects of the historic building**. While this may aid in the planning process for carrying out any ongoing or new use or restoration of the building, this approach is not a substitute for developing an understanding about the significance of an historic building and the district in which it is located. If the various materials, features and spaces that give a building its visual character are not recognized and preserved, then essential aspects of its character may be damaged in the process of change.

A building's character can be irreversibly damaged or changed in many ways, for example, by inappropriate repointing of the brickwork, by removal of a distinctive side porch, by changes to the window sash, by changes to the setting around the building, by changes to the major room arrangements, by the introduction of an atrium, by painting previously unpainted woodwork, etc.

Three-Step Process to Identify the Visual Character

This Brief outlines a three-step approach that can be used by anyone to identify those materials, features and spaces that contribute to the visual character of a building. This approach involves first examining the building from afar to understand its overall setting and architectural context; then moving up very close to appreciate its materials and the craftsmanship and surface finishes evident in these materials; and then going into and through the building to perceive those spaces, rooms and details that comprise its interior visual character.

Step 1: Identify the Overall Visual Aspects

Identifying the overall visual character of a building is nothing more than looking at its distinguishing physical aspects without focusing on its details. The major contributors to a building's overall character are embodied in the general aspects of its setting; the shape of the building; its roof and roof features, such as chimneys or cupolas; the various projections on the building, such as porches or bay windows; the recesses or voids in a building, such as open galleries, arcades, or recessed balconies; the openings for windows and doorways; and finally the various exterior materials that contribute to the building's character.

Step One involves looking at the building from a distance to understand the character of its site and setting, and it involves walking around the building where that is possible. Some buildings will have one or more sides that are more important than the others because they are more highly visible. This does not mean that the rear of the building is of no value whatever but it simply means that it is less important to the overall character. On the other hand, the rear may have an interesting back porch or offer a private garden space or some other aspect that may contribute to the visual character. Such a general approach to looking at the building and site will provide a better understanding of its overall character without having to resort to an infinitely long checklist of its possible features and details. Regardless of whether a building is complicated or relatively plain, it is these broad categories that contribute to an understanding of the overall character rather than the specifics of architectural features such as moldings and their profiles.

Overall Visual Character: Shape

The **shape** of a building can be an important aspect of its overall visual character. The building illustrated here, for example, has a distinctive horizontal boxlike shape with the middle portion of the box projecting up an extra story.

This building has other visual aspects that help define its overall character, including the pattern of vertical bands of windows, the decorative horizontal bands which separate the base of the building from the upper floors, the dark brown color of the brick, the large arched entranceway, and the castle-like tower behind the building.

Left Photo—Overall Visual Character: Shape. Right Photo—Overall Visual Character: Openings.

Overall Visual Character: Openings

The **opening** illustrated here dominates the visual character of this building because of its size, shape, location, materials, and craftsmanship. Because of its relation to the generous staircase, this opening places a strong emphasis on the principal entry to the building. Enclosing this arcade-like entry with glass, for example, would materially and visually change the character of the building.

Overall Visual Character: Roof and Related Features

This building pictured on the left has a number of character-defining aspects which include the windows and the decorative stonework, but certainly the roof and its related features are visually important to its overall visual character. The **roof** is not only highly visible, it has elaborate stone dormers, and it also has decorative metalwork and slatework. The red and black slates of differing sizes and shapes are laid in patterns that extend around the roof of this large and freestanding building. Any changes to this patterned slatework, or to the other roofing details would damage the visual character of the building.

Overall Visual Character: Roof and Related Features

Overall Visual Character: Roof and Related Features

On this building pictured on the right, the most important visual aspects of its character are the **roof and its related features**, such as the dormers and chimneys. The roof is important to the visual character because its steepness makes it highly visible, and its prominence is reinforced by the patterned tinwork, the six dormers and the two chimneys. Changes to the roof or its features, such as removal or alterations to the dormers, for example, would certainly change the character of this building. This does not discount the importance of its other aspects, such as the porch, the windows, the brickwork, or its setting; but the roof is clearly crucial to understanding the overall visual character of this building as seen from a distance.

Left Photo—Overall Visual Character: Projections. Middle Photo—Overall Visual Character: Trim. Right Photo—Overall Visual Character: Setting.

Overall Visual Character: Projections

A **projecting porch or balcony** can be very important to the overall visual character of almost any building and to the district in which it is located. Despite the size of this building (3-1/2 stories), and its distinctive roofline profile, and despite the importance of the very large window openings, the lacy wrap-around iron balcony is singularly important to the visual character of this building. It would seriously affect the character to remove the balcony, to enclose it, or to replace it with a balcony lacking the same degree of detail of the original material.

Overall Visual Character: Trim

If one were to analyze the overall shape or form of this building, it would be seen that it is a gable-roofed house with dormers and a wrap-around porch. It is similar to many other houses of the period. It is the **wooden trim** on the eaves and around the porch that gives this building its own identity and its special visual character.

Although such wooden trim is vulnerable to the elements, and must be kept painted to prevent deterioration; the loss of this trim would seriously damage the overall visual character of this building, and its loss would obliterate much of the closeup visual character so dependent upon craftsmanship for the moldings, carvings, and the see-through jigsaw work.

Overall Visual Character: Setting

Even architecturally modest buildings frequently will have a **setting** that contributes to their overall character. In this very urban district, setbacks are the exception, so that the small front yard is something of a luxury, and it is important to the overall character because of its design and materials, which include the iron fence along the sidewalk, the curved walk leading to the porch, and the various plantings. In a district where parking spaces are in great demand, such front yards are sometimes converted to off-street parking, but in this instance, that would essentially destroy its setting and would drastically change the visual character of this historic property.

Step 2: Visual Character at Close Range

Step Two involves looking at the building at close range or arm's length, where it is possible to see all the surface qualities of the materials, such as their color and texture, or surface evidence of craftsmanship or age. In some instances, the visual character is the result of the juxtaposition of materials that are contrastingly different in their color and texture. The surface qualities of the materials may be important because they impart the very sense of craftsmanship and age that distinguishes historic buildings from other buildings. Furthermore, many of these close up qualities can be easily damaged or obscured by work that affects those surfaces. Examples of this could include painting previously unpainted masonry, rotary disk sanding of smooth wood siding to remove paint, abrasive cleaning of tooled stonework, or repointing reddish mortar joints with gray portland cement.

There is an almost infinite variety of surface materials, textures and finishes that are part of a building's character which are fragile and easily lost.

Arm's Length Visual Character: Materials

At arm's length, the visual character is most often determined by the surface qualities of the **materials and craftsmanship**; and while these aspects are often inextricably related, the original choice of materials often plays the dominant role in establishing the close range character because of the color, texture, or shape of the materials.

In this instance, the variety and arrangement of the materials is important in defining the visual character, starting with the large pieces of broken stone which form the projecting base for the building walls, then changing to a wall of roughly rectangular stones which vary in size, color, and texture, all with accentuated, projecting beads of mortar, then there is a rather precise and narrow band of cut and dressed stones with minimal mortar joints, and finally, the main building walls are composed of bricks, rather uniform in color, with fairly generous mortar joints. It is the juxtaposition and variety of these materials (and of course, the craftsmanship) that is very important to the visual character. Changing the raised mortar joints, for example, would drastically alter the character at arm's length.

Arm's Length Visual Character: Materials

Arm's Length Visual Character:
Craft Details

Arm's Length Visual Character: Craft Details

There are many instances where **craft details** dominate the arm's length visual character. As seen here, the craft details are especially noticeable because the stones are all of a uniform color, and they are all squared off, but their surfaces were worked with differing tools and techniques to create a great variety of textures, resulting in a tour-de-force of craft details. This texture is very important at close range. It was a deliberately contrived surface that is an important contributor to the visual character of this building.

Step 3: Identify the Visual Character of Interior Spaces, Features and Finishes

Perceiving the character of interior spaces can be somewhat more difficult than dealing with the exterior. In part, this is because so much of the exterior can be seen at one time and it is possible to grasp its essential character rather quickly. To understand the interior character, Step Three says it is necessary to move through the spaces one at a time. While it is not difficult to perceive the character of one individual room, it becomes more difficult to deal with spaces that are interconnected and interrelated. Sometimes, as in office buildings, it is the vestibules or lobbies or corridors that are important to the interior character of the building. With other groups of buildings the visual qualities of the interior are related to the plan of the building, as in a church with its axial plan creating a narrow tunnel-like space which obviously has a different character than an open space like a sports pavilion. Thus the shape of the space may be an essential part of its character.

With some buildings it is possible to perceive that there is a visual linkage in a sequence of spaces, as in a hotel, from the lobby to the grand staircase to the ballroom. Closing off the openings between those spaces would change the character from visually linked spaces to a series of closed spaces. For example, in a house that has a front and back parlor linked with an open archway, the two rooms are perceived together, and this visual relationship is part of the character of the building. To close off the open archway would change the character of such a residence.

The importance of interior features and finishes to the character of the building should not be overlooked. In relatively simple rooms, the primary visual aspects may be in features such as fireplace mantels, lighting fixtures or wooden floors. In some rooms, the absolute plainness is the character-defining aspect of the interior. So-called secondary spaces also may be important in their own way, from the standpoint of history or because of the family activities that occurred in those rooms. Such secondary spaces, while perhaps historically significant, are not usually perceived as important to the visual character of the building. Thus we do not take them into account in the visual understanding of the building.

Interior Visual Character: Interior Features

Interior Visual Character: Individually Important Spaces

In assessing the interior visual character of any historic building, it is necessary to ask whether there are spaces that are important to the character of this particular building, whether the building is architecturally rich or modest, or even if it is a simple or utilitarian structure.

The character of the **individually important space**, which is illustrated here, is a combination of its size, the twin curving staircases, the massive columns and curving vaulted ceilings, in addition to the quality of the materials in the floor and in the stairs. If the ceiling were to be lowered to provide space for heating ducts, or if the stairways were to be enclosed for code reasons, the shape and character of this space would be damaged, even if there was no permanent physical damage. Such changes can easily destroy the visual character of an individually important interior space. Thus, it is important that the visual aspects of a building's interior character be recognized before planning any changes or alterations.

Interior Visual Character: Individually Important Spaces

Interior Visual Character: Related Spaces

Many buildings have interior spaces that are visually or physically related so that, as you move through them, they are perceived not as separate spaces, but as a sequence of **related spaces** that are important in defining the interior character of the building. The example which is illustrated here consists of two spaces that are visually linked to each other.

The photo shows a vestibule which is of a generous size and unusual in its own right, but more important, it visually relates to the staircase off of it.

The stairway, bottom photo, is the second part of this sequence of related spaces, and it provides continuing access to the upper floors. These related spaces are very important in defining the interior character of this building. Almost any change to these spaces, such as installing doors between the vestibule and the hallway, or enclosing the stair would seriously impact their character and the way that character is perceived.

Interior Visual Character: Related Spaces

Interior Visual Character: Interior Features

Interior features are three-dimensional building elements or architectural details that are an integral part of the building as opposed to furniture. Interior features are often important in defining the character of an individual room or space. In some instances, an interior feature, like a large and ornamental open stairway may dominate the visual character of an entire building. In other instances, a modest iron stairway (like the one illustrated here) may be an important interior feature, and its preservation would be crucial to preserving the interior character of the building.

Interior Visual Character: Interior Features

Such features can also include the obvious things like fireplace mantles, plaster ceiling medallions, or paneling, but they also extend to features like hardware, lighting fixtures, bank tellers cages, decorative elevator doors, etc.

Interior Visual Character: Surface Materials and Finishes

When identifying the visual character of historic interior spaces one should not overlook the importance of those materials and finishes that comprise the **surfaces of walls, floors and ceilings**. The surfaces may have evidence of either handcraft or machine made products that are important contributors to the visual character, including patterned or inlaid designs in the wood flooring, decorative painting practices such as stenciling, imitation marble or wood grain, wallpapering, tinwork, tile floors, etc.

The example illustrated here involves a combination of real marble at the base of the column, imitation marble patterns on the plaster surface of the column (a practice called scagliola), and a tile floor surface that uses small mosaic tiles arranged to form geometric designs in several different colors. While such decorative materials and finishes may be important in defining the interior visual character of this particular building, it should be remembered that in much more modest buildings, the plainness of surface materials and finishes may be an essential aspect of their historic character.

Interior Visual Character: Surface Materials and Finishes

Interior: Exposed Structure

Interior: Exposed Structure

If features of the **structural system** are exposed, such as loadbearing brick walls, cast iron columns, roof trusses, posts and beams, vigas, or stone foundation walls, they may be important in defining the building's interior visual character.

Fragility of A Building's Visual Character

Some aspects of a building's visual character are fragile and are easily lost. This is true of brickwork, for example, which can be irreversibly damaged with inappropriate cleaning

techniques or by insensitive repointing practices. At least two factors are important contributors to the visual character of brickwork, namely the brick itself and the craftsmanship. Between these, there are many more aspects worth noting, such as color range of bricks, size and shape variations, texture, bonding patterns, together with the many variable qualities of the mortar joints, such as color, width of joint and tooling.

These qualities could be easily damaged by painting the brick, by raking out the joint with power tools, or repointing with a joint that is too wide. As seen here during the process of repointing, the visual character of this front wall is being dramatically changed from a wall where the bricks predominate, to a wall that is visually dominated by the mortar joints.

The Architectural Character Checklist/Questionnaire

This checklist can be taken to the building and used to identify those aspects that give the building and setting its essential visual qualities and character. This checklist consists of a series of questions that are designed to help in identifying those things that contribute to a building's character. The use of

Fragility of A Building's Visual Character

this checklist involves the threestep process of looking for: 1) the overall visual aspects, 2) the visual character at close range, and 3) the visual character of interior spaces, features and finishes.

Because this is a process to identify architectural character, it does not address those intangible qualities that give a property / building or its contents its historic significance, instead this checklist is organized on the assumption that historic significance is embodied in those tangible aspects that include the building's setting, its form and fabric.

STEP ONE

1. Shape

What is there about the form or shape of the building that gives the building its identity? Is the shape distinctive in relation to the neighboring buildings? Is it simply a low, squat box, or is it a tall, narrow building with a corner tower? Is the shape highly consistent with its neighbors? Is the shape so complicated because of wings, or ell, or differences in height, that its complexity is important to its character? Conversely, is the shape so simple or plain that adding a feature like a porch would change that character? Does the shape convey its historic function as in smoke stacks or silos?

2. Roof and Roof Features

Does the roof shape or its steep (or shallow) slope contribute to the building's character? Does the fact that the roof is highly visible (or not visible at all) contribute to the architectural identity of the building? Are certain roof features important to the profile of the building against the sky or its background, such as cupolas, multiple chimneys, dormers, cresting, or weather vanes? Are the roofing materials or their colors or their patterns (such as patterned slates) more noticeable than the shape or slope of the roof?

3. Openings

Is there a rhythm or pattern to the arrangement of windows or other openings in the walls; like the rhythm of windows in a factory building, or a threepart window in the front bay of a house; or is there a noticeable relationship between the width of the window openings and the wall space between the window openings? Are there distinctive openings, like a large arched entranceway, or decorative window lintels that accentuate the importance of the window openings, or unusually shaped windows, or patterned window sash, like small panes of glass in the windows or doors, that are important to the character? Is the plainness of the window openings such that adding shutters or gingerbread trim would radically change its character? Is there a hierarchy of facades that make the front windows more important than the side windows? What about those walls where the absence of windows establishes its own character?

4. Projections

Are there parts of the building that are characterdefining because they project from the walls of the building like porches, cornices, bay windows, or balconies? Are there turrets, or widely overhanging eaves, projecting pediments or chimneys?

5. Trim and Secondary Features

Does the trim around the windows or doors contribute to the character of the building? Is there other trim on the walls or around the projections that, because of its decoration or color or patterning contributes to the character of the building? Are there secondary features such as shutters, decorative gables, railings, or exterior wall panels?

6. Materials

Do the materials or combination of materials contribute to the overall character of the building as seen from a distance because of their color or patterning, such as broken faced stone, scalloped wall shingling, rounded rock foundation walls, boards and battens, or textured stucco?

7. Setting

What are the aspects of the setting that are important to the visual character? For example, is the alignment of buildings along a city street and their relationship to the sidewalk the essential aspect of its setting? Or, conversely, is the essential character dependent upon the tree plantings and out buildings which surround the farmhouse? Is the front yard important to the setting of the modest house? Is the specific site important to the setting such as being on a hilltop, along a river, or, is the building placed on the site in such a way to enhance its setting? Is there a special relationship to the adjoining streets and other buildings? Is there a view? Is there fencing, planting, terracing, walkways or any other landscape aspects that contribute to the setting?

STEP TWO

8. Materials at Close Range

Are there one or more materials that have an inherent texture that contributes to the close range character, such as stucco, exposed aggregate concrete, or brick textured with vertical grooves? Or materials with inherent colors such as smooth orange colored brick with dark spots of iron pyrites, or prominently veined stone, or green serpentine stone? Are there

combinations of materials, used in juxtaposition, such as several different kinds of stone, combinations of stone and brick, dressed stones for window lintels used in conjunction with rough stones for the wall? Has the choice of materials or the combinations of materials contributed to the character?

9. Craft Details

Is there high quality brickwork with narrow mortar joints? Is there hand tooled or patterned stonework? Do the walls exhibit carefully struck vertical mortar joints and recessed horizontal joints? Is the wall shinglework laid up in patterns or does it retain evidence of the circular saw marks or can the grain of the wood be seen through the semitransparent stain? Are there hand split or handdressed clapboards, or machine smooth beveled siding, or wood rusticated to look like stone, or Art Deco zigzag designs executed in stucco?

Almost any evidence of craft details, whether handmade or machinemade, will contribute to the character of a building because it is a manifestation of the materials, of the times in which the work was done, and of the tools and processes that were used. It further reflects the effects of time, of maintenance (and/or neglect) that the building has received over the years. All of these aspects are a part of the surface qualities that are seen only at close range.

STEP THREE

10. Individual Spaces

Are there individual rooms or spaces that are important to this building because of their size, height, proportion, configuration, or function, like the center hallway in a house, or the bank lobby, or the school auditorium, or the ballroom in a hotel, or a courtroom in a county courthouse?

11. Related Spaces and Sequences of Spaces

Are there adjoining rooms that are visually and physically related with large doorways or open archways so that they are perceived as related rooms as opposed to separate rooms? Is there an important sequence of spaces that are related to each other, such as the sequence from the entry way to the lobby to the stairway and to the upper balcony as in a theatre; or the sequence in a residence from the entry vestibule to the hallway to the front parlor, and on through the sliding doors to the back parlor; or the sequence in an office building from the entry vestibule to the lobby to the bank of elevators?

12. Interior Features

Are there interior features that help define the character of the building, such as fireplace mantels, stairways and balustrades, arched openings, interior shutters, inglenooks, cornices, ceiling medallions, light fixtures, balconies, doors, windows, hardware, wainscoting, panelling, trim, church pews, courtroom bars, teller cages, waiting room benches?

13. Surface Finishes and Materials

Are there surface finishes and materials that can affect the design, the color or the texture of the interior? Are there materials and finishes or craft practices that contribute to the interior character, such as wooden parquet floors, checkerboard marble floors, pressed metal ceilings, fine hardwoods, grained doors or marbled surfaces, or polychrome painted surfaces, or stenciling, or wallpaper that is important to the historic character? Are there surface finishes and materials that, because of their plainness, are imparting the essential character of the interior such as hard or bright, shiny wall surfaces of plaster or glass or metal?

14. Exposed Structure

Are there spaces where the exposed structural elements define the interior character such as the exposed posts, beams, and trusses in a church or train shed or factory? Are there rooms with decorative ceiling beams (nonstructural) in bungalows, or exposed vigas in adobe buildings?

This concludes the three-step process of identifying the visual aspects of historic buildings and is intended as an aid in preserving their character and other distinguishing qualities. It is not intended as a means of understanding the significance of historical properties or districts, nor of the events or people associated with them. That can only be done through other kinds of research and investigation.

Summary and References

Using this three-step approach, it is possible to conduct a walk through and identify all those elements and features that help define the visual character of the building. In most cases, there are a number of aspects about the exterior and interior that are important to the character of an historic building. The visual emphasis of this brief will make it possible to ascertain those things that should be preserved because their loss or alteration would diminish or destroy aspects of the historic character whether on the outside, or on the inside of the building.

Acknowledgements

This Preservation Brief was originally developed as a slide talk/methodology in 1982 to discuss the use of the Secretary of the Interior's Standards for Rehabilitation in relation to preserving historic character; and it was amplified and modified in succeeding years to help guide preservation decision making, initially for maintenance personnel in the National Park Service.

A number of people contributed to the evolution of the ideas presented here. Special thanks go to Emogene Bevitt and Gary Hume, primarily for the many and frequent discussions relating to this approach in its evolutionary stages; to Mark Fram, Ontario Heritage Foundation, Toronto, for suggesting several additions to the Checklist; and more recently, to my coworkers, both in Washington and in our regional offices, especially Ward Jandl, Sara Blumenthal, Charles Fisher, Sharon Park, AIA, Jean Travers, Camille Martone, Susan Dynes, Michael Auer, Anne E. Grimmer, Kay Weeks, Betsy Chittenden, Patrick Andrus, Carol Shull, Hugh Miller, FAIA, Jerry Rogers, Paul Alley, David Look, AIA, Margaret Pepin-Donat, Bonnie Halda, Keith Everett, Thomas Keohan, the Preservation Services Division, MidAtlantic Region, and several reviewers in state preservation offices, especially Ann Haaker, Illinois; and Stan Graves, AIA, Texas; for providing very critical and constructive review of the manuscript.

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

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3.2.3 Guidelines for painting interior and exterior surfaces (GSA 2017a)

General Guidelines for Painting Exterior and Interior Surfaces

Procedure code:

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Division:

Finishes

Section:

Painting

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GENERAL GUIDELINES FOR PAINTING EXTERIOR AND INTERIOR SURFACES

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes general guidelines for painting and finishing interior and exterior surfaces. General descriptions pertaining to surface preparation, priming and application of finish coats are also provided herein, where called for, should be used along with shop priming and surface treatment specified in other procedures.

B. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically shown not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the contracting officer will select from standard colors or finishes available.

C. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces (except as may be specified in other repair procedures) and operating parts. Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. For guidance on surface preparation, see the following (references are to GSA Technical Documents):

1. For wood, see 06300-02-R.
2. For iron and steel, see 05010-05-R.

E. For general information on primers and paints, see the following:

1. For wood, see 06300-01-S.
2. For iron and steel, see 05010-13-S.

F. For guidance on paint removal, see the following:

1. For wood, see 06400-07-R, 06400-02-S, 06400-09-R.
2. For iron and steel, see 05010-05-R, 05010-16-R and 05010-17-R.
3. For masonry, see 04211-14-R.

1.02 DEFINITIONS

A. "Paint" includes coating systems materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.

1.03 SUBMITTALS

A. Product Data: (Submit to the appropriate Cultural Resources Manager (CRM) or designated representative for approval)

1. Provide manufacturers' technical information, label analysis, and application instructions for each material proposed for use.
2. List each material and cross-reference the specific coating and finish system and application. Identify each material by the manufacturer's catalog number and general classification.

B. Samples: Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.

1. Define each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture is achieved.
2. Provide a list of materials and application for each coat of each sample. Label each sample as to location and application.

1.04 QUALITY ASSURANCE

A. Qualifications: Restoration Specialist: Work must be done by a firm having not less than 10 years' successful experience in comparable painting restoration/rehabilitation projects and employing personnel skilled in the processes and operations indicated.

B. Source of Materials: Provide primers and undercoat paint produced by the same manufacturer as the finish coats. Primers and undercoat paints shall be made to be used with the selected finish coat.

C. Regulatory Requirements:

1. Codes and Standards: Comply with all pertinent codes and regulations, including the minimum standards for materials and application as set forth in the Architectural Specifications Manual, latest edition as published by Specification Services, Washington State Council Painting and Decorating Contractors of America (PDCA), 23830 Pacific Hwy. S., Suite 102, Kent, WA 98032, (206) 878-6630.
2. Comply with applicable recommendations of the Steel Structures Painting Council (SSPC) and PDCA's Architectural Specifications Manual.
3. Where choice of painting method is to be selected from several options in SSPC and PDCA recommendations, obtain contracting officer's representatives review and approval before start of work.

D. Field Samples: On wall surfaces and other exterior and interior components, duplicate finishes of prepared samples.

1. Provide full-coat finish samples on at least 200 sq. ft. minimum of surface until required sheen, color and texture are

obtained.

2. Simulate finished lighting conditions for review of in place work.

3. Final acceptance of colors will be from job-applied samples.

4. The contracting officer's representatives will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.

a. Apply coatings in this room or surface according to the schedule or as specified.

b. After finishes are accepted, this room or surface will be used for evaluation of coating systems of a similar nature.

E. Coordination of Work:

1. Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates.

2. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

3. Notify the contracting officer of problems anticipated using the materials specified.

F. Inspections and Tests: Work in this procedure is subject to inspection and testing according to the provisions of the Architectural Specifications Manual, latest edition. Payment for inspection and testing service is responsibility of the contractor. Notify Inspection Agency at least four full working days before starting work. Allow full access to the work and give full cooperation always with the Inspection Agency in the performance of their duties in inspection and testing of the work.

1. The Inspection Agency will make field control tests specified after this for surfaces requiring painting and finishing and shall notify the specifying authority, in writing, of any defects or problems before starting work in this specification, or after failure of, or defects in, the prime coat or substrate provided by other trades. Furnish approved or alternate materials for testing, from the source or job site, upon request of the Inspection Agency.

G. Inspection Agency: Paint testing and inspection shall be done by an independent Inspection Agency acceptable to the specifying authority and as endorsed by specification service.

H. Material Quality:

1. Provide the manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturers' product identification will not be acceptable.

2. Federal Specifications establish a minimum quality level for paint materials, except where other product identification is used. Provide written certification from the manufacturer that materials provided meet or exceed these criteria.

3. Products that comply with qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to the contracting officer's representative. Furnish material data and manufacturer's certificate of performance to contracting officer's representative for proposed substitutions.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping: Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturers' name and label and the following information:

1. Product name or title of material

2. Product description (generic classification or binder type)

3. Federal Specification number, if applicable
4. Manufacturers' stock number and date of manufacture
5. Contents by volume, for pigment and vehicle constituents
6. Thinning instructions
7. Application instructions
8. Color, name and number

B. Storage and Protection:

1. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F. (7 degrees C.). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
2. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.
3. Do not open containers of coatings or components unless for immediate use. Keep containers closed when not in use.

1.06 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 500 F. (100 C.) and 900 F. (320 C.). Do not apply if, within 24 hours after application, temperature is expected to fall below 400 F. (40 C.).
2. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 450 F. (70 C.) and 950 F. (350 C.).
3. Do not apply paint in snow, rain, fog or mist when the relative humidity exceeds 85%, at temperatures less than 50 F. (30 C.) above the dew point, or to damp or wet surfaces.
4. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during applications and drying periods.
5. Do not apply paint when dust is present. Program surface preparation and painting so that dust and other contaminants from the surface preparation process and other work done will not fall or settle in wet, newly painted surfaces.
6. Do not apply paint to interior surfaces until the area is enclosed. Paint surfaces which will be inaccessible for painting.
7. Protect other work whether to be painted or not against defacement or damage by painting. Use masking materials to protect adjacent surfaces and materials.
8. Comply with manufacturers' instructions for paint curing period temperatures, humidity and time periods.
9. On wood, do not apply paint when the moisture content of the wood exceeds 12% as measured by an electronic moisture meter.
10. Lighting: Work under this section shall not proceed unless adequate lighting is available.

11. Ventilation: Assure that there is adequate ventilation for the type of coating and cleaning materials used. If necessary, consult paint manufacturer for recommendations.
12. Paint pots shall not be cleaned at sinks or other drainage facilities nor shall any debris be allowed to run into drainage lines of the building.
13. All fine arts, furniture and adjacent finishes shall be protected with drop cloths or other suitable methods from paint spatters, dirt or other damage during the progress of the work, and the contractor will be held responsible for any damage to fine arts incident to the work done under the contract.

PART 2---PRODUCTS

2.01 MATERIALS

A. Unless otherwise indicated, furnish scheduled products according to Chapters Five, Six and Seven of referenced Architectural Specifications Manual, including paint, varnish, stain, enamel, lacquer, fillers, and related products for prime, intermediate, and finish coats.

1. Materials not specifically suggested, but required, such as linseed oil, shellac, thinners and the like are to be of quality not less than required by applicable Federal or State Specification Standards.

B. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturer.

C. Color Pigments: Pure, nonfading, applicable types to suit substrates and service suggested.

1. Lead content in pigment, if any, is limited to contain no more than 0.06% lead, as lead metal based on the nonvolatile total (dry-film) of paint by weight.

NOTE: THE USE OF LEAD-BASE PAINTS HAS BEEN RESTRICTED SINCE 1978.

D. Paint may be thinned only when recommended by the manufacturer's printed instructions. Type of thinner and quantity shall be as specified by the manufacturer.

E. Primers

F. Undercoat Materials

G. Interior and Exterior Finish Paint Material

2.02 EQUIPMENT

A. For Brush Application:

1. Natural bristle brushes: Precondition by soaking in raw linseed oil for 24 hours.

B. For Roller Application:

1. Pipe rollers

C. For Mechanical Application:

1. Hot-air spray
2. Cold-air spray (automatic or hand)
3. Electrostatic air spray (powder or fluid)

PART 3---EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which painting will be done for compliance with requirements for application of paint.

B. Do not begin paint application until unsatisfactory conditions have been corrected.

C. Start of surface preparation/painting is the applicator's notice that the surfaces and conditions within a particular area are acceptable to begin work.

3.02 PREPARATION

NOTE: See also surface preparation procedures for specific materials referenced in Part 1 of this procedure.

A. Protection:

1. Do all preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.
2. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection before surface preparation and painting.
  - a. Remove these items if necessary for complete painting of the items and adjacent surfaces.
  - b. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.
3. Adjacent surfaces shall be protected against spatters, stains, or soiling. Each coat of primer or paint shall be evenly spread without skips, runs, sags, and clogging, and allowed to dry before next coat is applied.
4. Provide ample illumination in areas where painting work is in progress to fully light the work being done.
  - a. Examine areas and conditions where painting is to be done and correct any defects before beginning paint application.
  - b. Starting to paint is applicator's notice that surface preparation is acceptable.

B. Surface Preparation: Clean and prepare new surfaces to be painted according to the manufacturer's instructions for each particular substrate condition.

1. Clean surfaces before applying paint or surface treatments.
  - a. Remove oil and grease before cleaning.
  - b. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
2. Hand sand between each undercoat and finish coats on smooth surface materials where oil and synthetic resin base paint and varnish systems are scheduled.
  - a. Use extra-fine sandpaper on painted surfaces.
  - b. Remove dust from surfaces after sanding with tack cloths.
  - c. Note any additional requirement for rubbed finishes on architectural woodwork, scheduled with that finish.

C. Materials Preparation: Carefully mix and prepare paint materials according to manufacturers' directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and

residue.

2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
3. Use only thinners approved by the paint manufacturer, and only within recommended limits.
4. Tinting: Tint each undercoat a lighter shade to ease identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.03 ERECTION, INSTALLATION, APPLICATION

A. General:

1. Assume all responsibility for paint coats applied over surfaces and undercoats which have not been approved by CRM.
  2. Remove paint and apply any additional coats of paint, as directed by CRM, where surface preparation and undercoats have not been approved before finish painting.
  3. Provide finish coats that are compatible with primers used.
  4. Where different colors meet, provide a clear line of natural juncture.
  5. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
  6. Finish doors on tops, bottoms and side edges, the same as the exterior faces.
  7. Paint the back sides of access panels, removable or hinged covers to match the exposed surfaces.
    - a. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, and similar components are in place.
    - b. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
  8. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces.
  9. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
  10. Include field prime coats on metalwork in addition to any shop prime coats.
  11. Sand lightly between each succeeding enamel and varnish coat.
- NOTE: DO NOT PAINT OVER DIRT, RUST, SCALE, GREASE, MOISTURE, SCUFFED SURFACES, OR CONDITIONS DETRIMENTAL TO FORMATION OF A DURABLE SMOOTH PAINT FILM.

B. Scheduling Painting:

1. Apply the first coat to surfaces cleaned, pretreated, or otherwise prepared for painting when practicable after preparation and before subsequent surface deterioration.
2. Allow sufficient time between successive coats to allow proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Apply paint following manufacturers' directions. Use applicators and techniques best suited for substrate and type of material being applied.

NOTE: CLOUDINESS, SPOTTING, HOLIDAYS, LAPS, BRUSH MARKS, RUNS, SAGS, ROPINESS, OR OTHER SURFACE IMPERFECTIONS WILL NOT BE ACCEPTABLE.

1. Methods of Application:

a. Brush application:

- 1) Brush-out and work brush coats in both directions onto the surfaces in a uniform film.
- 2) Use brushes best suited for the type of material being applied.
- 3) Neatly draw all glass and color break lines.

b. Roller application:

- 1) Roll-out and work roller coats in both directions onto the surfaces in a uniform film.
- 2) Sleeves used on the rollers to be clean, full clipped pile, or as recommended by paint manufacturer for material and texture required.
- 3) Use brush at corners, fasteners, irregular surfaces or items, and other like conditions.

c. Mechanical application:

NOTE: USE MECHANICAL METHODS FOR PAINT APPLICATION ONLY WHEN ACCEPTABLE. CONSULT WITH CRM.

- 1) Spray painting, if permitted, should be accomplished using pressure settings, application technique, spray tip, mesh filter screens, and mesh tip strainer as recommended by the coating manufacturer.
- 2) Do not double back with spray equipment to build up film thickness of two coats in one pass.

2. Minimum Coating Thickness:

- a. Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.
- b. The number of coats and film thickness required is the same, despite the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface according to the manufacturer's directions.

3. Prime Coats: PRIME COAT APPLICATION SHOULD MATCH ORIGINAL FINISH APPLICATION.

NOTE: BRUSH APPLY ALL PRIME COATS UNLESS OTHERWISE ALLOWED TO USE ROLLER OR MECHANICAL APPLICATORS.

- a. Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material required to be painted or finished and has not been prime coated by others.
- b. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.
- c. Omit primer on metal surfaces that have been shop-primed and touch up painted.

4. Top Coats: TOP COAT APPLICATION SHOULD MATCH ORIGINAL FINISH APPLICATION.

- a. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces.
- b. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- c. For Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.
- d. For Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- e. For Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.

5. Completed Work:

- a. Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.
- b. Finish painted surfaces shall be free of clouding due to no coverage of ground coats or surfaces to which applied. Finish coat shall match specified color.
  - 1) Edges adjoining other materials or colors shall be true without overlapping.
  - 2) Each coat shall be applied to ornamental work in a way that will not obscure ornament and texture.
  - 3) Each coat shall be even.

3.04 FIELD QUALITY CONTROL

A. GSA reserves the right to invoke the following test procedure any time and as often as it deems necessary during the period when paint is being applied.

- 1. GSA may engage the services of an independent testing laboratory to sample the paint material being used. Samples of material delivered to the project will be taken, identified, sealed, and certified in the presence of the contractor.
- 2. The testing laboratory will do appropriate tests for the following characteristics as required by GSA.
  - a. Quantitative materials
  - b. Abrasion resistance
  - c. Apparent reflectivity
  - d. Flexibility
  - e. Washability
  - f. Absorption
  - g. Accelerated weathering
  - h. Dry opacity
  - i. Accelerated yellowness

- j. Recoating
- k. Skinning
- l. Color retention
- m. Alkali and mildew resistance

B. If the test results show that the paint materials do not comply with the specified requirements, stop the painting work, and remove noncomplying paint; repaint surfaces coated with the rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with the specified paint, the two coatings are non-compatible. Use corrective methods as directed.

3.2.4 Surface preparation for brick, metal, wood, and plaster (GSA 2016a)

U.S. General Services Administration

Surface Preparation Guidelines For Brick, Metal, Wood And Plaster

Procedure code:

990008G

Source:

National Capitol Region Specification - Old Executive Office Building

Division:

Finishes

Section:

Painting

Last Modified:

08/02/2016

PART 1---GENERAL

1.01 SUMMARY

- A. This procedure includes guidance on preparing various surface types for repainting. These include brick, metal, wood and plaster.
- B. See "General Project Guidelines" 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. Red Devil, Inc.
Pryor, OK

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. Mineral spirits:

1. A petroleum distillate that is used especially as a paint or varnish thinner.
2. Other chemical or common names include Benzine* (not Benzene); Naphtha*; Petroleum spirits*; Solvent naphtha*.
3. Potential Hazards: TOXIC AND FLAMMABLE.
4. Safety Precautions:
  - a. AVOID REPEATED OR PROLONGED SKIN CONTACT.
  - b. ALWAYS wear rubber gloves when handling mineral spirits
  - c. If any chemical is splashed onto the skin, wash immediately with soap and water.
  - d. Available from construction specialties distributor, hardware store, paint store, or printer's supply distributor

B. Water-soluble detergent

C. Clean, potable water

D. Sandpaper

E. Trisodium Phosphate (TSP)

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.

1. Strong base-type powdered cleaning material sold under brand names.
2. Other chemical or common names include Sodium Orthophosphate; Tribasic sodium phosphate; Trisodium orthophosphate; TSP*; Phosphate of soda*; (also sold under brand names such as Red Devil).
3. Potential Hazards: CORROSIVE TO FLESH.
4. Available from chemical supply house, grocery store or supermarket or hardware store.
5. Chemical deglosser
6. White *shellac*, or other approved knot sealer
7. Primer
8. Varnish, or other approved sealer

2.02 EQUIPMENT

- A. Wood and metal scrapers
- B. Wire brushes (non-ferrous bristle)
- C. Stiff bristle brushes

PART 3---EXECUTION

2.01 PREPARATION

- A. Protection: Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.
- B. Surface Preparation: Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.02 ERECTION, INSTALLATION, APPLICATION

- A. Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.
- B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.
  - 1. Brick: Clean brick surfaces to be painted for loose or peeling paint, dirt, oil, or other foreign substances with scrapers, stiff bristle brushes and mineral spirits as required. Wash entire surface with a water-soluble detergent and rinse thoroughly with clean water to remove cleaner residue and soil.
  - 2. Ornamental Metal: Clean ornamental metal surfaces to be painted of dirt, oil or other foreign substances with scrapers and solvent cleaners as required. Remove loose or peeling paint by gently wire brushing surfaces. Sandpaper smooth any rough edges created by removal of peeling or loose paint to create an even plane across surface.
  - 3. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.
    - a. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with same type shop primer.
    - b. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum-based solvent.
  - 4. New Wood:
    - a. Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.
    - b. Prime, stain or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, and paneling.
    - c. When transparent finish is required, use spar varnish for back priming.
    - d. Back prime paneling on interior partitions only where masonry, plaster or other wet wall construction occurs on backside.
    - e. Seal tops, bottoms, and cut-outs of unprimed wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery to job
  - 5. Existing Wood:
    - a. Scrape existing wood surfaces to be painted with a flat blade scraper to remove all peeling or blistering paint finish. Sand surface to a smooth finish, flush with contiguous surfaces. To ensure bonding of new paint material, clean surfaces free of dirt, oil, dust or other foreign substances with trisodium phosphate (TSP) cleaning solution. Rinse thoroughly with clean water to remove cleaner residue and soil. Lightly sand or treat existing surfaces with a chemical paint bonding agent.
    - b. Clean existing wood surfaces to receive a clear finish with mineral spirits to remove dirt, oil, or other foreign substances and wipe with a clean cloth. Wipe entire surface with a pre-impregnated tack rag and immediately apply finish.
  - 6. Plaster:
    - a. Clean plaster surfaces to be painted for dirt, oil or other foreign substances with scrapers, mineral spirits and sandpaper. Wash entire surface with a trisodium phosphate (TSP) cleaning solution and rinse thoroughly with clean water to remove cleaner residue and soil.
    - b. Prepare plaster areas by first scraping the entire surface to remove all loose paint of finish plaster. Apply a bonding agent to exposed areas and then apply complete skim finish coat over the

low areas to bring the entire finished surface out flush with adjacent firm and sound layers of plaster or paint. Sandpaper smooth to create a flat plane without bumps, cracks or depressions, ready to receive paint.

- C. Mix and prepare painting materials in accordance with manufacturer's directions.
- D. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.
- E. Stir materials before application to produce a mixture of uniform density and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3.03 ADJUSTING/CLEANING

- A. During progress of work, remove from site discarded materials, rubbish, cans and rags at end of each work day.
- B. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

3.04 PROTECTION

- A. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to RHPO.
- B. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.2.5 Routine building inspection checklist (GSA 2017b)

Checklist For The Routine Inspection Of Buildings

Procedure code:

180001G

Source:

Kansas State Historical Society - Historic Preservation Dept

Division:

General Requirements

Section:

Maintenance

Last Modified:

02/17/2017

Exterior Inspection

All building materials deteriorate with age and exposure to the weather. Through routine inspection and cyclical maintenance, the useful life span of a building and its historic fabric will be greatly increased. The principal reason for developing this building inspection form is to advise building owners on the maintenance of their properties. The money invested in a building is considerable and care and effort are required to preserve and increase the value of the property. Unfortunately, many building owners use the "squeaky wheel" technique in their approach to maintenance, doing little or nothing until failure occurs. And when it does the owner is hit with high repair bills and great inconvenience. The job of maintenance can be simplified if it is done systematically instead of haphazardly. Preventive maintenance involves regular inspection of those parts of the building that are most likely to get out of working order. The accompanying checklist is intended to help a building owner or manager identify and keep an accurate record or inventory of the building's problems to facilitate systematic repair and maintenance.

This procedure is a brief but comprehensive overall building inspection. Each of the areas addressed may have more extensive inspection procedures which could be followed in the case of specific problems.

1. ROOFS

A roof is all that stands between the interior of a building and the weather outside. A neglected roof will result in higher costs from damages caused by leaks than a carefully maintained roof. Roofing materials and elements should be inspected twice a year, before and after the harsh weather of winter, to determine maintenance needs. The most common types of roof include gable, hip, hip-and-valley, gambrel, and flat or built-up roof.

- a. Asphalt Shingles: Pay particular attention to shingles on the ridge, hips, and at roof edges; they get the hardest wear. Also watch for lumpiness that indicates a new roof has been applied over old shingles; all sorts of damage could be covered up. Look for:
  1. Mineral granules almost totally worn off shingles
  2. Mineral granules collecting in gutters and base of downspouts
  3. Edges of shingles look worn
  4. Nails popping up
  5. Roof looks new but lumpy
  6. Mold or moss forming on shingles
  7. Holes in the roof from guy cables, TV antennas etc.
  8. Leading edge of roof damaged by ladders
- b. Clay Tiles: Clay tiles will weather well but are prone to breakage from mechanical shock, such as a falling tree limb or people walking on the tiles without protecting them. Check for:
  1. Broken tiles
  2. Missing tiles
  3. Nails popping up
  4. Mold or moss forming on tile
- c. Slate: Some slates are more durable than others, but a properly laid top quality slate should last a century or more (slate longevity varies depending on slate source). Check for:
  1. Broken slates
  2. Missing slates
  3. Slate flaking apart
  4. Nails letting go
  5. Slate particles collecting in valley flashing
- d. Metal: If the metal isn't copper, zinc, stainless steel, and other corrosion-resistant metal blends your primary task will be to fight rust by keeping the roof painted. Check for:
  1. Rust or corrosion spots
  2. Signs of previous patch jobs
  3. Punctures in metal
  4. Joints and seams broken
- e. Wood Shingles and Shakes: For maximum roof life, shingles and shakes require proper air circulation underneath so they can dry after rain. Therefore, they should be laid on open sheathing. If you find that they are improperly laid, you can help them dry by providing adequate ventilation in your attic. Look for:
  1. Biological attack (moss or mold, insects, birds)
  2. Cupping and warping
  3. Deep cracks and splits
  4. Wood has become unevenly thin from erosion
- f. Built-up Roof: The roof membrane of a built-up roof consists of one or more plies of roofing felt bonded together either by hot or cold applied roof coatings. Deterioration of the membrane produces areas of the surface of the roof where leaks can occur. It is particularly difficult to diagnose leaks in flat roofs because water can enter at one point and migrate horizontally for long distance before leaking inside the building. Check for:
  1. Blisters or slits in the membrane
  2. Ponding of water (or dried areas where ponding was)
  3. Drain pipes are plugged
  4. Drip edges are provided

5. Gravel covers roof well
6. Flashing are well positioned or seated
7. Trash build-up

g. Membrane Roof: A further development and evolution of a built-up roof is a membrane roof composed of rolls/sheets of materials such as synthetic rubber, thermoplastics, or other man-made materials. Such roofs are often installed over a layer of rigid insulation. These types of membrane roofs may not have a stone top layer. Also, these roof are often white or other reflective colors to reduce solar heat gain and the urban heat island effect. Checklist is generally similar as noted in "f. Built-up Roof".

h. Green Roof: The "green roof" with a living plant material layer at the top surface is typically a membrane roof as noted in "g." above, but with a very important root-resisting and waterproof layer(s) to isolate the living plant material layer from layers below. For further reference see the links below from the Whole Building Design Guide:

<http://www.wbdg.org/resources/greenroofs.php>

2. ROOFING ELEMENTS

- a. Projections: Anything that breaks through the roof surface, such as a chimney or vent pipe, offers an entrance for water and so must be adequately flashed. Check that no projection or ornament is so weak or damaged that it could topple and smash roofing materials. Check for:
  1. Proper flashing around projections
  2. Weathering of mortar joints at chimneys
  3. Loose mortar joints that admit water
  4. Chimney leans
  5. Loose and wobbly antennae
  6. Loose lightning rods
  7. Loose and wobbly weather vane
- b. Galvanic Action: Corrosion of metals can be caused by galvanic action. Check for:
  1. Ferrous metals touching dissimilar metals, such as galvanized nails in copper flashing
- c. Cornice: Roofs frequently fail first at the edges and admit water into the cornice. Check for:
  1. Moisture causing paint to peel on cornice, especially at the underside
  2. Broken or missing cornice
  3. Cracks and other damages
- d. Underside of Roof: Pay particular attention to projections and eaves. Inspect on a rainy day to see if water stains are current or past problem. Look for:
  1. Water stains on soffit boards
  2. Damaged soffit boards
  3. Damaged fascia boards
- e. Flashing: Flashing is usually made of thin metal, such as copper, aluminum, or galvanized steel. It should be installed completely around every protrusion through the roof, and at every joint where vertical wall intersects the roof. Check for:
  1. Loose, corroded, or broken flashing
  2. Missing and uncaulked openings at the tops of flashing
  3. Daubs of roof cement on flashing (They may hide leaks that have not been corrected)
  4. Base flashing and counterflashing of vertical joints

- f. Gutters and Leaders: Leaking gutters can cause extensive damage to the entire building, not just the roof. Pay special attention to built-in gutters which can feed hidden leaks directly to the cornice and down into the main structure. Check for:
1. Gutters clogged with debris or ice
  2. Gutters that are rusty or corroded
  3. Gutters that are loose, tilted, or missing
  4. Broken seams in metal linings of built-in gutters
  5. Birds nests and roosting places

3. EXTERIOR WALL MATERIAL

The accumulated effects of hot sun, wind, rain, hail, dust, winter snow, and ice over the years will weather even the best quality masonry wall and/or siding. Natural finishes, including paint, deteriorate and show signs of peeling and blistering. Cracks develop as members weather and caulking and mortar joints give way to water penetration. The following checklist will be useful in inspecting buildings on a regular basis to determine maintenance needs.

- a. Masonry & Mortar: The inspector should pay particular attention to loose mortar joints, cracks, stains and wet spots on the wall.
1. Cracks can be horizontal, vertical, diagonal, hairline or major. Document the nature of the crack, explaining as best as possible the causes of the cracks. Note if cracks are running through just the mortar or also the masonry units.
  2. Mortar: Inspect mortar joints to determine if they are loose or missing and evaluate their condition as good, fair or poor.
  3. Brick: Check for stains, wet spots, bulges, spalling, efflorescence, and missing brick.
  4. Stone: Inspect stone work for wet spots, stains, spalling, bulges, and efflorescence. For a comprehensive inspection checklist for stone, see 04400-01-S.
- b. Stucco/Plaster: Inspect for:
1. Cracks, staining, loose stucco, soft spots, blisters or bulges, and falling stucco.
- c. Siding, Shingles, and Sheathing: Hot sun, wind, rain, hail, dust and winter snow and ice are the principal causes of damages to siding and sheathing. Inspect siding, shingles, soffits and wood trim such as cornices for:
1. Cracked boards, loose boards, or broken boards
  2. Rotted and missing members
  3. Signs of veins of dirt (termite tunnels)

4. EXTERIOR FINISHES

Finishes need to be renewed periodically by application of a fresh penetrating stain coat or a paint coat when wear begins to show. There are many causes of poor paint wear. Most common are vapor or condensation problems. Other causes are rain or other water behind siding or shingles and also improperly applied priming coat.

- a. Painting: Inspect all finished surfaces for:
1. Signs of peeling, cracks, and alligatoring
  2. Document the overall findings as good, fair, or poor
- b. Decorative Elements: Ornamental elements also undergo wear and tear. Inspect not only the ornament but also its supports, such as anchors, for expansion due to rust.
1. Cast iron: Inspect for rust, deterioration, corrosion, and loose and missing members

2. Stone/terra cotta: Inspect for loose, eroded, spalled, and stained tiles
3. Wood: Inspect for rot, moisture, cracks, missing and loose members

5. FENESTRATION

Doors and windows constitute main sources of energy loss through air infiltration. Energy losses can be reduced by weatherstripping. Inspect to ensure that weatherstripping is properly installed and all sources of infiltration are in check.

- a. Doors: Inspect doors, frames, and weatherstripping. Check:
  1. Door alignment
  2. All parts for deterioration
  3. All door hardware for proper operation
- b. Windows: Inspect windows for material soundness at sill, joint between sill and jamb, corners of bottom rail and muntins. Check for:
  1. Proper operation of all sash (including upper sash of double hung units)
  2. Proper operation of hardware
  3. Loose, cracked or missing glazing putty
  4. Soundness of weatherstripping
  5. Cracks and other damages to lintel
  6. Rot and/or deterioration of wood framing

6. EXTERIOR CEILINGS AND DECKS

- a. Porch: Moisture problems in an exterior ceiling are indications of faulty drainage from the roof above. Inspect the roof to make sure water isn't entering the main structure of the building as well. Check for:
  1. Peeling paint and water stains on the ceiling
  2. Rotted and warped boards in the deck
  3. Damaged and/or loose steps and handrails
  4. Rotted boards and other damages to ceiling
  5. Cracks and other damages on a concrete floor
  6. Spalling, cracks, loose and/or missing mortar joints on brick or stone
- b. Wooden Supports: Wood destroying insects and fungi can cause considerable damage to the wooden supports of exterior ceilings and decks. Early detection of pests and decay can help building owners avoid expensive repairs. Inspectors should pay particular attention to:
  1. Molds and fungus
  2. Wood rot and termite infestation
  3. Seal of deck at foundation
  4. Corrosion of iron fittings on members
- c. Infestation: Chemical treatment of the structure and adjacent soil will drive insects away. No matter what protective measures are taken, a periodic inspection should be made at least every six months. The existence of termites or infestation in older buildings with crawl space is difficult to detect because contact with the soil is usually direct and termite tubes are not evident. Inspection by professional exterminators is essential in such cases. Check for:
  1. The need of treatment for ants and other wood destroying insects
  2. Termites
  3. Damage and rot on all wood members

7. GROUNDS

The ground should be properly graded to direct the flow of rainwater away from the building and from the lot to prevent standing water. The property should always be checked after a heavy rain to see if it drains properly.

- a. Driveways and Sidewalks: Check for:
  - 1. Safety hazards (heaves and depressions)
  - 2. Cracks on and deterioration of paved material
  - 3. Damages to and curb clearances
  - 4. Oil stains and pools of water
- b. Window Well: Check for:
  - 1. Leaks and standing water
  - 2. Leaves and other debris
  - 3. Other damages to window well material
- c. Storm Drains: Check for proper drainage and/or clogging of drain line.
- d. Retaining Wall: Check for:
  - 1. Cracks, spalling from subflorescence and freezing
  - 2. Leaning and Bulges
  - 3. Loose, crumbling, and missing mortar joints
- e. Foundation: Inspect to ensure that there is no collection of leaves and other debris at the edges of the foundation and for proper drainage. Check for:
  - 1. Cracks, spalling from subflorescence and freezing
  - 2. Leaning and Bulges
  - 3. Loose, crumbling, and missing mortar joints
- f. Landscape: Check all landscape features eg. Trees, Bushes for diseased or dead parts. Check if:
  - 1. Trees overhang or touch building which cause damage or trash build-up
  - 2. Creepers and vines are causing damage (paint peeling, joint deterioration etc.)
  - 3. Plants holding water against structure
  - 4. Tree roots damaging structure
  - 5. Bare spots show in lawn and /or shrubs need pruning

8. INTERIOR INSPECTION

BASEMENT AND CRAWL SPACE: Foundation walls are subject to a wide variety of stresses and strains that cause concrete and other masonry to expand and contract. This sometimes results in cracks, leaks or condensation problems. Inspect to ensure that rainwater and other sources of moisture drain away from the building. Check for dampness on surfaces and for mold on joists at the point where the first floor joists meet the foundation wall.

- a. Load Bearing Masonry Wall: Inspect load bearing walls for structural damages paying particular attention to the following:
  - 1. Cracks caused by either structural movement or material shrinkage
  - 2. Leaning and bulges
  - 3. Loose/damp mortar joints and spalling
  - 4. Wet spots, stains and water penetration
  - 5. Insect/termite infestation and decay on wood members

- b. Cast-in-Place Concrete Wall: Look for:
  - 1. Settlement, cracks, and leaning
  - 2. Water penetration, wet spots, and stains
  - 3. Moisture conditions (dampness etc.)
  - 4. Insect/termite infestation and decay on wood members
- c. Wood Joists & Beams: Check for:
  - 1. Sagging at the center of span
  - 2. Springiness or vibration
  - 3. Pronounced slope in one direction
  - 4. Split at bottom of joist or beam
  - 5. Floor squeaking and insect infestation/decay
  - 6. Bearing on masonry
  - 7. Bulging or sagging plaster ceiling
  - 8. Overloading of joists and beams
- d. Steel Beams/Concrete Deck: Check for:
  - 1. Deflection at midspan
  - 2. Sloping floor
  - 3. Corroded connections
  - 4. Missing connections and connections bearing on masonry
  - 5. Settlement effects, mechanical or exterior leakage
- e. Reinforced Concrete Floor: Check for:
  - 1. Spalling and exposed reinforced steel
  - 2. Wide, regularly spaced cracks in floor
  - 3. Cracks near and parallel to masonry wall
  - 4. Surface dusting and cracked concrete near columns
- f. Masonry Floors: Check for:
  - 1. Leaks, cracks, and spalling
  - 2. Alterations and new holes cut on floor for stairs, mechanical installations etc.
  - 3. Efflorescence
  - 4. Sidewalk vaults and subgrade storage
  - 5. Crack at the crown of the arch and between supporting walls
- g. Wood Floor: Wood floors members bearing directly to the soil are susceptible to insect and fungus attack. Check the underside of boards and floor joists for fungus, insect and or termite attack. Look for:
  - 1. Cracks and badly damaged boards
  - 2. Twisted boards
  - 3. Squeaking
  - 4. If floor boards need refinishing
- h. Carpet: Inspect for:
  - 1. Frayed edges
  - 2. Damaged portions
  - 3. Stains and worn out areas
- i. Ceramic Tile: Inspect for:
  - 1. Adherence and grout in joints
  - 2. Loose joints

3. Splits and cracks
  4. Missing tiles
- j. Interior Wall Finishes: Includes but not is limited to plaster/stucco, gypsum board, wood, and wallpaper.
1. Push on suspect wall surfaces to check for looseness
  2. Check for signs of dampness (this suggests leaks, either from the roof or internal pipes)
  3. Inspect for cracks, bulges, peeling, blistering and mildew
- k. Ceiling Finishes: May be plaster/stucco, gypsum board, wood, wallpaper, or any other material. Specify this other material in your inspection record sheet. Check for:
1. Signs of damp plaster on ceilings (this suggests leaks from the roof or plumbing and mechanical pipes)
  2. Loose plaster, cracks and bulges
  3. Blistering and peeling
- l. Interior Decorative Masonry: This includes window sills, walls, wainscot, and floors. Check for:
1. Dullness of surfaces
  2. Stains, dampness, and spalling
- m. Fireplace: Inspect active fireplaces thoroughly for fire safety, material soundness, and structural stability. Check:
1. Connection with flues
  2. If damper is operable
  3. If the flue is lined with a clay-tile liner to prevent fire and fumes leakage into the building
  4. If the flue is unobstructed all the way to the roof
  5. If the fire box has a firebrick liner
- n. Metal Surfaces: Brass, cast iron, and bronze. Inspect all exposed ornamental metal trim. Check for:
1. Built-up dirt, stain and rust
  2. Corrosion and cracked surfaces
- o. Stairs: (refers to wooden stairs) Check for:
1. Secureness of all railings
  2. Gaps between treads, risers and stringers
  3. Stair pulling away from the wall
  4. Looseness or other damage to balustrades
  5. Looseness and other damage to newel post
  6. Irregular riser-tread ratios
- p. Interior Doors and Wood Trim: Check for:
1. Proper door alignment, fit and operation
  2. Presence of all door hardware
  3. Proper operation of all locks
  4. Deterioration of hinges and pins
  5. Condition of finish and other problems
- q. Interior Windows and Wood Trim: Check for:
1. Proper window alignment, fit and operation
  2. Presence and functioning of all window hardware
  3. Proper operation of locks, hinges and pins
  4. Signs of water leakage at frames
  5. Movement of sash up and down the frame
  6. Seals around window panes
  7. Condition of finish and record other problems

- r. Kitchen Cabinets/Counters: Inspect cabinets and counters to ensure that all drawers and doors are properly hung and secure, and that no movements are restricted and to ensure that all units are securely anchored to walls and floor.

Check for:

1. Missing handles and hardware
2. Badly worn or stained countertops
3. Condition of finish

9. MECHANICAL AND ELECTRICAL:

- a. Electrical: Ascertain that there are sufficient power circuits to run all the appliance and equipment the owner uses. Remember that older buildings were not originally wired to take care of the many electrical appliances and the equipment used today. Check:
1. The condition of incoming service wires and supports
  2. The operation of all exterior outlets and switches
  3. Whether all exterior plugs and kitchen, bathroom, wet area plugs as required by code are fitted with ground fault connectors
  4. Whether fuses or circuit breakers trip frequently
  5. Whether an electrician has periodically checked all aluminum wire connections
  6. Whether power is brought in overhead rather than underground (if so, look for trees or other hazards that could cause problems)
- b. Plumbing and Mechanical Systems: Note which types of heating, ventilating and air conditioning systems the building presently has. Inspect the furnaces, ducts, registers, and radiators.
1. Look for any obvious signs of deterioration, damage, stains and rot
  2. Inspect the water supply and waste pipes for rust and leaks
  3. Has the local gas company tested gas lines for leaks (if not, have them do so).

10. ATTIC

- a. Condensation occurs in the attic principally because of easy pathways for moisture to migrate from the occupied areas, or because of inadequate ventilation. The ventilators (louvers) in the unfinished and unconditioned attic should remain open to provide circulation of air throughout the year. Check for:
1. Any signs of roof or flashing leaks on rafters and insulation
  2. Signs of mildew on underside of roof boards
  3. Smoke or water leaks or breaks in the mortar joints of the chimney
  4. Straightness and sound condition of roof rafters
  5. Adequacy and condition of insulation
  6. Nests and blockages of ventilation openings
  7. Operation of vent and/or attic fan

4 Interior – Overview and Immediate Concerns

The interiors of the buildings at the USMMA range from having many character-defining features to some character-defining features to no character-defining features. The interiors of Wiley Hall (Figure 9–Figure 17) and the American Merchant Marine Museum (Barstow Mansion; Figure 18–Figure 23) have the most character-defining features, and they need to be treated with the utmost care in consultation with the NY SHPO. The interiors of the Mariner’s Memorial Chapel (Figure 24–Figure 26), Delano Hall (Figure 27–Figure 31), and O’Hara Hall have certain character-defining features that need to be preserved, while the dorms and classroom buildings do not have interior character-defining features. Please refer to *Character-Defining Features of Contributing Buildings and Structures in the United States Merchant Marine Academy Historic District* report (Smith, Ensore, and Adams 2014) to help guide this process, in coordination with the NY SHPO.

Figure 9. The entrance hall in Wiley Hall (ERDC-CERL, 2013).

Figure 10. Main staircase in Wiley Hall (ERDC-CERL, 2013).

Figure 11. Detail of dining room fireplace surround in Wiley Hall (ERDC-CERL, 2103).

Figure 12. Painted plaster ceiling in Wiley Hall with non-historic light fixture (ERDC-CERL, 2013).

Figure 13. Painted plaster over concrete ceiling in the entrance hall at Wiley Hall (ERDC-CERL, 2013).

Figure 14. Terra cotta tile floor in Wiley Hall (ERDC-CERL, 2013).

Figure 15. Wood door and surround in Wiley Hall (ERDC-CERL, 2013).

Figure 16. One of the many original light fixtures in Wiley Hall (ERDC-CERL, 2013).

Figure 17. One of the many character-defining bathrooms in Wiley Hall with original sink and tile (ERDC-CERL, 2013).

Figure 18. An original shower in Wiley Hall with original tile and fixtures (ERDC-CERL, 2013).

Figure 19. Entrance hall in the American Merchant Marine Museum (Barstow Mansion) (ERDC-CERL, 2013).

Figure 20. Painted plaster ceiling in the American Merchant Marine Museum (Barstow Mansion) (ERDC-CERL, 2013).

Figure 21. Original light fixture in the American Merchant Marine Museum (Barstow Mansion) (ERDC-CERL, 2013).

Figure 22. One of the many character-defining bathrooms in the American Merchant Marine Museum (Barstow Mansion) with original Batchelder tile, sink, tub, and toilet (ERDC-CERL, 2013).

Figure 23. Another of the many character-defining bathrooms in the American Merchant Marine Museum (Barstow Mansion) with original Batchelder tile, sink, tub, and toilet (ERDC-CERL, 2013).

Figure 24. Interior of the Mariner's Memorial Chapel (ERDC-CERL, 2013).

Figure 25. Detail of wood pews in the Mariner's Memorial Chapel (ERDC-CERL, 2013).

Figure 26. Stained glass window in the Mariner's Memorial Chapel (ERDC-CERL, 2013).

Figure 27. Interior of Delano Hall (ERDC-CERL, 2013).

Figure 28. Mural in Delano Hall (ERDC-CERL, 2013).

Figure 29. Light fixture in Delano Hall (ERDC-CERL, 2013).

4.1 Immediate concerns for interior features

Generally, immediate concerns for historic interiors are due to subtle shifting of the buildings and damage to certain decorative elements of the interior (Figure 30–Figure 31) due to age, water infiltration, past transformations of interior spaces to accommodate school and administrative needs (Figure 32–Figure 33) and other environmental issues, plus a reduced need for many bathrooms that subsequently have been used for storage (Figure 34–Figure 35). Larger issues also exist, such as water in the basement and water damage to architectural elements (Figure 36 and Figure 37).

Figure 30. Crack in the plaster over concrete ceiling in the entrance hall at Wiley Hall (ERDC-CERL, 2013).

Figure 31. Damage to painted plaster ceiling (ERDC-CERL, 2013).

Figure 32. Use of bedrooms on the third floor of the American Merchant Marine Museum (Barstow Mansion) for storage purposes that possibly exceeds the live load capability of the structure (ERDC-CERL, 2013).

Figure 33. Use of former veranda space in Wiley Hall for administration space (ERDC-CERL, 2013).

Figure 34. Use of bathrooms in Wiley Hall for storage space (ERDC-CERL, 2013).

Figure 35. Use of some bathrooms in the American Merchant Marine Museum (Barstow Mansion) for storage purposes is potentially damaging the Batchelder tile (ERDC-CERL, 2013).

Figure 36. Water leak from steam system in basement of Wiley Hall
(ERDC-CERL, 2013).

Figure 37. Damage to plaster architectural element in the basement of Wiley Hall
(ERDC-CERL, 2013).

4.2 Guidelines, briefs, bulletins, and sources for interior

In addition to the information contained in this manual, the authors have compiled the following federal resource publications (reproduced here for convenience, with links for online access given in References) to inform managers about standards, guidelines, and procedures for understanding architecture, and caring for, preserving, and rehabilitating historic buildings with emphasis on historic interior features (see subsections 4.2.1–4.2.12).

4.2.1 Identifying and preserving character-defining elements (Jandl 1988 – Preservation Brief #18)

Technical Preservation Services

National Park Service
U.S. Department of the Interior

[Home](#) > [How to Preserve](#) > [Preservation Briefs](#) > 18 Rehabilitating Interiors

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

PRESERVATION BRIEFS

18

Rehabilitating Interiors in Historic Buildings: Identifying and Preserving Character-Defining Elements

H. Ward Jandl

[Identifying and Evaluating](#)

[Recommended Approaches](#)

[Meeting Building, Life Safety and Fire Codes](#)

[Sources of Assistance](#)

[Protecting Interior Elements](#)

[Summary and References](#)

[Reading List](#)

[Download the PDF](#)

A floor plan, the arrangement of spaces, and features and applied finishes may be individually or collectively important in defining the historic character of the building and the purpose for which it was constructed. Thus, their identification, retention, protection, and repair should be given prime consideration in every preservation project. Caution should be exercised in developing plans that would radically change character-defining spaces or that would obscure, damage or destroy interior features or finishes.

The interiors of mills and industrial buildings are frequently open, unadorned spaces with exposed structural elements. While these spaces can serve many new uses, the floor to ceiling height and exposed truss system are character-defining features that should be retained in rehabilitation. Photo: NPS files.

While the exterior of a building may be its most prominent visible aspect, or its "public face," its interior can be even more important in conveying the building's history and development over time. Rehabilitation within the context of the Secretary of the Interior's Standards for Rehabilitation calls for the preservation of exterior and interior portions or features of the building that are significant to its historic, architectural and cultural values.

Interior components worthy of preservation may include the building's plan (sequence of spaces and circulation patterns), the building's spaces (rooms and volumes), individual architectural features, and the various finishes and materials that make up the walls, floors, and ceilings. A theater auditorium or sequences of rooms such as double parlors or a lobby leading to a stairway that ascends to a mezzanine may comprise a building's most important spaces. Individual rooms may contain notable features such

Detail of carving on interior shutter, Hammond-Harwood House, Annapolis, Maryland. Photo: NPS files.

as plaster cornices, millwork, parquet wood floors, and hardware. Paints, wall coverings, and finishing techniques such as graining, may provide color, texture, and patterns which add to a building's unique character.

Virtually all rehabilitations of historic buildings involve some degree of interior alteration, even if the buildings are to be used for their original purpose. Interior rehabilitation proposals may range from preservation of existing features and spaces to total reconfigurations. In some cases, depending on the building, restoration may be warranted to preserve historic character adequately; in other cases, extensive alterations may be perfectly acceptable.

This Preservation Brief has been developed to assist building owners and architects in identifying and evaluating those elements of a building's interior that contribute to its historic character and in planning for the preservation of those elements in the process of rehabilitation. The guidance applies to all building types and styles, from 18th century churches to 20th century office buildings. The Brief does not attempt to provide specific advice on preservation techniques and treatments, given the vast range of buildings, but rather suggests general preservation approaches to guide construction work.

Not only are the features of this early 20th century interior worthy of preservation, the planned sequence of spaces impart a grandeur that is characteristic of high style residences of the period. Photo: Jack E. Boucher, HABS collection.

Identifying and Evaluating the Importance of Interior Elements Prior to Rehabilitation

Before determining what uses might be appropriate and before drawing up plans, a thorough professional assessment should be undertaken to identify those tangible architectural components that, prior to rehabilitation, convey the building's sense of time and place—that is, its "historic character." Such an assessment, accomplished by walking through and taking account of each element that makes up the interior, can help ensure that a truly compatible use for the building, one that requires minimal alteration to the building, is selected.

Researching The Building's History

A review of the building's history will reveal why and when the building achieved significance or how it contributes to the significance of the district. This information helps to evaluate whether a particular rehabilitation treatment will be appropriate to the building and whether it will preserve those tangible components of the building that convey its significance for association with specific events or persons along with its architectural importance. In this regard, National Register files may prove useful in explaining why and for what period of time the building is significant. In some cases research may show that later alterations are significant to the building; in other cases, the alterations may be without historical or architectural merit, and may be removed in the rehabilitation.

Identifying Interior Elements

Interiors of buildings can be seen as a series of primary and secondary spaces. The goal of the assessment is to identify which elements contribute to the building's character and which do not. Sometimes it will be the sequence and flow of spaces, and not just the individual rooms themselves, that contribute to the building's character. This is particularly evident in buildings that have strong central axes or those that are consciously asymmetrical in design. In other cases, it may be the size or shape of the space that is distinctive.

The importance of some interiors may not be readily apparent based on a visual inspection; sometimes rooms that do not appear to be architecturally distinguished are associated with important persons and events that occurred within the building.

Primary spaces, are found in all buildings, both monumental and modest. Examples may include foyers, corridors, elevator lobbies, assembly rooms, stairhalls, and parlors. Often they are the places in the building that the public uses and sees; sometimes they are the most architecturally detailed spaces in the building, carefully proportioned and finished with costly materials. They may be functionally and architecturally related to the building's external appearance. In a simpler building, a primary space may be distinguishable only by its location, size, proportions, or use. Primary spaces are always important to the character of the building and should be preserved.

Secondary spaces are generally more utilitarian in appearance and size than primary spaces. They may include areas and rooms that service the building, such as bathrooms,

Many institutional buildings possess distinctive spaces or floor plans that are important in conveying the significance of the property. This grand hall, which occupies the entire floor of the building, could not be subdivided without destroying the integrity of the space. Photo: NPS files.

The interior of this 19th worker's house has not been properly maintained, but it may be as important historically as a richly ornamented interior. Its wide baseboards, flat window trim, and four-panel door should be carefully preserved in a rehabilitation project. Photo: NPS files.

and kitchens. Examples of secondary spaces in a commercial or office structure may include storerooms, service corridors, and in some cases, the offices themselves. Secondary spaces tend to be of less importance to the building and may accept greater change in the course of work without compromising the building's historic character.

Spaces are often designed to interrelate both visually and functionally. The sequence of spaces, such as vestibule-hall-parlor or foyer-lobby-stair-auditorium or stairhall-corridor-classroom, can define and express the building's historic function and unique character. Important sequences of spaces should be identified and retained in the rehabilitation project.

Floor plans may also be distinctive and characteristic of a style of architecture or a region. Examples include Greek Revival and shotgun houses. Floor plans may also reflect social, educational, and medical theories of the period. Many 19th century psychiatric institutions, for example, had plans based on the ideas of Thomas Kirkbride, a

Philadelphia doctor who authored a book on asylum design.

In addition to evaluating the relative importance of the various spaces, the assessment should identify architectural features and finishes that are part of the interior's history and character. Marble or wood wainscoting in corridors, elevator cabs, crown molding, baseboards, mantels, ceiling medallions, window and door trim, tile and parquet floors, and staircases are among those features that can be found in historic buildings. Architectural finishes of note may include grained woodwork, marbleized columns, and plastered walls. Those features that are characteristic of the building's style and period of construction should, again, be retained in the rehabilitation.

Features and finishes, even if machine-made and not exhibiting particularly fine craftsmanship, may be character defining; these would include pressed metal ceilings and millwork around windows and doors. The interior of a plain, simple detailed worker's house of the 19th century may be as important historically as a richly ornamented, high-style townhouse of the same period. Both resources, if equally intact, convey important information about the early inhabitants and deserve the same careful attention to detail in the preservation process.

The location and condition of the building's existing heating, plumbing, and electrical systems also need to be noted in the assessment. The visible features of historic systems—radiators, grilles, light fixtures, switchplates, bathtubs, etc.—can contribute to the overall character of the building, even if the systems themselves need upgrading.

Assessing Alterations and Deterioration

In assessing a building's interior, it is important to ascertain the extent of alteration and deterioration that may have taken place over the years; these factors help determine what degree of change is appropriate in the project. Close examination of existing fabric and original floorplans, where available, can reveal which alterations have been additive, such as new partitions inserted for functional or structural reasons and historic features covered up rather than destroyed. It can also reveal which have been subtractive, such as key walls removed and architectural features destroyed. If an interior has been modified by additive changes and if these changes have not acquired significance, it may be relatively easy to remove the alterations and return the interior to its historic appearance. If an interior has been greatly altered through subtractive changes, there may be more latitude in making further alterations in the process of rehabilitation because the integrity of the interior has been compromised. At the same time, if the interior had been exceptionally significant, and solid documentation on its historic condition is available, reconstruction of the missing features may be the preferred option.

This corridor has glazed walls, oak trim, and marble wainscoting, typical of those found in the late 19th and early 20th century office

It is always a recommended practice to photograph interior spaces and features thoroughly prior to rehabilitation. Measured floor plans showing the existing conditions are extremely useful. This documentation is invaluable in drawing up rehabilitation plans and specifications and in assessing the impact of changes to the property for historic preservation certification purposes.

Drawing Up Plans and Executing Work

If the historic building is to be rehabilitated, it is critical that the new use not require substantial alteration of distinctive spaces or removal of character-defining architectural features or finishes. If an interior loses the physical vestiges of its past as well as its historic function, the sense of time and place associated both with the building and the district in which it is located is lost.

The recommended approaches that follow address common problems associated with the rehabilitation of historic interiors and have been adapted from the Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings. Adherence to

buildings. Corridors such as this, displaying simple detailing, should be a priority in rehabilitation projects involving commercial buildings. Photo: NPS files.

these suggestions can help ensure that character-defining interior elements are preserved in the process of rehabilitation. The checklist covers a range of situations and is not intended to be all-inclusive. Readers are strongly encouraged to review the full set of guidelines before undertaking any rehabilitation project.

Recommended Approaches for Rehabilitating Historic Interiors

1. Retain and preserve floor plans and interior spaces that are important in defining the overall historic character of the building. This includes the size, configuration, proportion, and relationship of rooms and corridors; the relationship of features to spaces; and the spaces themselves such as lobbies, reception halls, entrance halls, double parlors, theaters, auditoriums, and important industrial or commercial use spaces. Put service functions required by the building's new use, such as bathrooms, mechanical equipment, and office machines, in secondary spaces.

2. Avoid subdividing spaces that are characteristic of a building type or style or that are directly associated with specific persons or patterns of events. Space may be subdivided both vertically through the insertion of new partitions or horizontally through insertion of new floors or mezzanines. The insertion of new additional floors should be considered only when they will not damage or destroy the structural system or obscure, damage, or destroy character-defining spaces, features, or finishes. If rooms have already been subdivided through an earlier insensitive renovation, consider removing the partitions and restoring the room to its original proportions and size.

3. Avoid making new cuts in floors and ceilings where such cuts would change character-defining spaces and the historic configuration of such spaces. Inserting of a new atrium or a lightwell is appropriate only in very limited situations where the existing interiors are not historically or architecturally distinguished.

Furring out exterior walls to add insulation and suspending new ceilings to hide ductwork can change a room's proportions and cause interior features to appear fragmented. The interior character of this school classroom that was converted to apartment use has been destroyed. Drawing: Neal A. Vogel

4. Avoid installing dropped ceilings below ornamental ceilings or in rooms where high ceilings are part of the building's character. In addition to obscuring or destroying significant details, such treatments will also change the space's proportions. If dropped ceilings are installed in buildings that lack character-defining spaces, such as mills and factories, they should be well set back from the windows so they are not visible from the exterior.

5. Retain and preserve interior features and finishes that are important in defining the overall historic character of the building. This might include columns, doors, cornices, baseboards, fireplaces and mantels, paneling, light fixtures, elevator cabs, hardware, and flooring; and wallpaper, plaster, paint, and finishes such as stenciling, marbling, and graining; and other decorative materials that accent interior features and provide color, texture, and patterning to walls, floors, and ceilings.

6. Retain stairs in their historic configuration and to location. If a second means of egress is required, consider constructing new stairs in secondary spaces. The application of fire-retardant coatings, such as intumescent paints; the installation of fire suppression systems, such as sprinklers; and the construction of glass enclosures can in many cases permit retention of stairs and other character-defining features.

7. Retain and preserve visible features of early mechanical systems that are important in defining the overall historic character of the building, such as radiators, vents, fans, grilles, plumbing fixtures, switchplates, and lights. If new heating, air conditioning, lighting and plumbing systems are installed, they should be done in a way that does not destroy character-defining spaces, features and finishes. Ducts, pipes, and wiring should be installed as inconspicuously as possible: in secondary spaces, in the attic or basement if possible, or in closets.

8. Avoid "furring out" perimeter walls for insulation purposes. This requires unnecessary removal of window trim and can change a room's proportions. Consider alternative means of improving thermal performance, such as installing insulation in attics and basements and adding storm windows.

9. Avoid removing paint and plaster from traditionally finished surfaces, to expose masonry and wood. Conversely, avoid painting previously unpainted millwork. Repairing deteriorated plasterwork is encouraged. If the plaster is too deteriorated to save, and the walls and ceilings are not highly ornamented, gypsum board may be an acceptable replacement material. The use of paint colors appropriate to the period of the building's construction is encouraged.

Plaster has been removed from perimeter walls, leaving brick exposed. The plaster should have been retained and repaired, as necessary. Photo: NPS files.

10. Avoid using destructive methods—propane and butane torches or sandblasting—to remove paint or other coatings from historic features. Avoid harsh clearing agents that can change the appearance of wood.

Meeting Building, Life Safety and Fire Codes

Buildings undergoing rehabilitation must comply with existing building, life safety and fire codes. The application of codes to specific projects varies from building to building, and town to town. Code requirements may make some reuse proposals impractical; in other cases, only minor changes may be needed to bring the project into compliance. In some situations, it may be possible to obtain a code variance to preserve distinctive interior features. (It should be noted that the Secretary's Standards for Rehabilitation take precedence over other regulations and codes in determining whether a rehabilitation project qualifies for Federal tax benefits.) A thorough understanding of the applicable regulations and close coordination with code officials, building inspectors, and fire marshals can prevent the alteration of significant historic interiors.

Sources of Assistance

Rehabilitation and restoration work should be undertaken by professionals who have an established reputation in the field.

Given the wide range of interior work items, from ornamental plaster repair to marble cleaning and the application of graining, it is possible that a number of specialists and subcontractors will need to be brought in to bring the project to completion. State Historic Preservation Officers and local preservation organizations may be a useful source of information in this regard. Good sources of information on appropriate preservation techniques for specific interior features and finishes include the Bulletin of the Association for Preservation Technology and The Old-House Journal; other useful publications are listed in the bibliography.

Protecting Interior Elements During Rehabilitation

Architectural features and finishes to be preserved in the process of rehabilitation should be clearly marked on plans and at the site. This step, along with careful supervision of the interior demolition work and protection against arson and vandalism, can prevent the unintended destruction of architectural elements that contribute to the building's historic character.

Protective coverings should be installed around architectural features and finishes to avoid damage in the course of construction work and to protect workers. Staircases and floors, in particular, are subjected to dirt and heavy wear, and the risk exists of incurring costly or irreparable damage. In most cases, the best, and least costly, preservation approach is to design and construct a protective system that enables stairs and floors to be used yet protects them from damage. Other architectural features such as mantels, doors, wainscoting, and decorative finishes may be protected by using heavy canvas or plastic sheets.

Summary and References

In many cases, the interior of a historic building is as important as its exterior. The careful identification and evaluation of interior architectural elements, after undertaking research on the building's history and use, is critically important before changes to the building are contemplated. Only after this evaluation should new uses be decided and plans be drawn up. The best rehabilitation is one that preserves and protects those rooms, sequences of spaces, features and finishes that define and shape the overall historic character of the building.

Acknowledgements

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

October 1988

After rehabilitation, this severely deteriorated space was returned to its original elegance. Plaster was repaired and repainted; scagliola columns were restored to match marble; and missing decorative metalwork was re-installed in front of the windows. Photo: Carol M. Highsmith.

Reading List

There are few books written exclusively on preserving historic interiors, and most of these tend to focus on residential interiors. Articles on the subject appear regularly in *The Old-House Journal*, the *Bulletin of the Association for Preservation Technology*, and *Historic Preservation Magazine*.

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4.2.2 Repairing flat plaster walls and ceilings (MacDonald 1989 – Preservation Brief #21)

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PRESERVATION BRIEFS

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Repairing Historic Flat Plaster Walls and Ceilings

Mary Lee MacDonald

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Plasterers applying rough and finish coats of plaster. Drawing: From the "Book of Trades."

Plaster in a historic building is like a family album. The handwriting of the artisans, the taste of the original occupants, and the evolving styles of decoration are embodied in the fabric of the building. From modest farmhouses to great buildings, regardless of the ethnic origins of the occupants, plaster has traditionally been used to finish interior walls.

A versatile material, plaster could be applied over brick, stone, half-timber, or frame construction. It provided a durable surface that was easy to clean and that could be applied to flat or curved walls and ceilings.

Plaster could be treated in any number of ways: it could receive stenciling, decorative painting, wallpaper, or whitewash. This variety and the adaptability of the material to nearly any building size, shape, or configuration meant that plaster was the wall surface chosen for nearly all buildings until the 1930s or 40s.

Plaster was used as the interior surface coating of this elegant 1911 church located in Eugene, Oregon. Photo: NPS files.

Historic plaster may first appear so fraught with problems that its total removal seems the only alternative. But there are practical and historical reasons for saving it. First, three-coat plaster is unmatched in strength and durability. It resists fire and reduces sound transmission. Next, replacing plaster is expensive. A building owner needs to think carefully about the condition of the plaster that remains; plaster is often not as badly damaged as it first appears.

Of more concern to preservationists, however, original lime and gypsum plaster is part of the building's historic fabric—its smooth troweled or textured surfaces and subtle contours evoke the presence of America's earlier craftsmen. Plaster can also serve as a plain surface for irreplaceable decorative finishes. For both reasons, plaster walls and ceilings contribute to the historic character of the interior and should be left in place and repaired if at all possible.

The approaches described in this Brief stress repairs using wet plaster, and traditional materials and techniques that will best assist the preservation of historic plaster walls and ceilings—and their appearance. Dry wall repairs are not included here, but have been written about extensively in other contexts. Finally, this Brief describes a replacement option when historic plaster cannot be repaired. Thus, a veneer plaster system is discussed rather than dry wall. Veneer systems include a coat or coats of wet plaster—although thinly applied—which can, to a greater extent, simulate traditional hand-troweled or textured finish coats. This system is generally better suited to historic preservation projects than dry wall.

To repair plaster, a building owner must often enlist the help of a plasterer. Plastering is a skilled craft, requiring years of training and special tools. While minor repairs can be undertaken by building owners, most repairs will require the assistance of a plasterer.

Historical Background

Plasterers in North America have relied on two materials to create their handiwork—lime and gypsum. Until the end of the 19th century, plasterers used lime plaster. Lime plaster was made from four ingredients: lime, aggregate, fiber, and water. The lime came from ground-and-heated limestone or oyster shells; the aggregate from sand; and the fiber from cattle or hog hair. Manufacturing changes at the end of the 19th century made it possible to use gypsum as a plastering material. Gypsum and lime plasters were used in combination for the base and finish coats during the early part of the 20th century; gypsum was eventually favored because it set more rapidly and, initially, had a harder finish.

Not only did the basic plastering material change, but the method of application changed also. In early America, the windows, doors, and all other trim were installed before the plaster was applied to the wall. Generally the woodwork was prime-painted before plastering. Obtaining a plumb, level wall, while working against built-up moldings, must have been difficult. But sometime in the first half of the 19th century, builders began installing wooden plaster "grounds" around windows and doors and at the base of the wall. Installing these grounds so that they were level and plumb made the job much easier because the plasterer could work from a level, plumb, straight surface. Woodwork was then nailed to the "grounds" after the walls were plastered. Evidence of plaster behind trim is often an aid to dating historic houses, or to discerning their physical evolution.

Lime Plaster

When building a house, plasterers traditionally mixed bags of quick lime with water to "hydrate" or "slake" the lime. As the lime absorbed the water, heat was given off. When the heat diminished, and the lime and water were thoroughly mixed, the lime putty that resulted was used to make plaster.

When lime putty, sand, water, and animal hair were mixed, the mixture provided the plasterer with "coarse stuff." This mixture was applied in one or two layers to build up the wall thickness. But the best plaster was done with three coats. The first two coats made up the coarse stuff; they were the scratch coat and the brown coat. The finish plaster, called "setting stuff," contained a much higher proportion of lime putty, little aggregate, and no fiber, and gave the wall a smooth white surface finish.

Compared to the 3/8-inch-thick layers of the scratch and brown coats, the finish coat was a mere 1/8-inch thick. Additives were used for various finish qualities. For example, fine white sand was mixed in for a "float finish." This finish was popular in the early 1900s. (If the plasterer raked the sand with a broom, the plaster wall would retain swirl marks or stipples.) Or marble dust was added to create a hard-finish white coat which could be smoothed and polished with a steel trowel. Finally, a little plaster of Paris, or "gauged stuff," was often added to the finish plaster to accelerate the setting time.

Although lime plaster was used in this country until the early 1900s, it had certain disadvantages. A plastered wall could take more than a year to dry; this delayed painting or papering. In addition, bagged quick lime had to be carefully protected from contact with air, or it became inert because it reacted with ambient moisture and carbon dioxide. Around 1900, gypsum began to be used as a plastering material.

Gypsum Plaster

Gypsum begins to cure as soon as it is mixed with water. It sets in minutes and completely dries in two to three weeks. Historically, gypsum made a more rigid plaster and did not require a

The builders of this mid-18th century house installed the baseboard molding first, then applied a mud and horse hair plaster. Lime was used for the finish plaster. Photo: NPS files.

Schifferstadt, a simple house of German origin that dates to 1756, utilized plaster for both flat and curved walls. The building is located in Frederick, Maryland. Photo: NPS files.

fibrous binder. However it is difficult to tell the difference between lime and gypsum plaster once the plaster has cured.

Many of these traditional plastering tools are still used today. Drawing: NPS files.

Despite these desirable working characteristics, gypsum plaster was more vulnerable to water damage than lime. Lime plasters had often been applied directly to masonry walls (without lathing), forming a suction bond. They could survive occasional wind-driven moisture or water wicking up from the ground. Gypsum plaster needed protection from water. Furring strips had to be used against masonry walls to create a dead air space. This prevented moisture transfer.

In rehabilitation and restoration projects, one should rely on the plasterer's judgment about whether to use lime or gypsum plaster. In general, gypsum plaster is the material plasterers use today. Different types of aggregate may be specified by the architect such as clean river sand, perlite, pumice, or vermiculite; however, if historic finishes and textures are being replicated, sand should be used as the base-coat aggregate. Today, if fiber is required in

a base coat, a special gypsum is available which includes wood fibers. Lime putty, mixed with about 35% gypsum (gauging plaster) to help it harden, is still used as the finish coat.

Lath

Lath provided a means of holding the plaster in place. Wooden lath was nailed at right angles directly to the structural members of the buildings (the joists and studs), or it was fastened to nonstructural spaced strips known as furring strips. Three types of lath can be found on historic buildings.

Wood Lath

Wood lath is usually made up of narrow, thin strips of wood with spaces in between. The plasterer applies a slight pressure to push the wet plaster through the spaces. The plaster slumps down on the inside of the wall, forming plaster "keys." These keys hold the plaster in place.

Metal Lath

Metal lath, patented in England in 1797, began to be used in parts of the United States toward the end of the 19th century. The steel making up the metal lath contained many more spaces than wood lath had contained. These spaces increased the number of keys; metal lath was better able to hold plaster than wood lath had been.

Rock Lath

A third lath system commonly used was rock lath (also called plaster board or gypsum-board lath). In use as early as 1900, rock lath was made up of compressed gypsum covered by a paper facing. Some rock lath was textured or perforated to provide a key for wet plaster. A special paper with gypsum crystals in it provides the key for rock lath used today; when wet plaster is applied to the surface, a crystalline bond is achieved.

Rock lath was the most economical of the three lathing systems. Lathers or carpenters could prepare a room more quickly. By the late 1930s, rock lath was used almost exclusively in residential plastering.

Common Plaster Problems

When plaster dries, it is a relatively rigid material which should last almost indefinitely. However, there are conditions that cause plaster to crack, effloresce, separate, or become detached from its lath framework. These include:

- Structural problems
- Poor workmanship
- Improper curing
- Moisture

Structural Problems

Overloading

Stresses within a wall, or acting on the house as a whole, can create stress cracks. Appearing as diagonal lines in a wall, stress cracks usually start at a door or window frame, but they can appear anywhere in the wall, with seemingly random starting points.

Builders of now-historic houses had no codes to help them size the structural members of buildings. The weight of the roof, the second and third stories, the furniture, and the occupants could impose a heavy burden on beams, joists, and studs. Even when houses were built properly, later remodeling efforts may have cut in a doorway or window without adding a

structural beam or "header" across the top of the opening. Occasionally, load-bearing members were simply too small to carry the loads above them. Deflection or wood "creep" (deflection that occurs over time) can create cracks in plaster.

Overloading and structural movement (especially when combined with rotting lath, rusted nails, or poor quality plaster) can cause plaster to detach from the lath. The plaster loses its key. When the mechanical bond with the lath is broken, plaster becomes loose or bowed. If repairs are not made, especially to ceilings, gravity will simply cause chunks of plaster to fall to the floor.

Settlement/Vibration

Cracks in walls can also result when houses settle. Houses built on clay soils are especially vulnerable. Many types of clay (such as montmorillonite) are highly expansive.

In the dry season, water evaporates from the clay particles, causing them to contract. During the rainy season, the clay swells. Thus, a building can be riding on an unstable footing. Diagonal cracks running in opposite directions suggest that house settling and soil conditions may be at fault. Similar symptoms occur when there is a nearby source of vibration—blasting, a train line, busy highway, or repeated sonic booms.

Stress cracks in plaster over a kitchen door frame can be repaired using fiberglass mesh tape and joint compound. Photo: NPS files.

Lath Movement

Horizontal cracks are often caused by lath movement. Because it absorbs moisture from the air, wood lath expands and contracts as humidity rises and falls. This can cause cracks to appear year after year. Cracks can also appear between rock lath panels. A nail holding the edge of a piece of lath may rust or loosen, or structural movement in the wood framing behind the lath may cause a seam to open. Heavy loads in a storage area above a rock-lath ceiling can also cause ceiling cracks.

Errors in initial building construction such as improper bracing, poor corner construction, faulty framing of doors and windows, and undersized beams and floor joists eventually "telegraph" through to the plaster surface.

Poor Workmanship

In addition to problems caused by movement or weakness in the structural framework, plaster durability can be affected by poor materials or workmanship.

Poorly Proportioned Mix

The proper proportioning and mixing of materials are vital to the quality of the plaster job. A bad mix can cause problems that appear years later in a plaster wall. Until recently, proportions of aggregate and lime were mixed on the job. A plasterer may have skimmed on the amount of cementing material (lime or gypsum) because sand was the cheaper material. Over sanding can cause the plaster to weaken or crumble. Plaster made from a poorly proportioned mix may be more difficult to repair.

Incompatible Base Coats and Finish Coats

Use of perlite as an aggregate also presented problems. Perlite is a lightweight aggregate used in the base coat instead of sand. It performs well in cold weather and has a slightly better insulating value. But if a smooth lime finish coat was applied over perlited base coats on wood or rock lath, cracks would appear in the finish coat and the entire job would have to be redone. To prevent this, a plasterer had to add fine silica sand or finely crushed perlite to the finish coat to compensate for the dramatically differing shrinkage rates between the base coat and the finish coat.

Improper Plaster Application

The finish coat is subject to "chip cracking" if it was applied over an excessively dry base coat, or was insufficiently troweled, or if too little gauging plaster was used. Chip cracking looks very much like an alligatored paint surface. Another common problem is called map cracking—fine, irregular cracks that occur when the finish coat has been applied to an over-sanded base coat or a very thin base coat.

Too Much Retardant

Retarding agents are added to slow down the rate at which plaster sets, and thus inhibit hardening. They have traditionally included ammonia, glue, gelatin, starch, molasses, or vegetable oil. If the plasterer has used too much retardant, however, a gypsum plaster will not set within a normal 20 to 30 minute time period. As a result, the surface becomes soft and powdery.

Inadequate Plaster Thickness

The smooth-troweled lime finish has delaminated from the brown coat underneath. Photo: Marylee MacDonald.

Plaster is applied in three coats over wood lath and metal lath—the scratch, brown, and finish coats. In three-coat work, the scratch coat and brown coat were sometimes applied on successive days to make up the required wall thickness. Using rock lath allowed the plasterer to apply one base coat and the finish coat—a two-coat job.

If a plasterer skimped on materials, the wall may not have sufficient plaster thickness to withstand the normal stresses within a building. The minimum total thickness for plaster on gypsum board (rock lath) is 1/2 inch. On metal lath the minimum thickness is 5/8 inch; and for wood lath it is about 3/4 to 7/8 inch. This minimum plaster thickness may affect the thickness of trim projecting from the wall's plane.

Improper Curing

Proper temperature and air circulation during curing are key factors in a durable plaster job. The ideal temperature for plaster to cure is between 55 to 70 degrees Fahrenheit. However, historic houses were sometimes plastered before window sashes were put in. There was no way to control temperature and humidity.

Dry Outs, Freezing, and Sweat-outs

When temperatures were too hot, the plaster would return to its original condition before it was mixed with water, that is, calcined gypsum. A plasterer would have to spray the wall with alum water to reset the plaster. If freezing occurred before the plaster had set, the job would simply have to be redone. If the windows were shut so that air could not circulate, the plaster was subject to sweat-out or rot. Since there is no cure for rotted plaster, the affected area had to be removed and replastered.

Moisture

Plaster applied to a masonry wall is vulnerable to water damage if the wall is constantly wet. When salts from the masonry substrate come in contact with water, they migrate to the surface of the plaster, appearing as dry bubbles or efflorescence. The source of the moisture must be eliminated before replastering the damaged area.

Sources of Water Damage

Moisture problems occur for several reasons. Interior plumbing leaks in older houses are common. Roofs may leak, causing ceiling damage. Gutters and downspouts may also leak, pouring rain water next to the building foundation. In brick buildings, dampness at the foundation level can wick up into the above-grade walls. Another common source of moisture is splashback. When there is a paved area next to a masonry building, rainwater splashing up from the paving can dampen masonry walls. In both cases water travels through the masonry and damages interior plaster. Coatings applied to the interior are not effective over the long run. The moisture problem must be stopped on the outside of the wall.

Repairing Historic Plaster

Many of the problems described above may not be easy to remedy. If major structural problems are found to be the source of the plaster problem, the structural problem should be corrected. Some repairs can be made by removing only small sections of plaster to gain access. Minor structural problems that will not endanger the building can generally be ignored. Cosmetic damages from minor building movement, holes, or bowed areas can be repaired without the need for wholesale demolition. However, it may be necessary to remove deteriorated plaster caused by rising damp in order for masonry walls to dry out. Repairs made to a wet base will fail again.

Canvassing Uneven Wall Surfaces

Uneven wall surfaces, caused by previous patching or by partial wallpaper removal, are common in old houses. As long as the plaster is generally sound, cosmetically unattractive plaster walls can be "wallpapered" with strips of a canvas or fabric-like material. Historically, canvassing covered imperfections in the plaster and provided a stable base for decorative painting or wallpaper.

Filling Cracks

Hairline cracks in wall and ceiling plaster are not a serious cause for concern as long as the underlying plaster is in good condition. They may be filled easily with a patching material. For cracks that reopen with seasonal humidity change, a slightly different method is used. First the crack is widened slightly with a sharp, pointed tool such as a crack widener or a triangular can opener. Then the crack is filled. For more persistent cracks, it may be necessary to bridge the crack with tape. In this instance, a fiberglass mesh tape is pressed into the patching material.

After the first application of a quick setting joint compound dries, a second coat is used to cover the tape, feathering it at the edges. A third coat is applied to even out the surface, followed by light sanding. The area is cleaned off with a damp sponge, then dried to remove any leftover plaster residue or dust.

When cracks are larger and due to structural movement, repairs need to be made to the structural system before repairing the plaster. Then, the plaster on each side of the crack should be removed to a width of about 6 inches down to the lath.

The debris is cleaned out, and metal lath applied to the cleared area, leaving the existing wood lath in place. The metal lath usually prevents further cracking. The crack is patched with an appropriate plaster in three layers (i.e., base coats and finish coat). If a crack seems to be expanding, a structural engineer should be consulted.

Replacing Delaminated Areas of the Finish Coat

Sometimes the finish coat of plaster comes loose from the base coat. In making this type of repair, the plasterer paints a liquid plaster-bonding agent onto the areas of base-coat plaster that will be replastered with a new lime finish coat. A homeowner wishing to repair small areas of delaminated finish coat can use the methods described in "Patching Materials."

Patching Holes in Walls

For small holes (less than 4 inches in diameter) that involve loss of the brown and finish coats, the repair is made in two applications. First, a layer of base coat plaster is troweled in place and scraped back below the level of the existing plaster. When the base coat has set but not dried, more plaster is applied to create a smooth, level surface. One-coat patching is not generally recommended by plasterers because it tends to produce concave surfaces that show up when the work is painted. Of course, if the lath only had one coat of plaster originally, then a one-coat patch is appropriate.

In this New Hampshire residence dating from the 1790s, the original plaster was a single coat of lime, sand, and horsehair applied over split lath. A one-coat repair, in this case, is appropriate. Photo: John Leeke.

Flat-head wood screws and plaster washers were used to reattach loose ceiling plaster to the wood lath. After the crack is covered with fiberglass mesh tape, all will be skim-coated with a patching compound. Photo: John Obed Curtis.

For larger holes where all three coats of plaster are damaged or missing down to the wood lath, plasterers generally proceed along these lines. First, all the old plaster is cleaned out and any loose lath is re-nailed. Next, a water mist is sprayed on the old lath to keep it from twisting when the new, wet plaster is applied, or better still, a bonding agent is used.

To provide more reliable keying and to strengthen the patch, expanded metal lath (diamond mesh) should be attached to the wood lath with tie wires or nailed over the wood lath with lath nails. The plaster is then applied in three layers over the metal lath, lapping each new layer of plaster over the old plaster so that old and new are evenly joined. This stepping is recommended to produce a strong, invisible patch. Also, if a patch is made in a plaster wall that is slightly wavy, the contour of the patch should be made to conform to the irregularities of the existing work. A flat patch will stand out from the rest of the wall.

Patching Holes in Ceilings

Hairline cracks and holes may be unsightly, but when portions of the ceiling come loose, a more serious problem exists. The keys holding the plaster to the ceiling have probably broken. First, the plaster around the loose plaster should be examined.

Keys may have deteriorated because of a localized moisture problem, poor quality plaster, or structural overloading; yet, the surrounding system may be intact. If the areas surrounding the loose area are in reasonably good condition, the loose plaster can be reattached to the lath using flathead wood screws and plaster washers. To patch a hole in the ceiling plaster, metal lath is fastened over the wood lath; then the hole is filled with successive layers of plaster, as described above.

Establishing New Plaster Keys

If the back of the ceiling lath is accessible (usually from the attic or after removing floor boards), small areas of bowed-out plaster can be pushed back against the lath.

A padded piece of plywood and braces are used to secure the loose plaster. After dampening the old lath and coating the damaged area with a bonding agent, a fairly liquid plaster mix (with a glue size retardant added) is applied to the backs of the lath, and worked into the voids between the faces of the lath and the back of the plaster. While this first layer is still damp, plaster-soaked strips of jute scrim are laid across the backs of the lath and pressed firmly into the first layer as reinforcement. The original lath must be secure, otherwise the weight of the patching plaster may loosen it.

Loose, damaged plaster can also be re-keyed when the goal is to conserve decorative surfaces or wallpaper. Large areas of ceilings and walls can be saved. This method requires the assistance of a skilled conservator—it is not a repair technique used by most plasterers.

This beaded ceiling in one of the bedrooms of the 1847 Lockwood House, Harpers Ferry, West Virginia, is missing portions of plaster due to broken keys. Photo: NPS files.

The conservator injects an acrylic adhesive mixture through holes drilled in the face of the plaster (or through the lath from behind, when accessible). The loose plaster is held firm with plywood bracing until the adhesive bonding mixture sets. When complete, gaps between the plaster and lath are filled, and the loose plaster is secure.

Replastering Over the Old Ceiling

If a historic ceiling is too cracked to patch or is sagging (but not damaged from moisture), plasterers routinely keep the old ceiling and simply relath and replaster over it. This repair technique can be used if lowering the ceiling slightly does not affect other ornamental features. The existing ceiling is covered with 1x3-inch wood furring strips, one to each joist, and fastened completely through the old lath and plaster using a screw gun. Expanded metal lath or gypsum board lath is nailed over the furring strips. Finally, two or three coats are applied according to traditional methods. Replastering over the old ceiling saves time, creates much less dust than demolition, and gives added fire protection.

When ceiling repairs are made with wet plaster or with an injected adhesive mixture, the old loose plaster must be supported with a plywood brace until re-keying is complete. Photo: John Leake.

When Damaged Plaster Cannot be Repaired—Replacement Options

Partial or complete removal may be necessary if plaster is badly damaged, particularly if the damage was caused by long-term moisture problems. Workers undertaking demolition should wear OSHA-approved masks because the plaster dust that flies into the air may contain decades of coal soot. Lead, from lead based paint, is another danger. Long-sleeved clothing and head-and-eye protection should be worn. Asbestos, used in the mid-twentieth century as an insulating and fireproofing additive, may also be present and OSHA-recommended precautions should be taken. If plaster in adjacent rooms is still in good condition, walls should not be pounded—a small trowel or pry bar is worked behind the plaster carefully in order to pry loose pieces off the wall.

When the damaged plaster has been removed, the owner must decide whether to replaster over the existing lath or use a different system. This decision should be based in part on the thickness of the original plaster and the condition of the original lath. Economy and time are also valid considerations. It is important to ensure that the wood trim around the windows and doors will have the same "reveal" as before. (The "reveal" is the projection of the wood trim from the surface of the plastered wall). A lath and plaster system that will give this required depth should be selected.

Replastering—Alternative Lath Systems for New Plaster

Replastering Old Wood Lath

When plasterers work with old lath, each lath strip is re-nailed and the chunks of old plaster are cleaned out. Because the old lath is dry, it must be thoroughly soaked before applying the base coats of plaster, or it will warp and buckle; furthermore, because the water is drawn out, the plaster will fail to set properly. As noted earlier, if new metal lath is installed over old wood lath as the base for new plaster, many of these problems can be avoided and the historic lath can be retained. The ceiling should still be sprayed unless a vapor barrier is placed behind the metal lath.

Replastering Over New Metal Lath

An alternative to reusing the old wood lath is to install a different lathing system. Galvanized metal lath is the most expensive, but also the most reliable in terms of longevity, stability, and proper keying. When lathing over open joists, the plasterer should cover the joists with kraft paper or a polyethylene vapor barrier. Three coats of wet plaster are applied consecutively to form a solid, monolithic unit with the lath. The scratch coat keys into the metal lath; the second, or brown, coat bonds to the scratch coat and builds the thickness; the third, or finish coat, consists of lime putty and gauging plaster.

Replastering Over New Rock Lath

It is also possible to use rock lath as a plaster base. Plasterers may need to remove the existing wood lath to maintain the woodwork's reveal. Rock lath is a 16x36-inch, 1/2-inch thick, gypsum-core panel covered with absorbent paper with gypsum crystals in the paper. The crystals in the paper bond the wet plaster and anchor it securely. This type of lath requires two coats of new plaster—the brown coat and the finish coat. The gypsum lath itself takes the place of the first, or scratch, coat of plaster.

Painting New Plaster

The key to a successful paint job is proper drying of the plaster. Historically, lime plasters were allowed to cure for at least a year before the walls were painted or papered. With modern ventilation, plaster cures in a shorter time; however, fresh gypsum plaster with a lime finish coat should still be perfectly dry before paint is applied—or the paint may peel. (Plasterers traditionally used the "match test" on new plaster. If a match would light by striking it on the new plaster surface, the plaster was considered dry.) Today it is best to allow new plaster to cure two to three weeks. A good alkaline-resistant

primer, specifically formulated for new plaster, should then be used. A compatible latex or oil-based paint can be used for the final coat.

A Modern Replacement System—Veneer Plaster

Using one of the traditional lath and plaster systems provides the highest quality plaster job. However, in some cases, budget and time considerations may lead the owner to consider a less expensive replacement alternative. Designed to reduce the cost of materials, a more recent lath and plaster system is less expensive than a two-or-three coat plaster job, but only slightly more expensive than drywall. This plaster system is called veneer plaster.

The system uses gypsum-core panels that are the same size as drywall (4x8 feet), and specially made for veneer plaster. They can be installed over furring channels to masonry walls or over old wood lath walls and ceilings. Known most commonly as "blue board," the panels are covered with a special paper compatible with veneer plaster. Joints between the 4-foot wide sheets are taped with fiberglass mesh, which is bedded in the veneer plaster. After the tape is bedded, a thin, 1/16-inch coat of high-strength veneer plaster is applied to the entire wall surface. A second veneer layer can be used as the "finish" coat, or the veneer plaster can be covered with a gauged lime finish-coat—the same coat that covers ordinary plaster.

Although extremely thin, a two-coat veneer plaster system has a 1,500 psi rating and is thus able to withstand structural movements in a building or surface abrasion. With either a veneer finish or a gauged lime putty finish coat, the room will be ready for painting almost immediately. When complete, the troweled or textured wall surface looks more like traditional plaster than drywall.

The thin profile of the veneer system has an added benefit, especially for owners of uninsulated masonry buildings. Insulation can be installed between the pieces of furring channel used to attach blue board to masonry walls. This can be done without having to fur out the window and door jambs. The insulation plus the veneer system will result in the same thickness as the original plaster. Occupants in the rooms will be more comfortable because they will not be losing heat to cold wall surfaces.

Patching Materials

Plasterers generally use ready-mix base-coat plaster for patching, especially where large holes need to be filled. The ready-mix plaster contains gypsum and aggregate in proper proportions. The plasterer only needs to add water.

Another mix plasterers use to patch cracks or small holes, or for finish-coat repair, is a "high gauge" lime putty (50 percent lime; 50 percent gauging plaster). This material will produce a white, smooth patch. It is especially suitable for surface repairs.

Although property owners cannot duplicate the years of accumulated knowledge and craft skills of a professional plasterer, there are materials that can be used for do-it-yourself repairs. For example, fine cracks can be filled with an all-purpose drywall joint compound. For bridging larger cracks using fiberglass tape, a homeowner can use a "quicksetting" joint compound. This compound has a fast drying time—60, 90, or 120 minutes. Quick-setting joint compound dries because of a chemical reaction, not because of water evaporation. It shrinks less than all-purpose joint compound and has much the same workability as ready-mix base-coat plaster. However, because quick-set joint compounds are hard to sand, they should only be used to bed tape or to fill large holes. All-purpose joint compound should be used as the final coat prior to sanding.

Homeowners may also want to try using a ready-mix perlited base-coat plaster for scratch and brown coat repair. The plaster can be hand-mixed in small quantities, but bagged ready-mix should be protected from ambient moisture. A "millmixed pre-gauged" lime finish coat plaster can also be used by homeowners. A base coat utilizing perlite or other lightweight aggregates should only be used for making small repairs (less than 4 ft. patches). For large-scale repairs and entire room replastering, see the precautions in Table 1 for using perlite.

Homeowners may see a material sold as "patching plaster" or "plaster of Paris" in hardware stores. This dry powder cannot be used by itself for plaster repairs. It must be combined with lime to create a successful patching mixture.

When using a lime finish coat for any repair, wait longer to paint, or use an alkaline-resistant primer.

Summary and References

The National Park Service recommends retaining historic plaster if at all possible. Plaster is a significant part of the "fabric" of the building. Much of the building's history is documented in the layers of paint and paper found covering old plaster. For buildings with decorative painting, conservation of historic flat plaster is even more important. Consultation with the National Park Service, with State Historic Preservation Officers, local preservation organizations, historic preservation consultants, or with the Association for Preservation Technology is recommended. Where plaster cannot be repaired or

conserved using one of the approaches outlined in this Brief, documentation of the layers of wallpaper and paint should be undertaken before removing the historic plaster. This information may be needed to complete a restoration plan.

Plaster Terms

Scratch coat. The first base coat put on wood or metal lath. The wet plaster is "scratched" with a scarifier or comb to provide a rough surface so the next layer of base coat will stick to it.

Brown coat. The brown coat is the second application of wet, base-coat plaster with wood lath or metal systems. With gypsum board lath (rock lath, plasterboard), it is the only base coat needed.

Finish coat. Pure lime, mixed with about 35 percent gauging plaster to help it harden, is used for the very thin surface finish of the plaster wall. Fine sand can be added for a sanded finish coat.

Casing Bead. Early casing bead was made of wood. In the 19th century, metal casing beads were sometimes used around fireplace projections, and door and window openings. Like a wood ground, they indicate the proper thickness for the plaster.

Corner Bead. Wire mesh with a rigid metal spline used on outside corners. Installing the corner bead plumb is important.

Outside corners. Installing the corner bead plumb is important.

Cornerite. Wire mesh used on inside corners of adjoining walls and ceilings. It keeps corners from cracking.

Ground. Plasterers use metal or wood strips around the edges of doors and windows and at the bottom of walls. These grounds help keep the plaster the same thickness and provide a stopping edge for the plaster. Early plaster work, however, did not use grounds. On early buildings, the woodwork was installed and primed before plastering began. Some time in the early 19th century, a transition occurred, and plasterers applied their wall finish before woodwork was installed.

Gypsum. Once mined from large gypsum quarries near Paris (thus the name plaster of Paris), gypsum in its natural form is calcium sulfate. When calcined (or heated), one-and-a-half water molecules are driven off, leaving a hemi-hydrate of calcium sulfate. When mixed with water, it becomes calcium sulfate again. While gypsum was used in base-coat plaster from the 1890s on, it has always been used in finish coat and decorative plaster. For finish coats, gauging plaster was added to lime putty; it causes the lime to harden. Gypsum is also the ingredient in moulding plaster, a finer plaster used to create decorative moldings in ornamental plaster work.

Lime. Found in limestone formations or shell mounds, naturally occurring lime is calcium carbonate. When heated, it becomes calcium oxide. After water has been added, it becomes calcium hydroxide. This calcium hydroxide reacts with carbon dioxide in the air to recreate the original calcium carbonate.

Screed. Screeds are strips of plaster run vertically or horizontally on walls or ceilings. They are used to plumb and straighten uneven walls and level ceilings. Metal screeds are used to separate different types of plaster finishes or to separate lime and cement plasters.

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October 1989

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4.2.3 Preserving ornamental plaster (Flaherty 1990 – Preservation Brief #23)

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PRESERVATION BRIEFS

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Running and enriching a ceiling medallion. Photo: Peter Sanders.

From the time America struggled for a new identity as a constitutional republic—and well into the 20th century—its architecture and its decorative detailing remained firmly rooted in the European classicism of Palladio, Wren, and Mansart. Together with skilled masons and carpenters, ornamental plasterers saw their inherited trade flourish from the mid-18th century until the Depression years of the 1930s. During this two hundred year period, as the Georgian and Federal styles yielded to the revivals—Greek, Rococo, Gothic, Renaissance, and Spanish—decorative plaster reflected each style, resulting in the wide variety of ornamentation that survives. The traditional methods of producing and installing interior decorative plaster were brought from Europe to this country intact and its practice remains virtually unchanged to this day.

Like flat walls and ceilings, historic ornamental plaster is made of gypsum and lime which are stable and durable materials. An extremely versatile material, plaster can be modeled, cast, incised, colored, stamped, or stencilled. However, as an integral part of the building system it is subject to the typical problems of water intrusion, structural movement, vibration and insensitive alterations, both incrementally and from adaptive use projects.

This Preservation Brief has been prepared to assist property owners, architects, contractors, and Federal agency managers in identifying the causes of ornamental plaster failure, specifying repair and replacement techniques and engaging qualified professionals to do the work. The scope of this Brief is limited to the repair and restoration of existing ornamental plaster; certain forms of decorative plaster such as scagliola, composition ornament, and artificial Caen Stone are not addressed, nor is the design and installation of ornamental plasterwork in new construction. Finally, guidance on using substitute materials to match the historic appearance of ornamental plasterwork—a legitimate option within the Secretary of Interior's Standards

Ornamental plaster studios employed a variety of personnel, including sculptors who modelled in clay; casters who made production units; and finishers who cleaned the casts. Photo: Courtesy, M. Earle Felber.

for the Treatment of Historic Properties—is not discussed here, but will be the subject of another Brief on interiors.

The Ornamental Plaster Trade

Shop Personnel

As builders and architects were hired by an increasingly affluent clientele, ornamental plaster shops developed from the single artisan operations of the 18th century into the complex establishments of the early 20th century. American plaster studios employed immigrant and, later, native craftsmen. Plasterers' guilds were in existence in Philadelphia in the 1790s. In 1864, a plasterers' union was organized in the United States with members from the British Isles whose work there had been limited to palaces and churches. English and European craftsmen came to America where the demand for their skills had increased by the decade, offering them the unparalleled opportunity to open their own shops. Over the years, plaster elements became so popular in decorating interior spaces that a major industry was established. By the 1880s, catalogs were available from which property owners could select ornamentation for their splendid new buildings.

Methods of Production

Historically, ornamental plasterwork has been produced in two ways: it would be run in place (or on a bench) at the site; or cast in molds in a workshop. Plain plaster molding without surface ornamentation was usually created directly on the wall, or run on a flat surface such as a plasterer's workbench and attached to the wall after it set. Ornament such as coffering for ceilings, centers for light fixtures (medallions), brackets, dentils, or columns were cast in hide glue (gelatin) or plaster molds in an offsite shop, often in more than one piece, then assembled and installed in the building.

Decorative Plaster Forms—Cornices, Medallions, Coffers

Three decorative plaster forms in particular—the cornice, the ceiling medallion, and the coffered ceiling—historically comprised much of the ornamental plasterers' business. These forms appear individually or in combination from the 18th to 20th century, irrespective of stylistic changes.

For example, an elaborate parlor **cornice** consisted of plain moldings made of gypsum and lime run atop temporary lattice strips around the room. Tooling for plain-run moldings called for a sheet metal template of the molding profile mounted on a wooden "horse". Mitering was accomplished using a plaster and lime putty gauge (mix) tooled with miter rods at the joints. Decorative "enrichments" such as leaves, egg and dart moldings, and bead and reel units were cast in the shop and applied to the plain runs using plaster as an adhesive. Painting, glazing, and even gilding followed. Large houses often had plain run cornices on the upper floors which were not used for entertaining; modest houses also boasted cornice work without cast enrichment.

Mitering a plain-run cornice requires great dexterity using the miter rod. Photo: Old-House Journal.

This parlor medallion and pendant drops shown in a mid-19th century house in Annapolis, Maryland, were originally ordered from a catalog. Photo: M.E. Warren.

Among the most dramatic of ornamental plaster forms is the parlor **ceiling medallion**. Vernacular houses often used plain-run concentric circles from which lighting fixtures descended, usually hung from a wrought iron hook embedded in the central ceiling joist. More elaborate medallions were composed of shop-cast pieces, such as acanthus foliage often alternating with anthemion or other decorative designs. Medallions usually related stylistically to the cornice ornament found in the room and could be created with or without a plain-run surround. Of particular importance to the art of ornamental plaster was the mid-19th century double parlor plan. Architects often specified matching medallions of robust proportions and ornamentation. Later, in 20th century American Colonial Revival architecture, architects called for Federal style ceiling medallions. Some of the more successful were graceful one-piece units, utilizing classical motifs such as garlands and swags, and in their simplicity, reminiscent of Adamesque designs of the 1760s.

Yet another significant decorative form is the **coffered ceiling**. Coffering units were cast in the shop or onsite, then installed with hanging wires to form the ceiling. Ceiling design varied from period to period as to depth, panel shape, and ornamental complexity. Not always flat, coffering is seen inside domes, within barrel vaults and groin ceilings, along overhead ribs and soffits. Rosettes are usually centered in the panels and often enrich the intersections of

elaborate stiles bordering the panels. Flat ceiling coffers are generally identical in reflected plan; on domed or barrel ceilings, coffers differ from course to course so as to appear identical from various sight lines. The finish treatment of a coffered ceiling frequently exhibits the height of the painter's craft.

Foremost examples of ceiling coffering include the United States Capitol, and Washington DC's Union Station. As a popular decorative form with inherent acoustical benefits, the coffered ceiling is seen across the United States in many large public spaces such as theaters, courthouses, railroad stations, and hotels.

Unfortunately, these supposedly enduring decorative forms created by ornamental plaster tradesmen are subjected to the ravages of both nature and man and, consequently, seldom remain as originally designed. Minor changes of taste are perhaps the least injurious to plasterwork. Considerably greater damage and deterioration are caused by radical changes in building use and poor maintenance practices. Fortunately, in most cases, the form, detailing, and finish of historic ornamental plaster can be recaptured through careful repair and restoration.

The elaborate coffered ceiling was designed for the Willard Hotel in Washington, D.C. (1902-04) by Henry Janeway Hardenbergh. It was restored as part of a rehabilitation project in the 1980s. Photo: Carol M. Highsmith.

Causes of Ornamental Plaster Damage

Ornamental Plaster Substrate

For flat plaster walls and ceilings, as well as decorative forms, the system to attach interior plaster to walls and ceilings primarily consisted of 1/4" x 1-1/4" wooden lathing strips nailed 3/8" apart against studs and joists. First a scratch coat consisting of sand, lime, and cattle hair was troweled on the lath and pressed through the slots so as to slump over and form "keys." Next, a brown coat was applied to establish flat and plumb surfaces. The earliest plasterwork consisted of two coats of lime and sand plaster; later in the 19th century, a third or finish coat was applied that consisted of both lime and gypsum. Decorative units were generally attached to the substrate using plaster as an adhesive.

Signs of Failure

Failure of the substrate is more typical than failure of the plaster ornament itself. Among the reasons for deterioration, structural movement and water intrusion are the most deleterious. Buildings move and settle, causing deflection and delamination which result in stress cracking. These cracks often begin at the corners of windows and doors and extend upward at acute angles. Roof or plumbing leaks make finishes discolor and peel and cause efflorescence, especially on plain-run or enriched cornices. Unheated buildings with water intrusion are subject to freeze-thaw cycles which ultimately result in base coat and ornamental plaster failure.

Structural settling has caused this ceiling to deflect. A structural engineer will shore-up the ceiling from below and re-attach the sagging ceiling plaster with the joists above. Photo: NPS files.

In addition, keying and adhesive properties may be further jeopardized by weak original mixes that were improperly applied. Substrate failure typically results from faulty lathing or rusty lath nails, causing ceilings to fall. In the 20th century, vibration from heavy vehicular traffic, nearby blasting, and even repeated sonic booms may contribute to damaging ornamental plaster. Inadequate support in an original design may also be to blame when particularly heavy units have simply broken off over time. Finally, new mechanical systems, suspended ceilings and partition walls insensitively installed in adaptive use projects, show little regard for the inspired decorations of earlier periods.

Repairing and Replacing

Plaster failure is a matter of degree. For example, top coat failure can be repaired by applying a new finish coat over a sound early substrate. Also, if cracking or loss of all three coats has occurred and is not combined with major structural failure, it can be repaired much like flat wall plaster. For ornamental plaster, however, repair beyond patching is often equivalent to targeted replacement of entire lengths or portions of run-in-place and cast ornamentation. Pieces that are deteriorated or damaged beyond plain patching must be removed and replaced with new pieces that exactly match the existing historic plaster. For this reason, partial restoration is often a more accurate term than repair. But whichever term is used, it is not recommended that repair of ornamental plaster be undertaken at any level by property owners; it is a craft requiring years of training and experience. A qualified professional should always be called in to make an inventory of ornamental plaster enrichments and to identify those details which are repairable onsite and which should be removed for repair or remanufacture in the shop.

Immediate Action

Settlement caused stress cracking through both flat wall and ornamental plaster. Repairs to the cornice molding involve chamfering the stress cracks to a "V groove," and patching with a mixture of gypsum and lime. Photo: Jack E. Boucher, HAB S, NPS.

Once the cause and extent of damage have been determined, treatments such as shoring, stabilization, and limited demolition can begin, preparatory to repairing or restoring historic ornamental plaster.

First, roof or plumbing leaks must be repaired to eliminate the problem of water intrusion. General structural repairs should be undertaken to arrest building movement, which weakens the base coat plasters to which the ornamental enrichments are attached. Ornamental plaster deflection should be corrected by shoring from below followed by re-anchoring.

Testing for poor adhesion of base coat to lath or ornament to base coat, should be conducted to reduce further loss of enrichment. Adaptive use intrusions should be carefully removed to protect the existing decorative plasterwork.

Code-required fire suppression systems should be evaluated at this time. Modern building codes may require heat/smoke/flare detectors and automatic sprinkler systems of various types and applications. Fire suppression systems as well as all mechanical systems (HVAC, plumbing and electrical) systems should be designed so that they accomplish their purpose with minimal impact on the decorative plaster. Plumbing for an automatic sprinkler system, for example, can be run above new and existing coffering so that the sprinkler heads barely protrude from the rosette centers in the coffered design. Access should be provided for future system maintenance or repair.

Where this ceiling was suffering from structural failure, the first step was to shore it up from below. Then, toggle bolts (seen here) were used to re-attach the plaster molding to the ceiling joists. Finally, the ceiling was patched, prior to restoring significant finishes. Photo: NPS files.

A 20th Century Shop Tour—Personnel, Materials, and Processes

Before discussing how decorative forms such as cornices, medallions, and ceiling coffers are repaired onsite and in the shop by ornamental plasterers, the "shop tour" explains traditional casting processes used in conjunction with updated materials. A shop tour can be exciting, but confusing to the layman without some explanation of modeling, molding, and casting activities. For a prospective client, a visit to the plaster studio or site can be of value in choosing a qualified plastering contractor.

Shop and Personnel

Generally, a highly functional shop should look well organized—that is, not in disarray with remnants of past projects lying about to impede current production. Old molds may be in abundance, but hanging from the wall or otherwise "on file." Machinery (saws and drill presses) and hand tools should appear well maintained. In short, one might evaluate such a studio as one does an auto mechanic's shop: does it inspire confidence? This is the time to look around and ask questions. What is the shop's past project work experience? Is the firm mostly involved in new construction work or total reconstruction? More important than the way the shop looks, is the personnel sufficiently experienced in making repairs to historic decorative plaster? What about training and apprenticeships? How did the staff learn the trade? The more that is known about the total operation the better.

Molding Rubber

Familiarity with contemporary molding rubbers is desirable. There are several formulations currently on the market. In the past, flexible molds were made with hide glue melted in a double boiler and poured over plaster originals which had been prepared with an appropriate parting agent. Of the newer rubbers, latex (painted on the model coat by coat) is time consuming and has little dimensional accuracy; polysulfide distorts under pressure; and silicone is needlessly expensive. Urethane rubber, with a 30-durometer hardness, is the current choice. Urethanes are manufactured as pourable liquids and as thixotropic pastes so that they can be used on vertical or overhead surfaces. The paste is especially useful for onsite impressions of existing ornament; the liquid is best used in the shop much as hide glue or gelatin was historically. Urethane rubber has the ability to reproduce detail as fine as a fingerprint and does not degrade during most ornamental plaster projects. No flexible molding material lasts forever, so spare casts should be maintained for future remolding.

This plaster studio is well organized, with ample work space. Note the plaster casts hanging neatly on the wall. Photo: Berry and Homer, Philadelphia.

Molding Plaster

Molding plaster will also be in evidence; it is the product most similar to that used historically. This plaster is finely ground to accept the detail of the rubber molds, not so hard as to prohibit tooling, and combines readily with finish lime. High-

strength plaster is available in varying densities, some with added components for specific purposes. Most shops maintain these varieties, but use molding plaster for typical work.

Sheet Metal Templates

The contractor's familiarity with sheet metal is critical. Accurate template blades are required to reproduce both straight and curved sections of moldings. The blades must be carefully cut, filed, and sanded in order to form exact reproductive units. A tour of a sizeable shop will include observation of running techniques and the results of this activity should be much in evidence. Regardless of size, these runs should be smooth and true when made by qualified craftsmen.

Models

Models, whether of capitals, cornices, medallions or cartouches, are made as whole units or in parts depending on project demands. Completeness, accurate dimensions, and attention to historic styles are essential ingredients of successful models. Each part of a model has a name, i.e., dentil, guilloche, rinceau or bolection molding, modillion, egg and dart, and the designers and restorers of these ornaments should know their names. Failure to identify these parts correctly should be of concern to a prospective client.

Molds

Molds are "negative forms" produced from completed models. Simple flood molds require a separator or barrier coat over the original and a surrounding fence to prevent the liquid rubber from leaking out. Larger or more complicated molds are made in pieces or with a layer of rubber supported by a plaster shell or mother mold attached to a wooden or metal frame. Following completion of a successful mold, the original model is discarded because it is now possible for it to be accurately reproduced.

Casting the Molds

Casting operations should appear clean and efficient. A skillful caster's output can be voluminous and often looks effortless as it is being produced. Raw materials are close at hand, molds are rarely without curing plaster in them, production is stored so as not to warp while it is still wet and each cycle, from mixing to pouring, setting, and demolding is accomplished so as not to waste time or break plaster casts. A good caster generally obviates the need for a finishing department.

Two other aspects should be noted. Shipping facilities are critical to move the product to the restoration site safely. Drawing and design space should be separate from the production floor. In summary, the modern ornamental plaster shop inevitably looks quite different from that pictured earlier in this Preservation Brief, but, with the exception of contemporary tools and materials, the operations are the same. The following sections discuss how repairs are made by today's plaster tradesmen.

Repairing Historic Ornamental Plaster

Cornice

A plain run or ornamented plaster cornice which has undergone damage or severe deterioration can often be repaired. Footage which is beyond repair should be identified and be carefully demolished to expose the underlying structure beneath to which the molding was secured. To replace the missing lengths, the first step is to obtain a cross-section, or profile, through the cornice from finish ceiling to finish wall lines. This is best accomplished using one of these methods:

1. A section through the cornice may be determined by sawing through the molding, inserting a sheet metal blank in the slot and tracing the profile directly on the template. This is considerably more accurate than the profile gauge, but will require repointing the saw kerf; alternatively, the cut may be made on one of the deteriorated pieces, provided it was removed as an intact unit.
2. The section may be obtained by making a thixotropic rubber impression of the molding, casting the result in fresh plaster and sawing through the cast to transfer the cross-section to a sheet metal template.

With the section determined, it is drawn onto 22-gauge galvanized sheet metal, cut with tin snips and carefully filed to the line. The template is checked periodically against the original profile to assure a perfect match. With the template blade finally complete, it is nailed to stock and slipper, ready for running the replacement footage.

Short lengths of new cornice are best run on a bench using gypsum and lime; the reproduction molding should be somewhat longer than the required length. The new footage is cut and fit in place to match the existing cornice, then securely countersunk-screwed to studs, joists and/or blocking. The resulting joints are pointed with flat mitering rods, flush with adjacent members.

Longer lengths of cornice may be run in place, much as they were historically. Care should be taken that the position of the running mold engages with the existing work at either end of the run. Yet another method is to bench run the cornice to five or six feet, make a rubber mold of the model, and precast the replacement parts either at the site or in the shop.

If the damaged cornice is ornamented, samples of the enrichment should be removed, making sure that whole original units are obtained. This is a difficult process, since these units were stuck into plain-run recesses called "sinkages" using plaster as an adhesive. In order to insert a flat chisel behind the ornament to break the bond, some units may have to be sacrificed. Sacrifice should be minimal. The excised enrichment should then be removed to the shop for rubber molding and casting either with or without the paint buildup, depending on the demands of the project. Whereas molding with several layers of paint make it hard to discern new casts from originals, paint-stripped molding reveals the remarkable talents of the period model-makers. As noted, contemporary rubber materials have "fingerprint detail" capability. Modern casts are then applied to the new or original runs, again using plaster as an adhesive.

Ceiling Medallion

Ceiling medallions are often in greater jeopardy than cornices because the joist-lath-base-coat support system is susceptible to deflection and the force of gravity. The problems of ceiling failure are more frequent in the centers of parlors because circular-run and shop-cast ornament is often quite heavy and was not historically attached with any additional mechanical fasteners such as bolts and screws.

If the lath or keys have failed, plaster ceiling ornament may be saved, in whole or in part, by removing floor boards above, then drilling and injecting each lath with an elastic acrylic or epoxy material to reattach plaster to lath, and lath to the joists. This is a recently developed procedure which should only be undertaken by experienced professionals. The consolidation and reattachment process has been used successfully in period structures with dramatic results when important plaster and painted surfaces would otherwise have been lost.

Ceiling medallions may need repair or replacement, such as this elliptical medallion from Rockland, Fairmont Park, Philadelphia. An impression was taken of the existing plaster, then new plaster elements were cast. Photo: David Flaherty.

Historic lighting fixtures often hung from elaborate ceiling medallions. When these fixtures were later converted to gas and electrical service, the central ornamental plaster canopies were sometimes damaged by insensitive tradesmen. More recent adaptive use projects may have caused additional damage.

Damaged ceiling medallions can be repaired by carefully removing representative plaster ornamentation, molding and recasting in the shop and replacing the new enrichments so that they align perfectly with the original pattern. Polyvinyl acetate bonding agents are applied to the background and ornament so that the adhesive plaster grips tightly. Alternatively, a severely damaged medallion can be replaced using the fragments as physical documentation to cast a visually accurate replacement.

Sections of plain-run circular molding may also be repaired by determining a section through the run and the radius from molding to pivot point. As with cornices, the run should be made on a bench to a length greater than required, then cut and fit in place. Circular run sections are installed using plaster adhesives on bonded surfaces or modern construction adhesives after referring to manufacturers' instructions as to whether the adhesive is recommended for use on wet or dry materials. Coarse-threaded, galvanized screws are often countersunk to aid the bond; if possible, the screws should be inserted at points that will ultimately be covered with cast enrichments.

Ceiling medallions frequently appear in matching double parlors. It is not unusual for one ceiling to fail while its mate remains undamaged. The flat plastered ceiling over the location of the missing medallion often has a "ghost," confirming that a ceiling medallion once ornamented the parlor. The missing medallion may be remanufactured by securing a section, dimensions, and samples of cast enrichments from the surviving ornament and accurately following the original procedure. The ceiling on which the new work is to be set should be examined for its soundness and, if necessary, relathed (with self-furring metal lath) and plastered. The pivot point for a circular run is screwed into a wooden block, force-fit into the center electrical box, and removed after the run is completed.

After 1850, particularly in the South, ceiling medallions were often designed with cast ornament only; no plain-run surround was used. Repair of such medallions proceeds as described above but without bordering molding.

An important point needs to be made about adding ceiling medallions (or any other kind of ornamental plaster element) when there is a lack of historical evidence. If there is no ghost mark or other documentation, indicating a medallion once existed, then the room should remain unornamented as it was historically. Adding conjectural ornamentation of any type or material (i.e., shop-cast or glass fiber reinforced plaster or polystyrene foam substitutes) can create a false sense of historical development contrary to the preservation principles stated in *The Secretary of the Interior's Standards for the Treatment of Historic Properties*. However, if there is clear indication that a ceiling medallion once existed, but there is

inadequate documentation for its replacement, a medallion compatible with the room's historic character may be considered. Professional advice should be sought.

Coffered Ceiling

Like cornices and medallions, coffered ceilings suffer from poor maintenance practices and structural problems; however, these individually cast ceiling units are particularly vulnerable when a building is being rehabilitated and great care is not taken in executing the work. In the most serious of cases, portions of a roof can collapse, dropping heavy debris through the hanging coffering panels, and demolishing large portions of the ornamentation.

But even this level of damage can usually be remedied by restoration professionals. Immediate action calls for shoring the areas adjacent to the damage, and inspecting the hanging apparatus for unforeseen detachment and deflection. New channel iron is used to stabilize the existing coffers and ties reinforced, as necessary. An intact coffering unit is then identified and carefully removed to a casting shop for molding and casting. When rehung, the units are painted to match the historic coffering.

Coffered ceilings appear with plain run or enriched cornices. In most cases it is recommended that the cornice be repaired first in order to achieve straight and level moldings. Then the damaged coffers should be replaced with the matching new coffers and the joints between pointed. Access from above is critical.

The Yiddish Arts Theater, New York City, c. 1920s. The concrete roof of this building had collapsed, damaging portions of the existing Moorish style coffered ceiling. The square coffer unit was easily identifiable and was removed to a casting shop for reproduction. Photo: David Flaherty.

Finding and Evaluating a Contractor

When ornamental plaster damage or deterioration has been identified, the historic property owner, architect, or developer should secure the services of a reputable restoration contractor before proceeding further. It is clear as more and more projects are undertaken, that there is a wide disparity of skills within the trade today. This is partly due to the introduction of gypsum board as a substitute for traditional plastering. As gypsum board became popular after World War II, plasterers saw the demand for their skills decline. Plastering techniques were forgotten because they were often not passed down within shops and families. However, ornamental plaster studios have seen a resurgence in demand for their services in the last decade, particularly as more historic buildings are rehabilitated.

Locating an experienced contractor who is suitable for your particular project is the goal. First, many professional preservation organizations can provide references for suitable restoration contractors. Local plasterers' unions should also be able to identify contractors with experience in ornamental plaster restoration projects. Architects with preservation and restoration project experience may recommend contractors they feel have done a good job for them in the past. Museums with period rooms have engaged craftsmen to assemble the backgrounds for display of antique furniture and decorative arts. Finally, historical societies, either national, state, or municipally organized, may have funded projects which repaired and restored ornamental plaster.

Once several contractors have been identified, their specific abilities need to be evaluated. Prospective contractors should be invited to visit the job site to see and define the scope of work; written proposals, including prices, from all bidders, are essential for comparison. References should be provided and investigated. An outside consultant may be engaged or an informal adviser designated to aid in evaluating the experience and proposals of the bidders. To get a total picture, a completed project should ideally be visited by the prospective client with the contractor present to answer questions which often arise.

These Greek Revival columns (Gaineswood, Demopolis, Alabama, c. 1842-60) were drawn from Minard Lefever's *Beauties of Modern Architecture* of 1835. This bold new style began in New York City and quickly spread south and west. Photo: HABS Collection, NPS.

Finally, although this may not always be achievable, the bidder's studio may be visited, preferably on a normal working day (see A 20th Century Shop Tour, above.) Alternatively, the bidder may be visited while working onsite. Some ornamental plasterers simply do not have shops. They prefer to cast onsite, adhering the casts while the plaster is wet, and coordinating the job closely with the architect, who inspects each unit as it is cast and before it is installed.

Summary and References

Decorative plasterwork is usually a component of the historic character of interiors and, consequently, The Secretary of the Interior's Standards for Historic Preservation Projects call for its protection, maintenance, and repair. Where decorative plasterwork has deteriorated beyond repair, it should be replaced to match the old. Based on physical documentation, both repair and replacement can be accomplished using traditional molding plaster and casting procedures, together with the

best of the modern molding materials available. Once a "lost art" after the Depression years, the skills of today's ornamental plasterers are increasingly in demand as part of historic preservation project teams. The ingenious and inspired decorative work created by our earlier architects and artisans can now be assured an extended life.

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

October 1990

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4.2.4 Guidelines for painting interiors (Chase 1992 – Preservation Brief #28)

Technical Preservation Services

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PRESERVATION BRIEFS

28

Painting Historic Interiors

Sara B. Chase

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- [Oil-Based and Water-Based Paints](#)
- [Pre-1875 Paints](#)
- [Factory-Made Paints after 1875](#)
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- [Identifying Deteriorated and Damaged Paint Surfaces](#)
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Restoration of decorative paint finishes. Photo: Sara B. Chase.

The paint Americans used in the past is undeniably part of a technological and commercial record. But beyond that, the colors we have chosen and continue to select for our interior living and working spaces—bright and exuberant, purposefully somber, or a combination of hues—reflect our nation's cultural influences and our individual and collective spirit. Paint color is a simple, direct expression of the time, and of taste, values, and mood. To consider paint only as a protective coating is to misunderstand its meaning as an important aspect of America's heritage.

This Brief is about historic interior paints and choosing new paints for historic interiors if repainting is necessary or desirable. It addresses a variety of materials and features: plaster walls and ceilings; wooden doors, molding, and trim; and metal items such as radiators and railings. It provides background information about some of the types of paint which were used in the past, discusses the more common causes and effects of interior paint failure, and explains the principal factors guiding decisions about repainting, including what level of paint investigation may be appropriate. Careful thought should be given to each interior paint project, depending on the history of the building and its painted surfaces. Treatments may range from protecting extant decorative surfaces, to ordering custommade paint that replicates the original paint color, to using today's paint straight off the shelf and out of the can.

Researching the interior paint history is the key to a successful preservation or restoration project. The decorative detailing can be appreciated in this Puerto Rico Theater primarily because of appropriate paint color and paint placement. Photo: Max Toro.

Finally, stripping old paints or applying new oil/alkyd paints poses serious health and safety concerns; the State Historic Preservation Officer should be contacted for current legal and technical information on removal, disposal, and health and safety precautions.

Constituents of Historic Paint: Pigment, Binder, and Vehicle

Paint is a dispersion of small solid particles, usually crystalline, in a liquid medium. Applied to a surface, this liquid has the special quality of becoming a solid, protective film when it dries. Paint also enhances the appearance of surfaces. A late Victorian writer observed that the coming of a painter to a house was cause for celebration. Indeed, these statements not only indicate the chemical and physical complexity of paint, but also its emotional impact.

Pigment

Pigment made the paint opaque, thus preventing deterioration of the substrate caused by ultraviolet light, and added color, thus making the paint attractive. White lead, a whitish corrosion product of lead, was most often used to provide opacity. The white pigment in a colored paint is often called the "hiding" pigment. In addition to preventing the sun's damaging rays from hitting the surface of the substrate, the white lead also helped prevent the growth of mold and mildew. Not until early in the 20th century was a successful substitute, titanium dioxide (TiO₂), patented, and even then, it did not come into prevalent use by itself until the mid-20th century (earlier in the century, titanium oxide and white lead were often mixed). Zinc oxide was used briefly as a hiding pigment after 1850.

Early tinting pigments for house paints consisted of the earth pigments—ochres, siennas, umbers made from iron-oxide containing clay—and a few synthesized colorants such as Prussian blue, or mercuric sulfide (crimson). From the early 1800s on more pigments were developed and used to offer a wider and brighter variety of hues.

Binder

The most common binder in interior paints was, and still is, oil. Chalk was sometimes added to waterbased paints to help bind the pigment particles together. Other common binders included hide glue and gelatin.

Vehicle

The fluid component was termed the vehicle, or medium, because it carried the pigment. Historically, vehicles included turpentine in oil paints and water in waterbased paints, but other vehicles were sometimes used, such as milk in casein paints.

Oil-Based and Water-Based Paints

The two major types of paint are termed oil-based and water-based. For oilbased paints, linseed oil was frequently chosen because it is a drying oil. When thinned with an organic solvent such as turpentine for easier spreading, its drying speed was enhanced. To make the drying even faster, drying agents such as cobalt compounds were frequently added. Because the addition of driers was most successfully done in hot or boiling oil, boiled linseed oil was preferable. The drying rate of linseed oil paints was relatively rapid at first, for several days immediately after application, and paint soon felt dry to the touch; it is important to remember, however, that linseed oil paint continues to dry—or more precisely, to crosslink—over decades and thus continues to a point of brittleness as the paint ages. Strong and durable with a surface sheen, oil-based paints were mainly used for wood trim and metal.

Whitewashes and distemper paints differed from oil paints in appearance primarily because the vehicle was water. Waterbased paints were always flat, having no gloss of their own. Because the paint film dried to the touch as soon as the water evaporated, driers were not needed. Waterbase paints were fairly strong, with the pigments well bound as in hide glue distempers, but they did not hold up to abrasion. Wood trim, therefore, was rarely painted with these types of paint historically, though interior plaster surfaces were frequently coated with whitewash and calcimine. Distemper paints were commonly used for decorative work.

Recent Changes to Paint Constituents

Until the mid-20th century, almost all paints used in America could be divided according to the type of binder each had. Chemists sought to improve paints, especially when the two world wars made traditional paint components scarce and expensive. Modern paints are far more complex chemically and physically than early paints. More ingredients have been added to the simple threepart system of pigment, binder, and vehicle. Fillers or extenders such as clay and chalk were put in to make oil paints flow better and to make them cheaper as well. Mildewcides and fungicides were prevalent and popular

There were numerous companies producing white lead in the United States by mid-19th century. Shown is one manufacturer's flyer. Photo: NPS files.

until their environmental hazards were seen to outweigh their benefits. New formulations which retard the growth of the mildew and fungi are being used. As noted, lead was eliminated after 1950. Most recently, volatile organic solvents in oil paint and thinners have been categorized as environmentally hazardous.

A major difference in modern paints is the change in binder from the use of natural boiled linseed oil to an alkyd oil which is generally derived from soybean or safflower oil. Use of synthetic resins, such as acrylics and epoxies, has become prevalent in paint manufacture in the last 30 years or so. Acrylic resin emulsions in latex paints, with water thinners, have also become common.

Types of Historic Paints

Historic paints were often made with what was available, rather than adhering to strict formulas. Recipes for successful formulas can be found in historic documents, such as newspapers, illustrating the combinations of ingredients which could be used to produce a paint.

Oil-based paints: Linseed oil, a volatile thinner such as turpentine; a hiding pigment (usually white lead) and coloring pigments.

Enamels: natural resin varnish was added to oil-based paint to provide a hard, more glossy surface.

Glaze: a translucent layer applied to protect the paint and to impart a more uniform gloss surface. Usually made from linseed oil with natural resin varnish added. Some glazes have small quantities of tinting pigments such as verdigris or Prussian blue; some had no pigments added.

Water-based paints: Water, pigment, and a binder, such as hide glue, other natural glues, or gums. Usually used on interior plaster surfaces.

Whitewash: often used on interior plaster surfaces in utilitarian spaces and, at times, used on interior beams; consisted of water, slaked lime, salt, and a variety of other materials. Occasionally a pigment (usually an ochre or other earth pigment) was added to provide tint or color.

Distemper: used for interior applications, were made from water, glues (one or more different natural glues, gelatine, and gums) with whiting as the basic white pigment to which other tinting pigments were added.

Calimine, or kalsomine: often used on interior surfaces and is another common name for distemper.

Tempera: paint prepared with pigment, egg yolk or white and water; used almost exclusively for decorative treatments.

Gouache: a waterbased paint made of whiting, pigment, water, and gum arabic as the binder; used almost exclusively for decorative treatments.

Milk-based paint

Casein: also called milk paint, was made with hydrated (slaked) lime, pigment, and milk. Most often oil was added, making a strong emulsion paint. Various recipes call for a large variety of additives to increase durability. Casein paints were also used for exterior surfaces.

Pre-1875 Paints

Production and Appearance

How were paints made prior to the widespread use of factory-made paint after 1875? How did they look? The answers to these questions are provided more to underscore the differences between early paints and today's paints than for practical purposes. Duplicating the composition and appearance of historic paints, including the unevenness of color, the irregularity of surface texture, the depth provided by a glaze top coat, and the directional lines of application, can be extremely challenging to a contemporary painter who is using modern materials.

The Boston Stone (1737), a surviving relic of early paint production, was used

The pigments used in early paints were coarsely and unevenly ground, and they were dispersed in the paint medium by hand; thus, there is a subtle unevenness of color across the surface of many pre-1875 paints. The dry pigments had to be ground in oil to form a paste and the paste had to be successively thinned with more oil and turpentine before the paint was ready for application. The thickness of the oil medium produced the shiny surface desired in the 18th century. In combination with the cylindrical (or round) shaped brushes with wood handles and boar bristles, it also produced a paint film with a surface texture of brush strokes.

Geographical Variation

The early churches and missions built by the French in Canada and the Spanish in the southwestern United States often had painted decoration on whitewashed plaster walls,

for pigment grinding in the shop of Thomas Child of Boston, a London-trained painter and stainer. Photo: Courtesy, SPNEA.

done with early waterbased paints. By the mid-17th century oil paint was applied to wood trim in many New England houses, and whitewash was applied to walls. These two types of paint, one capable of highly decorative effects such as imitating marble or expensive wood and the other cheap to make and relatively easy to apply, brightened and enhanced

American interiors. In cities such as Boston, Philadelphia, New York, and later, Washington, painters and stainers who were trained guildsmen from England practiced their craft and instructed apprentices. The painter's palette of colors included black and white and grays, buffs and tans, ochre yellows and iron oxide reds, and greens (from copper compounds) as well as Prussian blue. That such painting was valued and that a glossy appearance on wood was important are substantiated by evidence of clear and tinted glazes which may be found by microscopic examination.

Brush Marks

Early paints did not dry out to a flat level surface. Leveling, in fact, was a property of paint that was much sought after later, but until well into the 19th century, oil paints and whitewashes showed the signs of brush marks. Application therefore was a matter of stroking the brush in the right direction for the best appearance. The rule of thumb was to draw the brush in its final strokes in the direction of the grain of the wood. Raisedfield paneling, then, required that the painter first cover the surface with paint and afterward draw the brush carefully along the vertical areas from bottom to top and along the top and bottom bevels of the panel horizontally from one side to the other.

In the 19th and early 20th centuries, for very fine finishes, several coats were applied with each coat being rubbed down with rotten stone or pumice after drying. A four to five coat application was typical; however nine coats were not uncommon at the end of the century for finishes in some of the grand mansions. Generally, they were given a final glaze finish. Though expensive, this type of finish would last for decades and give a rich, smooth appearance.

Color

Color matching is complicated by the fact that all early paints were made by hand. Each batch of paint, made by painters using books of paint "recipes" or using their own experience and instincts, might well have slight variations in color—a little darker or lighter, a little bluer and so on. The earliest known book of paint formulations by an American painter is the 1812 guide by Hezekiah Reynolds. It gives instructions for the relative quantities of tinting pigments to be added to a base, but even with proportions held constant, the amount of mixing, or dispersion, varied from workman to workman and resulted in color variations.

Knowing all of the facts about early paints can aid in microscopic paint study. For example, finding very finely and evenly ground pigments, equally dispersed throughout the ground or vehicle, is an immediate clue that the paint was not made by hand but, rather, in a factory.

By the first decades of the 19th century more synthetic pigments were available—chrome yellow, chrome green, and shades of red. Discoveries of light, bright, clear colors in the plaster and mosaic decoration of dwellings at Pompeii caught the fancy of many Americans and came together with the technology of paint to make for a new palette of choice, with more delicacy than many of the somewhat greyeddown colors of the 18th century. Of course, the blues which could be produced with Prussian blue in the 18th and 19th centuries were originally often strong in hue. That pigment—as were a number of others— is fugitive, that is, it faded fairly quickly and thus softened in appearance. It should be remembered that high style houses from the mid-17th to late 19th centuries often had wallpaper rather than paint on the walls of the important rooms and hallways.

Glossy/Flat

Another paint innovation of the early 19th century was the use of flatter oil paints achieved by adding more turpentine to the oil, which thus both thinned and flatted them. By the 1830s the velvety look of flat paint was popular.

Wherever decorative plaster was present, as it frequently was during the height of the Federal period, distemper paints were the coating of choice. Being both thin and readily removable with hot water, they permitted the delicate plaster moldings and elaborate floral or botanical elements to be protected and tinted but not obscured by the buildup of many paint layers. (The use of waterbased paints on ceilings continued through the Victorian years for the same reasons.)

Unfortunately, flat paints attract dirt, which is less likely to adhere to high gloss surfaces, and are thus harder to wash. Victorians tended to use high gloss clear (or tinted) finishes such as varnish or shellac on much of their wood trim and to use flat or oil paints on walls and ceilings.

Decorative Painting

In interiors, paint could be used creatively and imaginatively, most often to decorate rather than to protect. Decorative forms included stencilling, graining and marbledizing, and trompe l'oeil. Stencilling. Stencilled designs on walls were often used in the first

The task of preserving or restoring decorative work, such as the complex stencilling shown here, should only be undertaken by professionals who have specialized training. Photo: Alexis Elza.

half of the 19th century in place of wallpaper. Old Sturbridge Village, in Massachusetts, has paintings showing the interiors of a (c. 1815-1820) farmhouse which has both stencilled walls—imitating wallpaper—and painted floors or oiled and painted floor cloths, imitating fine carpets. By 1850 and for the next 60 years thereafter, stencilled and freehand-painted decoration for walls and ceilings became a high as well as a humble art. Owen Jones' *Grammar of Ornament*, published in 1859, provided the source for painted decoration from Portland to Peoria, Savannah to San Francisco.

Graining and Marbleizing

If floors, walls, and ceilings were decorated by paint in a variety of styles, the wood and stone trim of rooms was not omitted. The use of faux bois, that is, painting a plain or common wood such as pine to look like mahogany or some finer wood, or faux marbre, painting a wood or plaster surface to look like marble—realistically or fantastically—was common in larger homes of the 18th century. By the early 19th century, both stylized graining and marbleizing adorned the simple rural or small town houses as well. Often baseboards and stair risers were marbleized as were fireplace surrounds. Plain slate was painted to look like fine Italian marble. In many simple buildings, and, later, in the Victorian period, many prominent buildings such as town halls and churches, the wood trim was given a realistic graining to resemble quarter sawn oak, walnut, or a host of other exotic woods.

Trompe L'oeil

Churches, courthouses, and state capitols frequently received yet another remarkable use of paint: trompe l'oeil decoration. Applied by skilled artists and artisans, painted designs—most often using distemper paints or oils—could replicate three-dimensional architectural detailing such as ornate molded plaster moldings, medallions, panels, and more.

Factory-Made Paints after 1875

An enormous growth of the paint industry began in the 1860s, stimulated by the invention of a suitable marketing container—the paint can. The first factory-made paints in cans consisted of more finely ground pigments in an oil base; after purchase, additional oil was added to the contents of the can to make up the paint. Such paints saved the time of handgrinding pigments, and were discussed at length by John Masury in his numerous books. After 1875, factory-made paints were available at a reasonable cost and, as a result, greater numbers of people painted and decorated more of their buildings, and more frequently. The new commercial market created by ready-mixed paint became the cornerstone of our modern paint industry.

20th Century Paints

By the early decades of the 20th century, popular taste turned away from exuberant colors and decoration. Until the late 1920s both the Colonial Revival and Arts and Crafts styles tended toward more subdued colors and, in the case of Colonial Revival, a more limited palette. The use of faux finishes, however, continued. Residential architecture often featured stencilling, such as painted borders above wainscoting or at ceiling and wall edges to imitate decorative wallpaper. Institutional buildings in both cities and small towns used wood graining on metal-clad doors, door and window frames, and staircases, and had stencilled ceilings as well. Many high style public buildings of the 1920s had painted ceilings which imitated the Spanish and Italian late medieval and Renaissance styles.

Although stenciling, gilding, and faux finishes can be found, they did not express the modern style of the time. On the other hand, glaze treatments were often used in the early 20th century to "antique" walls and trim that had been painted with neutral colors, especially in Spanish Colonial Revival and Mission architecture. The glazes were applied by ragging, sponging, and other techniques which gave an interesting and uneven surface appearance. Colored plasters were sometimes used, and air brushing employed to give a craftsman-like appearance to walls, trim, and ceilings. During the same period, Williamsburg paint colors were produced and sold to people who wanted their houses to have a "historic Georgian look." Churches, country clubs, and many private buildings adopted the Williamsburg style from the late '20s onward.

Often decorated with simple molded plaster designs of the Art Deco and Art Moderne styles, interiors of the 1930s and 1940s were frequently accented with metal flake paints in a full range of metallic colors, from copper to bronze. And enamels, deep but

Historic doors may have graining patterns or clear finishes under one or several coats of plain paint, such as these restored 18th and 19th century doors. Photo: Jack E. Boucher, HABS, NPS.

The Art Deco style lobby foyer of the Paramount Theater in Sacramento, California (1931) features painted plaster columns and cornices which have been

subdued hues, became popular. Paint technology had progressed and varying degrees of gloss were also available, including the mid-range enamels, variously called satin, semigloss, or eggshell. In contrast to Victorian paint treatments, this period was characterized by simplicity. To some extent, the Bauhaus aesthetic influenced taste in the 1950s; interior paints were frequently chosen from a palette limited to a few "earth" colors and a "nearly neutral" palette of off-whites and pale greys.

While the trend in colors and decorative treatments was defined by its simplicity, paint chemists were developing paints of increasing complexity. Experimentation had started early in the 20th century and accelerated greatly after World War II. Of greatest significance was the manufacture of the latex paints for consumer use. Synthetic resin emulsions carried in water offered advantages over the traditional oil paints, and even over the oil/alkyd paints: they did not yellow; they permitted water cleanup until dried; and they emitted no toxic or hazardous fumes from solvent evaporation.

finished in gold and silver leaf. Photo: Gabriel Moulin Studios.

Paint Investigation

Understanding each project's historic preservation goal and knowing what level of information needs to be collected to achieve that goal is an important responsibility of the purchaser of the service. Before someone is hired, the owner or manager needs to decide if a thorough investigation of painted surfaces is actually needed, and how to use the results when one is done.

This conservator is shown collecting paint samples onsite. Then, in a laboratory, an ultra violet light microscope will be used to identify pigment and binding media. Photo: Courtesy, Matt Mosca.

Specialists with both training and field experience conduct paint investigations. These experts use sophisticated instruments and procedures such as field sampling, cross-section analysis, and fluorescent and chemical staining to learn about the components and behaviors of historic paints. In addition, they utilize written documentation, verbal research, and visual information about past painting in the building in conjunction with findings in the field.

Paint investigation can make several contributions to a project. A complete analysis of the paint layers on surfaces within a structure can tell a great deal about the sequence of alterations that have occurred within a building, as well as potentially providing ranges of dates for some of these changes. By establishing a full sequence of paint layers (termed a *chromochronology*), together with other research, alterations of various building spaces and features can be associated with specific paint layers. It is by establishing this association that the correct layer is identified; when the correct layer has been identified, the color may be matched.

In addition to its archeological value, paint analysis can determine the types and colors of paint on a given surface (identification of thin glazes, decorative paint schemes, binders and pigments). Beyond color identification, then, paint analysis is also recommended to diagnose causes of paint failure. Knowing a paint binder can often explain causes as well as guide appropriate preservation or conservation treatments.

Owners and managers should identify all of these needs before deciding on the extent of analysis. For example, a complete paint investigation is usually recommended as part of an historic structure report. For buildings with little documentation, additions and alterations can often be identified, and possibly dated, through analysis. Often the use of such seemingly expensive techniques can save money in the long run when determining the history of building change.

It is possible to do some analysis on site; this is a much simpler process that can be undertaken for less cost than the complex laboratory procedures described above. However, the usefulness of onsite analysis is limited and the results will not be as precise as results from samples that are analyzed in a laboratory with a good microscope. Any shortcut approaches to paint analysis that do not follow scientific procedures are generally not worth the expense. In summary, if preservation and restoration treatments are being undertaken, a complete investigation is recommended; for a rehabilitation project, onsite analysis and color matching may provide an adequate palette.

A dark layer can be seen beneath the flaking paint on these raised field panels. Depending on the project work goal and the period of the building's history being interpreted, any one of the paint layers could be duplicated in repainting. Photo: NPS files.

Choosing a Treatment

Most projects involve repainting. It is the historic appearance of the interior and the visual impression that will be created by new paint treatments that must be considered before choosing a particular course of action. The type and colors of paint obviously depend on the type of building and the use and interpretation of its interior spaces. A consistent approach is best.

Preservation

When the treatment goal is preservation, a building's existing historic features and finishes are maintained and repaired, saving as much of the historic paint as possible. Sometimes, cleaning and washing of painted surfaces is all that is needed. Or a coating may be applied to protect important examples of history or art. If repainting is required, the new paint is matched to existing paint colors using the safer, modern formulations. Recreating earlier surface colors and treatments is not an objective.

Interior spaces that are being rehabilitated for a new use can benefit from being repainted in historic period colors rather than a neutral off-white. Photo: NPS files.

Rehabilitation

In a typical rehabilitation, more latitude exists in choosing both the kind of new paint as well as color because the goal is the efficient reuse of interior spaces. Decisions about new paint often weigh factors such as economy and durability—use of a high quality standard paint from a local or national company and application by a qualified contractor. Color choices may be based on paint research reports prepared for interior rooms of comparable date and style. More often, though, current color values and taste are taken into account. Again, the safer paint formulations are used.

Interiors of institutional buildings, such as university buildings, city halls, libraries, and churches often contain rich decorative detailing. During rehabilitation, careful choices should be made to retain or restore selected portions of the decorative work as well as match some of the earlier colors to evoke the historic sense of time and place. At the least, it is important to use periodtypical paint color and paint placement.

Restoration

In a restoration project, the goal is to depict the property as it appeared during its period of greatest significance. This may or may not be the time of its original construction. For example, if a building dated from 1900 but historians deemed its significance to be the

1920s, the appropriate paint color match would be the 1920s layer, not the original 1900 layer.

Based on historical research, onsite collection of paint samples, and laboratory analysis, surface colors and treatments can be recreated to reflect the property at a particular period of time. It should be noted that scholarly findings may yield a color scheme that is not suited to the taste of the contemporary owner, but is nonetheless historically accurate. In restoration, personal taste in color is not at issue; the evidence should be strictly followed.

In the restoration process, colors are custom-matched by professionals to give an accurate representation. If an artist or artisan can be found, the historically replicated paint may be applied using techniques appropriate to the period of the restoration. Although custom paint manufacture is seldom undertaken, color and glazing are capable of being customized. In some projects, paint may be custom-made using linseed oil and, if building code variances allow it, white lead. For example, the repainting of a number of rooms at Mount Vernon demonstrates that it is possible to replicate historic paints and applications in all aspects; however, as noted, replication of historic paint formulation is not practical for the majority of projects.

Identifying Deteriorated and Damaged Paint Surfaces

Because painted surfaces are subject to abrasion, soiling, water damage, sunlight, and application of incompatible paints they generally need to be repainted or at least reglazed appropriately from time to time.

Abrasion

From the baseboards up to a level of about six feet off the floor, wood trim is constantly subjected to wear from being touched and inadvertently kicked, and from having furniture pushed against it. Chair rails were in fact intended to take the wear of having chairs pushed back against them instead of against the more delicate plaster wall or expensive wallpaper. Doors in particular, sometimes beautifully grained, receive extensive handling. Baseboards get scraped by various cleaning devices, and the lower rails of windows, as well as window seats, take abuse. The paint in all of these areas tends to become abraded. Two things are important to bear in mind about areas of abraded paint. Samples taken to determine original paint colors and layer sequences will not be accurate except at undamaged edges. Also, dirt and oil or grease need to be removed before applying any new paint because new paint will not adhere to dirty, greasy surfaces.

Dirt

Soiling is another problem of interior paint. Fireplaces smoked; early coal-fired furnaces put out oily black soot; gas lights and candles left dark smudges. Sometimes the dirt got deposited on plaster walls or ceilings in a way that makes the pattern of the lath behind the plaster quite clear. Another source of dirt was polluted outside air, from factories or other industries, infiltrating houses and other nearby buildings. Until smokestacks became very high, most air pollution was caused by nearby sources.

In paint investigation, dirt on the surface of paint layers; as seen under the microscope, can be very useful in suggesting the length of time a given paint layer remained exposed, and in distinguishing a finish layer from a prime or undercoat layer. This kind of soiling can happen on any painted surface in a room, but may be slightly heavier in the recesses of moldings and on upwardfacing horizontal edges. Using dirt as a sole measure, however, may be misleading if the surfaces have been cleaned. The fracture or bonding between paint layers is often used by professionals as a better means of indicating time differences between layers as well as indicating those layers that are part of a single decoration or painting.

Water

Water, the usual source of deterioration for many kinds of material, is also a prime cause of interior paint failure. As a liquid, it can come from roof leaks, from faulty plumbing or steam heating systems, or from firesuppression systems that have misfired. As a vapor, it may come from such human activities as breathing, showering, or cooking. Plaster walls sealed with unpigmented hideglue are notably susceptible to water damage because it forms a watersoluble layer between the plaster and the paint. This can cause the paint to lose adhesion when even small amounts of moisture come into contact with the watersoluble sealer.

Age/Sunlight

Finally, in historic interiors, especially where there is heavy paint buildup, paint can weaken and fail due to chemical or mechanical reasons. For example, the older linseed oil is, the more brittle it is. It also darkens when it is covered and gets no ultraviolet exposure. In rooms where there is more sunlight on one area than on others, the oil or even oil/alkyd paint will get discernibly darker in the less exposed areas in as short a time as six months. Painted over, the oil medium in older paints gets quite yellowbrown, thus changing the color of the paint. Prussian blue is one of the tinting pigments that is particularly vulnerable to fading.

Incompatible Paints

Understanding some basic differences in the strength of various paints helps to explain certain paint problems. Paints that dry to a stronger film are incompatible with those which are weaker. Acrylic latex paints are stronger than oil/alkyd paints. Oil or oil/alkyd paint is stronger than waterbased paint such as calcimine. When a stronger paint is applied over a weaker paint, it will tend to pull off any weaker paint which may have begun to lose its bond with its substrate. Thus, on many ceilings of older buildings where oil/alkyd paints have been applied over old calcimine, large strips of paint may be peeling.

Oil or varnish glazes over older paints become brittle with age, and can make removal of later paints rather easy. Sometimes it is possible to take advantage of this characteristic to reveal an earlier decorative treatment such as graining or marbleizing. Getting under the edge of the glaze with a scalpel blade can make the removal of later paints relatively simple, and relatively harmless to the fancier paint treatment. Sometimes, paints separate from each other simply due to poor surface preparation in the past or the hardening of the earlier surface paint. Use of alkaline paint strippers can cause paint to lose adhesion. When insufficiently neutralized, they leave salts in wood which cause oil or oil/alkyd paints to fail to adhere to the surface. If dirt or oily residues are not cleaned from the surfaces to be painted, new paint will not remain well adhered.

Surface Preparation

First, it is important to note that the earlier, linseed oil-based paints were penetrating type paints, forming a bond by absorption into the substrate. Often these thin oil coatings were slightly tinted with an ironoxide pigment so coverage could be seen; the next coating applied would adhere to this first oil layer. Modern paints, on the other hand, are primarily bonding paints with little ability to penetrate a substrate. For this reason, surface preparation is extremely important for today's paints.

Before preparing the interior for repainting, all moisture penetration from failing roofs or gutters or from faulty plumbing or interior heating elements should be identified and corrected. A paint job is only as good as the preparation that goes before it. The surface to be painted, old or new, wood, plaster, masonry, or metal must be made sound and capable of taking the paint to be applied.

Scraping and Sanding

The first step in preparing interior wood and plaster surfaces which are coherent and sound is to remove any loose paint (see Paint Hazards sidebar). Careful hand scraping is always advisable for historic surfaces. Use of mechanical sanders usually leaves traces of the sander's edges, visible through the new paint film. Hand sanding is also necessary to feather the edges of the firmly adhering layers down to the bare areas so that shadow lines are avoided. Preparing previously painted interior masonry for new paint is basically similar to preparing plaster. Metals elements, such as radiators, valences, or firebacks are somewhat different. In order to get a sound paint job on metal items, the work is primarily that of sanding to remove any rust before repainting. If the existing paint is well adhered over the entire metal surface, then it may be necessary only to sand lightly to roughen the existing paint, thus providing some "tooth" for the primer and new

paint layer. On wood, garnet sanding papers work well. Aluminum oxide and silicon carbide sandpapers are effective on other surfaces as well as wood; emery papers should be used on metals.

Paint Removal

When should surfaces be completely stripped? Obviously, new paint is wasted when applied on old paint which is loose, that is, extensively damaged and deteriorated. Sometimes paint on an architectural feature needs to be removed if it obscures delicate detailing. For the most part, however, if the surface is intact—and the presence of lead paint has been shown to present no health dangers to building occupants—the existing paint can be overpainted.

Well-adhered, intact paint layers (in at least one area of each room) should be covered with a sturdy protective tape, then painted over with the new paint and left in place to inform future research. The next owner may be interested in the building's past history, and methods of gleaning information from old paints grow more sophisticated all the time.

Heat/Scraping

Propane torches should never be used because they can damage historic wood features. Also, charred areas of wood will not hold the new paint. Use of a heat gun or heat plate may be relatively fast, but has both health and safety drawbacks. Heat oxidizes lead paint, causing poisonous fumes. And old walls may contain fine debris which acts like tinder and smolders when heated, bursting into flame hours after the stripping. (Heat methods are best limited to those interior elements that can be safely removed from the building for stripping and reinstalled). Finally, scraping to remove heatloosened paint may gouge and scar the wood or plaster substrate if not done carefully. Rotary wire brushes cut into wood and should be avoided altogether.

Chemical Stripping

Removing paint from wood and plaster features can be done with either caustic strippers (potassium or sodium hydroxide) or solvent strippers (organic compounds such as methylene chloride, methanol, or toluol). Caustic strippers are fairly fast acting, but can weaken wood fibers if left on too long, causing them to raise and separate. They also leave alkaline residues which must be neutralized by an acidic wash (usually white vinegar which contains 4% acetic acid). It is difficult to make the neutralizing 100% effective and, when it is not, chemical reactions between the alkaline residues and the new paint may cause the paint to lose adhesion.

Methylene chloride and other organic compounds are as effective as caustic strippers, but their fumes may be both flammable and toxic. While they may leave wood and plaster surfaces free from harmful residue, the newly cleaned surface must be washed down with mineral spirits or denatured alcohol before priming in order to remove additives, such as wax, that were put in the stripper to retard its drying. All hazard warnings on the labels of chemical strippers should be heeded.

Detergent or Vinegar and Water

Waterbased paints can usually be scrubbed off with hot water with a detergent added. Calcimine and whitewash are difficult to remove; because of the lime or whiting content (calcium carbonate), however, they can be broken down with acids. While strong acids may work quickly, they are very dangerous. Acetic acid in its most common form, vinegar, (4% acetic acid) is often used instead. In areas where any calcimine remains and is evident as chalk, the area can be coated with white shellac, which provides a stable surface for the new paint.

Air Pressure

Air pressure of 200-500 psi is effective for flat surfaces if there is a weak substrate surface bond. A flat nozzle is inserted between the paint layer and substrate, and the air pressure simply lifts the loose paint up for easy removal. When used carefully, this method is fast and causes little damage.

Patching and Repair

Once the substrate and its surface are sound and clean, free from crumbling, loose material or dust, the next step is to undercut and fill any cracks in plaster surfaces. Plaster which has lost its key and is sagging should be reattached or replaced. Friable plaster and punky wood need to be consolidated. Wood surfaces should be made as smooth as they were historically so that the paint film will cover a relatively uniform surface. Rotted wood must be removed and new wood carefully spliced in. Finally, gypsum plaster finishes can be painted as soon as the water has evaporated; a lime putty coat or traditional finish plaster can be primed almost immediately after drying as well, using alkali-resistant primers such as acrylic latex.

Priming

The importance of a primer can hardly be overstated. It is the intermediary material between the immediate substrate, which may be an old paint layer or may be bare wood, plaster, or metal (rarely stone, as around a fireplace opening), and the fresh paint itself. The primer must be capable of being absorbed to some extent by the material underneath while being compatible and cohesive with the paint to be applied on top. Most paint manufacturers will provide explicit instructions about which primers are most compatible with their paints. Those instructions should be followed.

The question of a primer for latex paint continues to be debated. Traditionalists recommend that the primer between an old oil paint and a new latex paint be an oil primer, but the improvements to latex paint in recent years have led many experts to the conclusion that today's top grade latex primers are best for latex finish paints. If a latex primer is selected, the label on the can should specify clearly that it is one which can bond to an older oil or oil/alkyd paint.

The most important general rule to remember is that softer or weaker paints should always go over harder and stronger paints. For instance, because latex is stronger than oil, an oil or oil/alkyd paint can go over a well adhered latex, but the reverse will run the risk of failure. Using primer and finish paints by a single company is a good way to guarantee compatibility.

Choosing Modern Paint Types/Finish Coats

Most frequently today, the project goal is preservation or rehabilitation. Because of the impracticality of replicating historic paints, restoration is least often undertaken. Given current laws restricting the use of toxic ingredients, such as lead, solvents, and thinners, contemporary substitute paints using safer ingredients need to be used. Many paint companies make latex paints in colors that are close to historic colors as well as appropriate gloss levels, but contain no white lead and no hazardous volatile organic compounds.

Work on historic properties generally requires the services of a qualified paint contractor who has had at least five years of experience and who can list comparable jobs that a potential client can see. Then, too, getting a sample or a mockup of any special work may be advisable before the job starts. While less experienced workers may be acceptable for preparing and priming, it is wise to have the most experienced painters on the finish work.

Oil-based/Alkyd Paints

Today's version of oil paint has a binder that usually contains some linseed oil (read the paint can label), but also has one of the improved synthesized oils, frequently soybased, known as alkyds. They dry hard, have flexibility, and discolor far less than linseed oil. They can also be manufactured to dry with a high sheen, and can take enough tinting pigment to create even the very deep Victorian period colors. However, they all contain volatile organic compounds, and thus are forbidden by law in some parts of the United States. They are also less simple and more dangerous to use, as cleaning up involves mineral spirits.

Traditional water-based paint and artists' brushes are being used to reproduce historic finishes within a restoration project. Photo: Courtesy, Alexis Elza.

Acrylic Waterborne Paints (latex)

Latex paints are synthetic resins carried in water. Before the paint dries or crosslinks, it can be cleaned up with water. Early in the history of latex paints, some contained styrene/butadiene resins. Now nearly all topgrade latex paints contain acrylic resins, which are superior. Also, until fairly recently, the latex paints, while offering great strength, quick drying, and water cleanup, had some disadvantages for jobs which needed to have an historic look. Today, there are latex product lines with better gloss characteristics and more historic colors from which to choose. In addition, latex paints often have excellent color retention with very little fading. Still, it is always a good idea to buy a quart and "test paint" the color chosen for the job on site before making a total commitment.

Calcimine/Whitewash

Modern waterbased paints such as calcimine can be purchased today and have much the same appearance as the early ones. The same is true of modern whitewash, although today's whitewashes do not leave the same ropy surface texture as the early ones.

Glazes

Glazes were often part of historic paint treatments. Traditionally oil and turpentine, sometimes with a scant amount of pigment, today's glazes can be formulated with a water base and are relatively simple to apply by brush. An experienced decorative painter should be consulted before deciding whether to use a glaze coat rather than a high-gloss enamel. The glaze is capable of providing protection as well as a more accurate historic appearance that includes a greater depth to the finish.

Epoxies/Urethane

These were not available until relatively recently and thus are not appropriate for replication of traditional finishes.

Applying Interior Paints

Because flat wall surfaces generally dominate an interior painting job, some flexibility in applicators is suggested below:

Brushes

Natural bristle brushes now have competition from synthetic brushes made of nylon or polyester which work well for applying either oil/alkyd or latex paints. Being harder than natural bristles, they tend to last longer. Since brushes come in a wide and very specific variety of types suited to different types of work, it is important to have a painter who will use the appropriate brush for the paint selected and for each portion of the job. One strong advantage of brushing paint on is that the paint is forced onto the surface and into all of its imperfections. Thus a good brushed-on paint job may last longer if the substrate is sound and the primer and finish coats are compatible and of top quality.

Rollers

There is no harm in using a roller, or even an airless sprayer, to apply a prime coat to a large flat area. Since all contemporary commercial paints dry with a smooth surface anyway, use of a roller or sprayer is acceptable for priming, and even for a first finish coat. However, to get paint well pushed into articulated surfaces and to add some texture to larger flat surfaces, a brush is best.

Types of Modern Paint

Oil-based/alkyd: Nonvolatile oils and resins, with thinners. (Alkyds are synthetic, gelatinous resins compounded from acids and alcohol.) Accept almost any type of coloring/hiding pigments. For use on interior wood and metal.

Acrylic waterborne paints (latex): Suspension of acrylic or polyvinyl resins in water, with other resins, plus hiding and coloring pigments and extenders. Dries by evaporation. Commercially produced acrylic or latex enamels are also available in a complete range of gloss levels which are produced with the addition of various acrylic polymers. Use on interior plaster especially.

Enamels: Modern alkyd paints are adjusted with the addition of synthetic varnishes to produce a complete range of gloss levels.

Metal finishes: Paints marketed for use on metals, can either be alkyd, latex, or epoxy based, or combinations. The primers used for metals are formulated with rust-inhibiting ingredients.

Special finishes: finishes such as urethane and epoxy-based paints, marketed for very high gloss surface treatments.

Finally, decorative paint work in an historic interior—whether simple or highstyle—is well worth preserving or restoring, and when such fancy work is being undertaken, traditional tools should always be used. To simplify by using shortcut methods or rejecting painted decoration is indeed to dismiss or skew history as well as to lose the enjoyment of a true historic finish.

Summary and References

First, it is most important to understand the range of approaches and treatments and to make choices with as much knowledge of the original and subsequent historic paints as possible, using the *Secretary of the Interior's Standards for the Treatment of Historic Properties* as a framework.

A paint's patina of age expresses decades or centuries of endurance in the face of changing climate and conditions. Documenting the sequence of interior paint layers and protecting this information for future investigation should be an integral part of any historic preservation project.

Except for the rare, scholarly restorations of historic interiors, most repainting jobs done today will employ modern paint formulations. Modern paints can recreate the appearance of historic colors, gloss and texture in varying degrees, but eliminate earlier toxic components such as white lead and volatile organic compounds.

CAUTION: Before Painting Know Paint Hazards and Take Action

Before undertaking any project involving paint removal, applicable State and Federal laws on lead paint abatement and disposal must be taken into account and carefully followed. State and Federal requirements may affect options available to owners on both paint removal and repainting. These laws, as well as any requirements prohibiting volatile organic compounds (VOCs), should be requested from the State Historic Preservation Officer in each State.

Below is a summary of the health hazards that owners, managers, and workers need to be aware of before removing paint and repainting:

Lead and other heavy metal compounds.

In virtually all paints made before 1950, the white or "hiding" pigment was a lead compound, or more rarely, zinc oxide. Work to remove lead paint such as scraping and dry sanding releases the lead—a highly damaging heavy metal—in dust.

When discovered, important examples of history, such as this pencilled Civil War graffiti, should be preserved. Photo: Kaye Ellen Simonson.

Lead dust then enters the human system through pores of the skin and through the lungs. The use of heat for stripping also creates toxic lead fumes which can be inhaled.

To mitigate the hazards of lead paint ingestion, inhalation, or contact, it is extremely important to prevent the dust from circulating by masking room openings and removing all curtains, carpeting, and upholstered furniture. Drop cloths and masking containing lead dust should be carefully enclosed in tight plastic bags before removal. Workers and others in the room should wear High Efficiency Particulate Air (HEPA) filters for lead dust (fume filters if heat stripping is being used), change clothing just outside the room leaving the work clothes inside, and avoid any contact between bare skin (hands) and the paint being removed. Workers should also not eat, drink, or smoke where lead dust is present. Finally, anyone involved in lead paint removal should undergo periodic blood testing. After work, ordinary vacuuming is not enough to remove lead dust; special HEPA vacuums are essential. The surfaces of the room must also be given a final wash with a solution of trisodium phosphate and water, changing the washing solution often and rinsing well.

In addition to lead, early oil paints also had cobalt or other heavy metal compounds in them to accelerate drying. A small amount of mercury is also included in some latex paints to help prevent mildew and mold formation.

Volatile Organic Compounds (VOCs)

Organic paint strippers, such as methylene chloride, and oil/alkyd paints have VOCs as their solvent base. Inhaling these fumes can lead to respiratory and other illnesses, and to cancer. Especially in closed spaces (but in the outdoor environment as well) these compounds pollute the air and can damage health.

Organizations

National Paint and Coatings Association

1500 Rhode Island Ave. N.W.

Washington, D.C. 20005

Painting and Decorating Contractors of America

3913 Old Lee Highway, Suite 33B

Fairfax, VA 22030

Federation of Societies for Coatings Technology

492 Norristown Rd.

Blue Bell, PA 19422-2350

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

June 1992

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4.2.5 Preserving ceramic tile floors (Grimmer and Conrad 1996 – Preservation Brief #40)

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PRESERVATION BRIEFS

40

Preserving Historic Ceramic Tile Floors

Anne E. Grimmer and Kimberly A. Conrad

[The Tile-Making Process](#)

[Historical Background](#)

[Ceramic Floor Tile Types](#)

[Laying Historic Tile Floors](#)

[Preservation and Maintenance](#)

[Damage and Deterioration Problems](#)

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This Minton encaustic floor tile was installed in the U.S. Capitol in the 1850s. Photo: NPS files.

With a tradition that dates to ancient civilizations, *ceramic tile flooring can be found in a variety of settings in diverse cultures and structures, including residential buildings ranging from large apartment buildings to small private houses, institutional buildings such as government offices and schools, and religious buildings such as cathedrals and mosques. Historically, its widespread use may be attributed to the fact that a readily available natural material—clay—could be converted by a relatively simple manufacturing process—baking or firing—into a very durable, long-lasting and attractive floor tile that is easy to maintain. Ceramic floor tiles exhibit a versatility of colored glazes and decoration, and they range from the plainest terra cotta tiles to highly decorated individual ceramic tiles and elaborately patterned tile floors. Their modularity, as standardized units, make them easy to fit into different sized spaces which also explains much of the popularity of ceramic floor tiles throughout history.

*Ceramic: Any product manufactured from a nonmetallic mineral (such as clay), by firing at high temperatures.

This Brief begins with an overview of ceramic tiles as a traditional flooring material. It includes an explanation of the various kinds of historic floor tiles used in the United States and how they were made. General guidance is given on preservation treatments, focusing on maintenance, and, when necessary, selective replacement of damaged floor tiles. The Brief is intended to provide owners and managers of historic properties with an understanding of the significance and historical background of ceramic floor tiles, and a basic awareness of maintenance techniques and various deterioration problems to which tile floors are especially prone. In the case of significant historic ceramic tile floors, a professional conservator of ceramics should be consulted to advise in matters of repair, restoration or conservation. Historically, ceramic tiles were used on walls as wainscoting, on fireplace hearths and fireplace surrounds, and even on furniture, as well as for flooring. However, because floor tiles are subject to greater damage and deterioration, they are the primary emphasis of this Brief. Highlights include: a short history of ceramic floor tiles; a description of ceramic tile types; a summary of traditional installation methods; maintenance techniques; and guidance on repair and replacement.

The Tile-Making Process

Clay is an earthen material, moldable or plastic when wet, non-plastic when dry, and permanently hard when baked or fired. It is widely distributed geographically, and often found mixed with sand in soils of a loam type—a mixture of clay, silt and sand. Relatively pure clay is not usually a surface deposit, although, in some cases, it may be exposed by erosion. Clay types vary throughout the world, and even within a region. Each type of clay possesses a unique combination of special properties such as plasticity, hardness and lightness, as well as color and texture, which makes some clays better suited for one kind of ceramic than another. The correct clay mixture needed for a particular purpose can be created by blending clays and adding other materials, but using the wrong type of clay can result in expensive production problems such as crazing (the formation of tiny cracks in a tile glaze) or warping of the tile itself. Traditionally, chalky clays have been preferred for many kinds of ceramic tiles, in part because they produce, when fired, a white body which is desirable for decorating. Other materials can be added, including grog (or ground-up fired clay) that helps aerate the clay and prevents warping, speeds firing and reduces shrinking, or calcined flint, to harden it.

There are several methods used for making ceramic tiles: extrusion; compaction or dust-pressing; cutting from a sheet of clay; or molded in a wooden or metal frame. Quarry tiles are extruded, but most ceramic floor tiles, including traditional encaustic, geometric and ceramic "mosaic" tiles are made from refined and blended ceramic powders using the compaction method, known as dust-pressing. Encaustic tiles, which were made by dust-pressing, are unique in that their designs are literally "inlaid" into the tile body, rather than surface-applied. Once formed, tiles are dried slowly and evenly to avoid warpage, then fired in a special kiln that controls high, even heat at temperatures up to 1200°C (or approximately 2500°F) for 30–40 hours. Higher temperatures produce denser tiles with harder glazes. Most ceramic tiles require only one firing to achieve low porosity and become vitrified or glass-like, but some, especially highly decorated tiles, are fired more than once. Non-vitreous and semi-vitreous tiles are fired at lower temperatures and are much more porous.

Colored slip, or liquid clay, is being poured into the indented portion of a reproduction encaustic tile, to create the pattern. Photo: H & R Johnson Tiles.

Historical Background

Historically, the use of ceramic floor tiles goes back to the fourth millennium B.C. in the Near and Far East. The Romans introduced tile-making in Western Europe as they occupied territories. However, that art was eventually forgotten in Europe for centuries until the 12th century when Cistercian monks developed a method of making encaustic floor tiles with inlaid patterns for cathedral and church floors. But, this skill was again lost in the 16th century following the Reformation. Except for finely decorated wall tiles made in Turkey and the Middle East, and Delft tiles made in Holland in the 17th century, ceramic floor tiles were not made again in Europe until almost the mid-19th century.

In the 19th century, Minton tiles were sold from this catalogue to American clients. Photo: NPS files.

The modern tile industry was advanced by Herbert Minton in 1843 when he revived the lost art of encaustic tile-making in England. The industry was further revolutionized in the 1840s by the "dust-pressing" method which consisted of compressing nearly dry clay between two metal dies. Dust-pressing replaced tile-making by hand with wet clay, and facilitated mechanization of the tile-making industry.

Throughout the rest of the 19th century, dust-pressing enabled faster and cheaper production of better quality floor tiles in a greater range of colors and designs. In the 1850s encaustic tiles were selected for such important structures as the new Palace at Westminster in London, and Queen Victoria's Royal Residence on the Isle of Wight. By the latter part of the 19th century, despite the fact that encaustic tiles were still quite expensive, they had become a common flooring material in many kinds of buildings.

Development of the Tile Industry in America

Although plain, undecorated ceramic tiles were traditionally a common flooring material in many parts of the Americas, especially in Latin and South America, ceramic floor and roof tiles were probably not made in the North American Colonies until the late-16th or early-17th century. It was, however, in the Victorian era that ceramic tile flooring first became so

prevalent in the United States. The production of decorative tiles in America began about 1870 and flourished until about 1930.

Like so many architectural fashions of the day, the popularity of ceramic tile floors in America was greatly influenced by the noted architect and critic, Andrew Jackson Downing. In his book *The Architecture of Country Houses*, published in 1850,

Downing recommended encaustic floor tiles for residential use because of their practicality, especially in vestibules and entrance halls.

The 1876 Philadelphia Centennial Exposition, with its European and even a few American exhibits of decorative floor tile, was a major factor in popularizing ceramic tile floors in the U.S. Initially, most ceramic tiles—other than purely utilitarian floor tiles—were imported from England, and their relatively high cost meant that only wealthy Americans could afford them. However, when English tile companies realized the potential for profitable export, they soon established agents in major U.S. cities to handle their American business. The English near monopoly actually stimulated the growth of the U.S. tile industry in the 1870s resulting in sharply decreased English imports by 1890.

The location of potteries and ceramic tile factories is dependent upon the ready availability of suitable ball clay (clay that balled or held together), kaolin (a white clay used as a filler or extender), and feldspar (a crystalline mineral), and an accessible market. Since the cost of shipping the manufactured products tended to restrict profitable sales to limited areas, this usually determined whether a factory would succeed. Although the United States Pottery in Bennington, Vermont, is known to have made encaustic tiles as early as 1853, the Pittsburgh Encaustic Tile Company (later the Star Encaustic Tiling Company), was the first successful American tile company, and is generally considered the first to manufacture ceramic tile in the U.S. on a commercial basis beginning in 1876.

At least 25 ceramic tile companies were founded in the United States between 1876 and 1894. In the East, several notable tile firms that were established in this period flourished in the Boston area, such as the Chelsea Ceramic Art Works, the Low Art Tile Works, and the Grueby Faience Company. Other East Coast companies organized in the late-19th and early-20th century included the International Tile & Trim Company, in Brooklyn, New York; the Trent Tile Company, Providential Tile Company, Mueller Mosaic Tile Company, and the Maywood Tile Company, all in New Jersey; and the Moravian Pottery and Tile Works in Doylestown, Pennsylvania.

Many factories were also established in the Midwest—in Indiana, Michigan, and, especially, in Ohio. In the last quarter of the 19th century, the town of Zanesville, Ohio, was the largest center for pottery and tile-making in the world. Some of the factories in Zanesville included: Ohio Encaustic Tile Company; Mosaic Tile Company; Zanesville Majolica Company; and J.B. Owens Pottery, later to become the Empire Floor and Wall Tile Company. The American Encaustic Tiling Company, established in 1876, was one of the first, and most successful manufacturers in Zanesville. In the early 1930s it was the largest tile company in the world, producing large quantities of floor tile, plain and ornamental wall tile, and art tile until it closed about 1935, as a result of the Depression. The United States Encaustic Tile Company, Indianapolis, Indiana; Rookwood Pottery, Cincinnati, Ohio; Cambridge Art Tile Works, Covington, Kentucky; and Pewabic Pottery, Detroit, Michigan, were some of the other well-known potteries in the Midwest.

Around the turn of the century, the industry began to expand as tilemakers moved West and established potteries there. Joseph Kirkham started the ceramic tile industry on the West Coast in 1900 when he set up the Pacific Art Tile Company in Tropic, California, after his company in Ohio was destroyed by fire. In 1904 the company became the Western Art Tile Company, surviving for five years until it went out of business in 1909. During the early-20th century, other companies were founded in Southern California, in and around Los Angeles. Batchelder & Brown, in particular, of Pasadena (later Batchelder-Wilson in Los Angeles), was well-known for its Arts and Crafts-style tiles in the teens and 1920s. By the early 1940s California had become one of the leading producers of tile, especially faience, in the U.S.

Ceramic engineers, potters and artists not only moved frequently from one pottery to another, but often struck out on their own and established new factories when dissatisfied with a former employer. Also, it was not uncommon for one company to reuse a defunct factory or purchase another pottery business, change the name and increase the product line. As a result, many of the companies in existence today are descendants of the early pioneering firms.

Changes in the Tile Industry

The majority of ceramic floor tile made in the U.S. before 1890 was encaustic, but various factories gradually began to develop and produce other kinds of tiles. The Trent Tile Company, among others, started to manufacture both white and colored ceramic mosaic tiles by the mid-1890s. White vitreous wall tile became available, as well as more decorative tiles with colored glazes, such as the variegated faience glazes intended to give a more hand-crafted appearance that were originated by the Grueby Faience and Tile Company in 1894, and soon adopted by other potteries.

In the 19th and early-20th century, many ceramic tile firms had their own engraving departments, while some used commercial designs supplied by professional printers. Well-known designers were often commissioned to work on specific product lines for a particular firm. These designers worked for one firm after another which resulted in similar designs being produced by different companies. (Historic ceramic floor tiles were usually identified by a manufacturer's or designer's mark on the back, if they were marked at all.) By the latter part of the 19th century ready-mixed glazes and colors were also available.

This was a great advantage for potters who, prior to this, had to mix their own colors and glazes.

During the 20th century, the floor tile industry continued to evolve as much as it had in the previous century. Modern methods of production employed sophisticated machinery, new materials and decorating techniques. In the years following World War II, there were many advances in the industry. Commercially manufactured dust-pressed tiles, which had previously required more than 70 hours just in the kiln, could be made in less than two hours from the raw material stage to finished tiles, boxed and ready to ship. Dried, unglazed tiles were sprayed with colored glaze evenly and automatically as conveyors carried the tiles into the tunnel kilns, and the extrusion process ensured that the tiles were cut to a uniform thickness and size. The changes and developments in the production of floor tile brought forth a wide range of shapes and sizes, along with new colors, glazes and decorating techniques.

Ceramic mosaic tiles are a practical floor covering in the entryway of this early 20th century school building. Photo: NPS files.

After the turn of the century, fewer encaustic floor tiles were used, particularly in residential architecture. The introduction of ceramic mosaic floor tiles was a factor in their decline. The development of rubber interlocking floor tiles in 1894, along with other, more resilient, flooring materials, was instrumental in the decreased popularity not only of encaustic tiles, but also other ceramic tile flooring. These new materials were not only cheaper, they were not as fragile; they were also lighter and thinner, and easier to install.

Ceramic mosaic tiles remained in common use through the 1930s in part because an innovative development had made laying such small tiles easier. The tiles were pre-mounted in decorative patterns on 12" x 12" sheets of paper, and sold ready to lay in cement. This greatly simplified the tile setter's work, and no doubt was a significant factor in the increased popularity of ceramic mosaic tiles. Sophisticated mosaic floor designs became common in entrance foyers of public and private buildings. Small, white, unglazed tiles in round, square, octagonal or hexagonal shapes were promoted for their sanitary qualities, particularly for bathroom floors, while larger, rectangular, white, glazed tiles were used for bathroom walls or wainscoting. Colored tiles were also popular, especially for bathrooms, and even kitchens. Quarry tile, which was larger and thicker than other ceramic floor tile of this period, was often used in public buildings, as well as for entrance halls, small studies, libraries, dining rooms and even living rooms in private homes. But, by the 1930s, the fashion for art tile had diminished to the point where floor tiles were, for the most part, generally regarded as primarily utilitarian, as opposed to important decorative elements.

Ceramic Floor Tile Types

The **thickness** of historic ceramic floor tiles varied considerably according to their intended use and when they were made. Floor tiles were thicker and harder than wall or ceiling tiles. Stove tiles, meant to retain the heat of the stove, were sometimes as much as several inches thick. Medieval floor tiles were usually one inch thick; encaustic tiles of the Victorian era tended to be slightly thinner. Modern, 20th-century tiles, with the exception of some art pottery tiles, are the thinnest, as a result of modern manufacturing methods. The backs of most, but not all, ceramic floor tiles are covered with raised (or sometimes recessed) ridges, circles or squares which help to increase the bonding capability of the tile.

Unglazed and Glazed Tiles

Ceramic floor tiles can generally be divided into two types: **unglazed** and **glazed**. Unglazed tiles include: quarry tiles; encaustic and geometric tiles; and ceramic mosaic tiles, which can be either glazed or unglazed. Most other ceramic floor tiles are glazed.

Unglazed Tiles

Quarry tiles are the most basic type of historic ceramic floor tile. Originally made from quarried stone, they are machine-made using the extrusion process. Quarry tiles are unglazed, semi-vitreous or vitreous, and essentially are square or rectangular slabs of clay baked in a kiln. The colors of quarry tiles are natural earthen shades of gray, red and brown determined by the clay and, to some extent, the temperature and duration of firing. Quarry tiles, which range from 1/4" to 1/2" in thickness, are available in square and rectangular shapes in sizes that include 3", 4-1/4", 6" (one of the most common sizes), 9" and 12" squares; 6" x 12", 6" x 9", 4-1/4" x 9", 3" x 6", and 3" x 9" rectangles; and 4" x 8" hexagon shapes. (Pavers or paver tiles are a simpler, and tend to be somewhat cruder, version of quarry tiles. Like quarry tiles, they are usually unglazed, but slightly thicker. Machine-made pavers are either semi-vitreous or vitreous, and generally formed by dust-pressing, although sometimes are extruded. Hand-made pavers which are common in Mexico and southern Europe are non-vitreous.)

Encaustic tiles are a type of traditional unglazed-yet decorative-floor tile, manufactured by the dust-pressed method.

Whereas most ceramic tiles are surface-decorated or decorated with impressed or embossed designs created by a mold, encaustic tiles are unique in that their decorative designs are not on the surface, but are inlaid patterns created as part of the manufacturing process. First, a thin, approximately 1/4" layer of fine, almost powder-dry, clay was pressed into a mold with a relief design at the bottom which formed a depression in the face of the tile. A second, thicker layer of coarser clay was laid over the first layer, then covered with another layer of fine clay. This "sandwich" helped prevent warping and ensured that the body of the tile was strong and had a fine, smooth surface. The layers of clay "dust" were compacted by presses, after which the mold was inverted and the die removed, thus producing a tile with an indented or intaglio pattern on top. After the tile dried, colored slip (liquid white clay colored with dyes), was poured to fill in the intaglio pattern. Each color had to dry before another color of slip was added. The recessed area was overfilled to allow for shrinkage, and after drying for several days, and before firing, the excess slip was scraped off the surface by a rotating cutter that created a flat, although not completely smooth, face. Problems might arise during the firing. Due to the dissimilar rates of contraction of the different clays, the inlaid clay could shrink too much and fall out of the tile recesses; or, the tile could be stained by the different pigments used for the design if impure or unstable.

Encaustic floor tiles were decorated with traditional as well as original designs. Over time, the decorations can be worn thin by heavy traffic. Photo: NPS files.

By the 1840s, encaustic tiles were made entirely with almost-dry clay using the dust-pressed method. This served to eliminate the possibility of staining the body of the tile with other colors and permitted the use of more colors on a single tile. Thus, an encaustic tile can sometimes be dated according to the complexity and the number of colors in its pattern. Red tiles with white figurative patterns were generally the earliest, followed by brown and buff colored tiles. In the 1860s, blue tiles with yellow or buff patterns were popular, succeeded by more subtle color schemes featuring a "chocolate" red with a soft grey. By 1860, up to six colors were used in a single tile to form a pattern. Toward the end of the century, white encaustic tiles with a black or gold design were common, as well as tiles with complicated color patterns of white, black, gold, pink, green and blue. Encaustic tiles were decorated with traditional as well as original designs. Some, particularly intricate, designs were painted on the surface of the tile with opaque colored glazes, instead of being inlaid. Most major tile manufacturers sold many of the same pre-formed encaustic floor tile patterns through catalogues. Encaustic tiles were produced in a variety of sizes, mostly square or octagonal in shape, and almost any design could be custom-made for a special purpose or to fit a particular space. Historic, 19th-century encaustic tiles were generally slightly less than 1" thick, about 15/16." Cheaper tiles of lesser quality were also made of clay or cement. These designs resembled those commonly found on encaustic tiles but applied as a transfer printed pattern, or using a multi-color lithographic or silkscreen process. These are still manufactured and popular in many parts of the world.

Smaller, single-colored versions of encaustic tiles that, when assembled together form a geometric pattern, are called **geometric tiles** in England. However, in the United States they are generally not differentiated from encaustic tiles. Based on the geometric segments of a six-inch square, they were typically rectangular, square, triangular or hexagonal in shape, and about the same thickness as patterned encaustic tiles. Geometric tiles were especially well suited for decorative borders, and a wide variety of floor designs could be created with their many shapes, sizes and colors—either alone or combined with patterned encaustic tiles. The cost of producing geometric tiles was much less than of encaustic tiles because each tile involved only one type of clay and one color. By the end of the 19th century, over 60 different shapes and sizes of geometric tiles were available in up to ten colors, including buff, beige or tan, salmon, light grey, dark grey, red, chocolate, blue, white and black.

Ceramic mosaic tiles are essentially smaller versions of geometric tiles (usually no larger than 2-1/4", and no thicker than 1/4") ranging in size from 1/2" to 2 3/16", in square, rectangular or oblong, hexagonal, pentagonal and trapezoidal shapes. Both vitreous and semi-vitreous mosaic tiles were available, unglazed in solid or variegated colors with a matte finish, or glazed in unlimited colors. Single, one-piece tiles were also fabricated to give the appearance of multiple mosaic pieces. This was achieved with a mold, which gave the appearance of recessed mortar joints separating individual "mosaics".

Glazed Tiles

With the exception of quarry tiles, encaustic tiles, and some mosaic tiles, most ceramic floor tiles are decorated with a glaze. While unglazed tiles derive their color solely from the clay, or from oxides, dyes or pigments added to the clay, the color of glazed tiles is provided by the glaze, either shiny or matte. Some potteries specialized in certain kinds of glazes and were famous for them. The earliest and most common method of clay tile decoration made use of tin-glazes which were essentially transparent lead glazes. Tiles were either dipped into the glaze or the

Ceramic mosaic tiles were practical for structures like this Bath House, Hot Springs, Arkansas (1914-1915).

glaze was brushed on the tile surface. Glazes were generally made with white lead, flint, or china clays ground up and mixed with finely ground metallic oxides that provided the color.

Photo: Jack E. Boucher, HABS Collection, NPS.

Colored glazes were commonly known as "enamels". Colors included blue derived from cobalt, green from copper, purple from manganese, yellow from antimony and lead, and reds and browns from iron. An opaque glaze was created by adding tin oxide.

Laying Historic Ceramic Tile Floors

19th Century Techniques

Aside from the use of improved tools and modern materials, installation methods have changed little since the mid-19th century. M. Digby Wyatt, an architect for one of the major 19th century encaustic tile manufacturers in Britain, Maw & Co., described this procedure for laying encaustic and geometric tiles in 1857:

First, either an even layer of bricks, a 2-1/2" bed of concrete of quicklime and gravel, or a mixture of Portland cement and clean sharp sand was laid to prepare a solid foundation for the tiles. If the tiles were to be laid over an existing wooden floor, the floor boards had to be pulled up, sawn into short lengths and fitted between the joists. Concrete filled in the spaces and made the base flush with the upper face of the joists, and created a level surface finished within 1" of the finished floor line. A layer of cement mortar was then laid on top. This allowed the tiles to fit in the same amount of space as the floorboards they replaced.*Before laying the tiles, skirting boards or shoe moldings were to be removed, and replaced after the tiles were laid. This eliminated having to cut the outer tiles to fit exactly, and resulted in a neater appearance.

Next, the floor design was marked off with mason's string or chalk lines which divided the space into equal quadrants. The first section to be laid out was defined by two parallel strips of wood, or guide pieces, about 4" wide. A level thickness of cement was spread between these strips. The tiles, thoroughly soaked in water, were laid in the cement and leveled with a straight-edge. The foundation had to be kept wet while the tiles were being laid. Small strips of wood temporarily placed at right angles to the guide pieces helped keep elaborate patterns straight.

When the bed was hard, the joints were filled with pure cement mortar-sometimes colored with lamp black, red ochre or other natural pigments-mixed to the consistency of cream. Excess mortar was wiped off the tiles with a piece of flannel or sponge.

A newly-laid tile floor could not be walked on for 4-6 days until the cement hardened properly. Occasional washing would remove the saline scum that often appeared on the surface right after the tiles were laid.

20th Century Techniques

Almost 50 years later, in 1904, the Tile Manufacturers of the United States of America published *Suggestions for Setting Tile* with the intent of bringing tile-laying up to a uniform standard. This guidance was very similar to that given by Wyatt. But, there were some differences, such as using hollow clay tile as a foundation material and heavy tar paper when laying tile over a wooden floor to protect the floor boards from the moisture of the mortar mix. Emphasis was placed on using the best quality cement, sand, and purest water to obtain a durable tile floor. Soaking the tiles before setting was no longer necessary, but using stiffer mortar was suggested to prevent it from rising up between the tiles.

Tile-laying methods changed somewhat more later in the 20th century, mostly due to the availability of new materials and techniques. By the 1920s small ceramic mosaic tiles were manufactured as 12" square sheets held together by a face-mounted paper "skin." This made it possible to lay the 12" square of tiles as a unit rather than each of the small tiles individually. Mounting the tiles directly in the cement resulted in a very strong bond. But the face-mounted paper obscured the tiles from view making it difficult for the tile-setter to see if the tiles were being laid straight. The fact that the paper was not removed until after the tiles were firmly set in the cement bond coat further complicated realignment of crooked tiles. This paper "skin" was eventually replaced with a fabric mesh backing. This permitted the tiles to be aligned as soon as the moisture from the bond coat loosened the mesh from the back of the tile; it also allowed a single tile to be cut away from the mesh and repositioned immediately. Although the fabric mesh made tile setting faster, sometimes it also resulted in a weaker bond by reducing the contact area between the backs of the tiles and the bond coat.

Following World War II, different methods of preparing a foundation for a ceramic tile floor were developed to be more compatible with new materials, such as reinforced concrete, expanded wire mesh, polyethylene and waterproof plywood. New adhesives and grouts also facilitated tile installation, and an increased variety of epoxy and cement mortars allowed for different setting bed thicknesses. But today, after half a century of practical application, some of these "new" materials, such as plywood, particle board, oriented strand boards and other wood panels, are no longer recommended for use with ceramic tile.

Mortar beds are lighter, more flexible, and much thinner than they were previously, having shrunk from several inches to as thin as 3/32". A greater variety of materials are used for setting ceramic floor tiles, including bonding agents and waterproof membranes. Basic installation methods have not changed significantly, but they vary according to the type of subfloor on which the tile is to be laid. While the same concerns for level underlayment and strong adhesion exist, advancement has occurred mostly in the increased speed and ease of laying the tiles.

*The traditional practice of sawing the original floor boards and fitting them between the joists, still used today to maintain a low finished floor profile, has resulted in numerous cracked tiles and other failures. Instead, a better approach is to leave the existing floor boards, if they are in good shape, and install a cementitious backer board (CBU) available in thicknesses ranging from 1/4" to 5/8" as the setting bed for the tiles.

Historic Ceramic Floor Tile: Preservation and Maintenance

Before undertaking any work more complicated than regular maintenance or a very simple repair on a significant historic ceramic tile floor, or on any historic tile floor where serious damage has occurred, it is recommended that a professional conservator of ceramics, an historical architect, an architectural historian, or a chemist with particular knowledge and experience in this field be consulted. This will ensure that all future work, whether it be regularly-scheduled maintenance or more technical and specialized repair and restoration, is done in accordance with *The Secretary of the Interior's Standards for the Treatment of Historic Properties*.

This tiled Presidential seal was laid in the floor of the Pension Building in 1901 at President McKinley's 2nd inauguration. Photo: NPS files.

Cleaning Methods

Ceramic tiles are essentially a practical, low-maintenance flooring material. Yet, even glazed tiles are somewhat porous, and can get dirty and stained, especially in heavy traffic areas or where oil, fat, and grass stains are likely to occur. Although heavily soiled areas may be difficult or impossible to clean completely, in most instances, cleaning ceramic tile floors is relatively easy. Cleaning should always begin with the gentlest means possible, which may be as simple as warm water. Regular maintenance should include sweeping, or preferably dry or damp mopping or vacuuming to reduce grit. Tiles can usually be cleaned with a non-soap-based household floor cleaner, such as one of the commercial products intended for cleaning ceramic tile floors available on the market.

All cleaning and stain-removal products should always be tested on a small, inconspicuous area before using. Abrasive cleaners (including powdered cleansers and even "mildly" abrasive creams) and mechanical equipment can damage and wear away the protective surface, as well as the decorative design on the tiles, and should not be used on ceramic tile floors. Generally, acid-based cleaning solutions should also not be used on ceramic tile floors because they can damage the complex silicates in a glaze. However, there are some acid-based cleaners specially formulated for cleaning and removing coatings from ceramic tile floors that may be acceptable, but even these must be used with caution. Sometimes an acid-based cleaner may, in fact, be needed to remove discoloration or staining caused by lime or cement mortar. But, it should be tested first, used with caution, and applied only to a thoroughly wetted tile floor from which excess water has been removed. Pre-wetting a ceramic tile floor before cleaning is a good policy to observe with all cleaners. The water saturates the porous tile and prevents chemicals or other cleaning agents from penetrating into the tile body. Floor tiles should be always rinsed thoroughly after cleaning.

Plastic pot-scrubbers may be effective in loosening and removing superficial dirt without abrading the glazed or vitrified surface of the tiles. Stubborn asphalt or oil stains, scuff marks, or soiling can sometimes be removed with ammonia or one of the household spray products intended for cleaning kitchen or bathroom tiles. If necessary, a solvent may be applied carefully to pre-wetted tiles, but it should not be left on the surface for an extended amount of time as it may cause discoloration. If possible, a stain should always be identified first in order to select the material best-suited to remove it.

Organic growth, such as mold or mildew, can be eliminated with a dilute solution of household bleach and a neutral household detergent, or a dilute (5-10%) solution of tri-sodium phosphate (TSP). After applying either of these solutions, it may be necessary to scrub the floor with a natural bristle or nylon brush, and then rinse with clear water. Even a dilute bleach solution should not be left on a ceramic tile floor for more than a few minutes, since the alkali in the bleach can lead to the formation of a white efflorescent deposit. Efflorescence (a whitish haze of water-soluble salts) may stain and streak the tile, or may even cause minor spalling around the joints.

Regular maintenance of a ceramic tile floor should always begin with vacuuming to remove loose dirt and grit. Then, a mild cleaning solution may be applied and left on the floor for 10-15 minutes, without letting it dry on the tiles. Heavily soiled areas may be scrubbed with a natural bristle or nylon brush to loosen dirt from the tile surface. Finally, the floor should be

thoroughly rinsed with clean, clear water, preferably twice, and dried with terry cloth towels, if necessary. Any proprietary cleaning product should always be used in accordance with the manufacturer's directions.

Protective Coatings

In most instances, traditional ceramic tile floors probably would not have been treated or given a protective coating other than wax. In the 19th century, some encaustic tile floors were treated with linseed oil, but this is not a practice recommended today because linseed oil tends to attract dirt and discolors as it ages. Most historic ceramic tile floors simply acquired a natural "polish" or sheen through use. Because the surface of ceramic tiles is already protected with a fired skin or a glaze, an additional protective coating should generally not be needed.

Opinions differ concerning the use of protective coatings, penetrating sealers, or waxes on ceramic tile floors, and, especially, on historic ceramic tile floors. If properly applied and regularly cleaned, a coating can sometimes be an effective maintenance treatment, but only on interior floors. However, if not adequately or properly maintained, rather than facilitating maintenance of ceramic tile floors in high traffic areas, such coatings may tend to emphasize traffic patterns as they wear away or become scratched. Some coatings may also peel in spots, or cause tile to appear hazy or cloudy if the coating is not applied in accordance with the manufacturer's specifications, or if the tiles are not perfectly clean when the coating is applied. Furthermore, applying such a coating may actually increase maintenance costs, since a coating requires periodic removal and renewal. The frequent removal of a coating can also damage a ceramic tile floor if it is carried out with harsh chemicals or abrasive mechanical equipment. If any coating is considered, a traditional coating, such as floor wax, may be the most suitable. Wax is easy to remove when it becomes worn, and does not impart a high, potentially inappropriate, gloss to the surface.

On the other hand, a penetrating sealer, or *impregnator*, may be worth considering to protect patterned encaustic tiles, or painted or printed tiles featuring a design that might be worn off, particularly in public buildings with a high volume of foot traffic. For example, some manufacturers of new, reproduction encaustic tiles recommend applying a penetrating sealer to the replacement tiles, as well as to the historic tiles. Impregnators do not change the color of the tile surface and, unlike some penetrating sealers, are completely invisible after they have been applied. They can reduce the porosity or water absorption of the tile surface, and provide some protection for the tile (and the grout) against staining. This may be particularly useful on light-colored floors. Whether to apply an impregnator to an historic ceramic tile floor, and what type or product to use, are decisions that should generally be made in consultation with a conservator or ceramic tile specialist. *It may also be necessary to comply with certain safety standards and friction requirements of the ADA (Americans with Disabilities Act). The ADA Guidelines recommend "a static coefficient of friction" of 0.6 for level surfaces and 0.8 for ramps. This may require the application of a non-slip sealer or wax to historic ceramic tile floors in some public buildings.*

Despite the non-traditional shiny finish they may impart to a floor surface, two-part, acrylic-based coating systems are commonly used today on historic ceramic tile floors in many public buildings, primarily because they facilitate easy maintenance. If it is decided that a sealer is to be used, a product with a matte or dull finish may be preferable, or more appropriate, for a historic ceramic tile floor than one with a high-gloss.

In some cases, temporary protection may be the best approach until a better solution is found. Non-permanent protection for an historic ceramic tile floor may be as simple as using floor mats at doors or in heavy traffic areas.

Historic Ceramic Floor Tile: Damage and Deterioration Problems

Worn encaustic tiles are still serviceable, but once the design has been lost, the tiles cannot be repaired. They must be replaced in kind, to match. Photo: NPS files.

Loss of Tile Surface and Pattern

Ceramic tiles are among the most durable of historic flooring materials, but natural wear and a certain amount of deterioration or damage is inevitable. Some tiles, such as dense, close-textured quarry tiles and ceramic mosaic tiles, resist abrasion and stain absorption very well. But many others, especially patterned encaustic and geometric tiles, are extremely susceptible to abrasion. Heavy traffic can also result in uneven wear, or even cupping, in certain areas of tile floors that get more use than others, such as doorway entrances. The particular clay mix, or the dye or pigment used to color the clay, can also affect the hardness and durability of individual tiles or an entire ceramic tile floor.

Tile Glaze Failure

Occasionally some glazes can become pitted or powdery as they age. Lead glazes used in the 19th century, which were fired at low temperatures, deteriorated relatively quickly. Glazes have different physical properties from the fired clay tile body itself, and as a result may sometimes crack or craze. Unless the crazing visibly extends into the porous clay of the tile

body beneath, this is not generally a serious material failure; however, dirt entering these cracks cannot be removed, and will discolor the tile. If the crazing penetrates through the glaze, it may increase the water absorption of the tile.

Tile Breakage

Ceramic floor tiles are very susceptible to damage and breakage caused when something heavy is dropped. Repeated passage of heavy objects, or carts, over a floor can also crack and break ceramic tiles, as well as heavy vibration from outside traffic.

Moisture Damage to Tile

Ceramic tile floors have been traditionally viewed as highly waterproof systems that do not require protection from moisture. In reality, however, this is not true. Water-related problems are one of the most common causes for the deterioration and failure of historic tile floors, particularly in bathrooms and other rooms where there is a lot of moisture. Water that is allowed to sit in areas around shower stalls and bathtubs can eventually damage grout and mortar, and loosen tiles. Some of the more porous kinds of tiles that are not as hard-fired may actually begin to powder or spall if subjected to constant moisture.

Loose, Cracked, Broken or Unbonded Tile Due to Mortar Failure

The durability of ceramic tile floors depends to a great extent on a sound mortar bed and sound mortar joints. The wrong mortar type or mortar that is inadequately mixed can also spell trouble for a ceramic tile floor. Failure of a tile floor system laid over a subfloor is often the result of weakened or deteriorated grout or mortar which allows the tiles to become loose. Mortar may also be weakened or loosened by cleaning solutions that are too strong.

Proper tile-laying technique includes the use of a material that will allow for some movement of the tiles. Traditionally, a layer of asphalt (replaced by a layer of plastic or building paper in more modern construction) was inserted to separate the base and the bedding underneath. This prevents bonding between the base and the bed, and allows for some "relative" movement. It is intended to prevent the ceramic tile floor from arching or ridging, a condition in which single or entire rows of tiles can pop up to relieve tension and separate completely from the bed. When this happens, the condition will probably require taking up and relaying many or all of the tiles.

Tile Damage or Loss Caused by Systems Update

The installation of new plumbing, electrical and HVAC systems, or the attachment of new fixtures and furnishings, may be one of the most common sources of damage to an historic ceramic tile floor. Earlier remodeling projects to remove old pipes or to replace "out-dated" bathroom fixtures may have resulted in the loss of floor tiles. Different shapes and sizes of new fixtures, equipment or pipes may have exposed previously untiled areas that have been inappropriately patched with cement. Careless workers and insensitive installations can also result in damage, breakage or removal of historic floor tiles. All of these conditions will require matching replacement tile.

Historic Ceramic Floor Tile: Repair and Replacement

The Secretary of the Interior's Standards for the Treatment of Historic Properties emphasize the retention and preservation of historic building material. Preservation and repair treatments are always preferable to replacement.

Mortar Joint Repair

Deteriorated mortar joints and loose mortar or grout can generally be repaired. First, the entire floor should be checked for loose tiles that need to be regouted. Damaged mortar should be carefully removed by hand and the joints wetted or a bonding agent applied in preparation for regrouting. When making mortar repairs, it is important to use grout that matches the old in color and consistency as closely as possible.

Tile Repair

Trying to remove one tile can endanger surrounding tiles. Thus, it may be better to preserve and retain an original historic tile that is only slightly damaged, rather than replace it. Sometimes cracks may be repaired, or a corner or piece of tile that has broken off may be re-attached, using an epoxy glue, or grout. If a tile is chipped or a small corner or edge is missing, a carefully executed patch of epoxy-mixed with colored enamel, or mortar tinted to blend with the tile, may be less conspicuous than trying to replace every tile that has even the slightest damage. And, it is a better preservation treatment.

In limited instances, glaze failure or surface powdering of ceramic floor tiles may sometimes be treated successfully by a conservator with a specially formulated, solvent-based, mineral densifying agent (such as silicic acid), followed by a siloxane sub-surface repellent, applied 24 hours later. Under the right circumstances, such a treatment can harden and bind the surface, and lower the absorbency of the tile, and still maintain the vapor transmission. But this is a highly

complex undertaking and should only be attempted by a conservator after appropriate testing. Not only are these chemicals highly toxic and dangerous to handle, but if used improperly, they can cause greater damage to the tile!

This inappropriate ceramic tile repair is easy to spot. Photo: NPS files.

Tile Replacement

When an individual tile or a larger portion of an historic ceramic tile floor is missing or so severely damaged that it cannot be repaired, or if it has become a safety hazard, then it should be replaced. When a ceramic tile floor has deteriorated as a result of long term wear and abrasion, or from settlement or vibration damage to the setting bed, there are a number of factors that need to be considered before choosing a preservation treatment. If damage to tiles is the result of more than normal wear and tear, the source of the problem needs to be identified, and the problem corrected before replacing the damaged tiles.

Successful replacement not only depends on the availability of matching tiles, but on the condition of the substrate on which the tiles are laid. Before installing the replacement tiles, any problems, such as settlement or vibration, will have to be addressed, and the height of the new setting bed may have to be adjusted for the thickness of the new tiles.

Selective Replacement of Individual Tiles

This cautious approach, typically an attempt to replace only the most seriously damaged tiles, is often taken or considered when only a small number of tiles are involved. Unless old, matching tiles can be found and reused, replacement often requires specially fabricated reproduction tiles. In some instances, individual historic tiles that are damaged may be replaced with matching tiles salvaged from other, less prominent areas of the floor or from other buildings. This is most feasible if the tiles to be replaced are either plain, and easy to match, or decorated with a common historic floor tile pattern.

In order to replace damaged tiles, it can be helpful to identify the manufacturer and the approximate date of the tiles, if possible. However, many mass-produced tiles are not marked and give little or no information as to their origin, although stylistic similarities with other marked tiles may sometimes provide a clue as to the manufacturer. Some decorating firms seldom signed their work, while many firms made bisque tiles (plain, unglazed, once-fired tiles) for other companies, as well as their own use. Identifying marks will generally be found on the back of the tile. A mark impressed or molded into the back of the tile may give the name or initials of the company which made the tile or the bisque; sometimes a printed or painted mark indicates if it was decorated by a different company, or artist. Historic building records and construction documents may provide information about the tile company or supplier. Catalogues of the period may also be useful in identifying the tile manufacturer of unmarked tiles.

Replacing a single damaged tile is based on the ability to remove only the deteriorated tile without harming surrounding tiles. Attempts to remove one or several damaged tiles often fail because a hammer and chisel are used. The shock of the blows to the tile being removed travels through the grout into surrounding tiles and cracks them. To avoid damaging good tiles, all the grout around the tile must be removed. This is best accomplished by an experienced tile installer using a hand tool called a grout saw or, for grout joints wider than 3/8", a dry-cutting diamond blade, mounted in an angle grinder or circular saw.

Other difficulties may be encountered when selectively replacing damaged tiles with reproduction tiles. New tiles, especially encaustic tiles, may be different in thickness and, sometimes, despite the attention to detail of the reproduction process, slightly different in color and design from historic tiles. This can cause both visual and physical problems, especially if the replacements are being laid in a piecemeal fashion.

If the setting bed does not have enough mortar to grip and hold the tile, one new tile laid among the originals will eventually come loose. If the new and old tiles are different thicknesses, the setting bed in which the new tiles are laid must be at a different height to create a level finished surface. In addition, the two levels of setting beds may be of different composition; one may be harder, stronger and less flexible than the other. This may also lead to problems, since the setting bed foundation should act and respond as a unit to the load and stresses placed upon it.

Sectional Replacement of Tiles

In some instances, the best approach may be to remove a complete section of damaged original tiles and replace that section of floor in its entirety with new reproduction tiles. Advantages of this method include the ability to lay a level setting bed, as well as achieving a finished product that is uniform in color and pattern match. Although this approach may involve replacing more original tiles with reproduction tiles than may be absolutely necessary, original tiles that remain in good condition can be saved to be reused in other sections where only a few tiles are damaged. This technique is generally most appropriate either when the section being replaced is the most damaged portion of the floor, or is in a relatively

inconspicuous location and the tiles that are removed will supply enough salvaged pieces to permit in-kind repair of a more visually prominent area.

When laying a section of reproduction tiles, it may be a good idea to use contemporary materials and installation methods such as expansion joints or flexible expansion material. One of the major causes of ceramic floor tile installation failure and cracked, broken or disbonded tiles is the lack of expansion joints. Expansion joints were sometimes used in laying historic ceramic tile floors, and these are frequently the ones that have survived in the best condition. Many preservation contractors hesitate to use conventional expansion joint filler materials because of their limited range of colors. However, there are new flexible sealants in a wide range of colors that are available in either sanded or unsanded textures to match the surrounding grout joints. As a result, the expansion joints are almost invisible. A bonding agent may also be considered-if recommended by the tile manufacturer-and any drawings provided by the manufacturer should be used to guide the installation.

Each preservation technique has advantages and disadvantages that the historic property owner or manager should take into consideration before deciding which one is best suited to the particular flooring problem. For example, slight differences in the shape, size, color and the pattern between the old and the new tiles are frequently encountered. If replacing an entire section, the slightest difference in size and dimension between the original tiles and the reproduction tiles, even if it is as small as 1/8" or 1/16", can mean that the new section of tile will not fit inside an existing border. Even though drawings and photos are provided to the manufacturer, there may be some variation in the design and pattern size on the new tiles. Thus, they may not align perfectly with the original tiles, and as a result the section of the floor that has been replaced may be quite conspicuous.

Summary and References

Historic ceramic tiles are a common flooring material in many different kinds of small, as well as large, private and public, structures throughout the United States. Whether plain, or decoratively patterned, traditional ceramic floor tiles are important in defining the character of historic buildings. Although ceramic floor tiles are a practical material, they are also fragile, and can be easily damaged by improper installation techniques, insensitive remodeling, harsh cleaning methods, and even regular daily use. Preserving them requires careful day-to-day maintenance. This should begin with using gentle, non-abrasive methods and materials to clean them, and, in some instances, using an appropriate coating or impregnator to protect them.

Some historic ceramic tile floors, due to their manufacturer, their unique design, or their location in a certain room or within a particular building, may have greater significance than those that are purely utilitarian. Such floors should be accorded special care, and a ceramics conservator or preservation specialist should always be consulted to prepare responsible maintenance plans and to provide guidance concerning repair treatments and replacement techniques for them.

Unless an historic ceramic tile floor is extensively damaged with many missing and broken tiles and, therefore, potentially hazardous, it may be preferable to leave it alone. An unevenly worn floor surface, worn colors or patterns on the tiles, or slight cracks, chips, or scratches in the tiles themselves does not necessarily mean that the tiles should be replaced. Such relatively minor imperfections seldom detract from the character of an historic ceramic tile floor. They may, in fact, impart character, and be less noticeable or obtrusive than replacement of a single tile or a larger section with new tiles that do not match the originals exactly. Each situation should be evaluated on its own basis before selecting the preservation approach best suited to the project.

Some Sources for Replacement Tiles

There are a number of companies that offer standard lines of reproduction tiles, while others focus on custom work. Some new lines of reproduction tile attempt to be exact replicas of original tiles from the late-19th and early-20th century, while others are modern interpretations or adaptations of traditional designs, and may not be appropriate as replacement tiles in a preservation or restoration project. For additional sources see: "Traditional Building's Ceramic Tile SourceList," *Traditional Building*, Vol. 9, No. 4 (July/August 1996), pp. 92-93.

Designs in Tile

P.O. Box 358

Mt. Shasta, CA 96067

Custom-made reproduction art tile.

Fulper Tile

P.O. Box 373

Northridge, CA 91327

Reopened factory reproduces historic tiles using original Arts and Crafts-period glazes.

HandR Johnson Tiles Ltd.

Head Office: Highgate Tile Works

Tunstall, Stoke-on-Trent

England ST6 4JX

U.S. Office: Johnson USA Inc.

P.O. Box 2335

Farmingdale, NJ 07727

Stock and custom reproductions of Minton Hollins encaustic and geometric tiles.

L'Esperance Tile Works

237 Sheridan Avenue

Albany, NY 12210

Custom-made encaustic, geometric, mosaic and other traditional ceramic tiles.

Moravian Pottery and Tile Works

Swamp Road

Doylestown, PA 18901

Reproduction tiles based on Henry Chapman Mercer's original designs.

Motawi Tileworks

33 North Staebler Road, Suite 2

Ann Arbor, MI 48103

Reproduction tiles in Arts and Crafts, Art Nouveau and other styles.

Native Tile and Ceramics

4230 Glencoe Avenue

Marina Del Rey, CA 90292

Reproduction decorative tiles in Southern California tradition of Craftsman, Mission, Art Deco and other styles.

Original Style

Stovax Ltd.

Falcon Road

Sowton Industrial Estate

Exeter, Devon

England EX2 7LF

Reproduction ceramic tiles from 1750-1902.

Pewabic Pottery, Inc.

10125 East Jefferson Avenue

Detroit, MI 48214

Reopened factory reproduces original tile designs and glazes.

Terra Designs Tileworks

241 East Blackwell Street

Dover, NJ 07801

Mosaic tesserae experts, and reproduction of historic ceramic tiles.

Tile Guild

2840 East 11th Street

Los Angeles, CA 90023

Reproduction of traditional Spanish, Portuguese, Dutch, Italian and English tiles.

Tile Restoration Center, Inc.

3511 Interlake N.

Seattle, WA 98103

Reproduction of Arts and Crafts-period tiles.

Helpful Organizations**The American Institute for Conservation of Historic and Artistic Works (AIC)**

1717 K Street, N.W., Suite 301

Washington, DC 20006

Ceramic Tile Institute of America, Inc.

12061 Jefferson Boulevard

Culver City, CA 90030-6212

Friends of Terra Cotta, Inc.

771 West End Avenue, 10E

New York, NY 10025

Tile Council of America

P.O. Box 1787

Clemson, SC 29633

Tile Heritage Foundation

P. O. Box 1850

Healdsburg, CA 95448

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

October 1996

Reading List

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The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring and Reconstructing Historic Buildings. Kay D. Weeks and Anne E. Grimmer. Washington, D.C.: U.S. Department of the Interior, National Park Service, Cultural Resource Stewardship and Partnerships, Heritage Preservation Services, 1995.

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4.2.6 Conserving decorative painting on plaster (GSA 2016b)

U.S. General Services Administration

Conserving Decorative Painting On Plaster

Procedure code:

990001S

Source:

National Capitol Region Specifications

Division:

Finishes

Section:

Painting

Last Modified:

07/28/2016

PART 1---GENERAL

1.01 SUMMARY

- A. This procedure includes guidance on cleaning and conserving decorative painting on existing plaster surfaces.
- 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 SchedulingGeneral 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 SUBMITTALS

- A. Product Data: Submit manufacturer's product specifications and installation instructions for each material, including other data as may be required to show compliance with these specifications.
- B. Operation and Maintenance Data: Submit written program for each phase of restoration process including protection of surrounding materials on building during operations. Describe in detail materials, methods and equipment to be used for each phase of restoration work.

1.03 QUALITY ASSURANCE

A. Field Samples: Prior to start of plaster work, prepare the following sample panels in building where directed by RHPO. Obtain RHPO's acceptance of visual qualities before proceeding with the work. Retain acceptable panels in undisturbed condition, suitably marked, during construction as a standard for judging completed work.

1. Decorative Painting Conservation: Demonstrate materials and methods to be used for cleaning and conserving of each type of decorative painting on plaster surfaces on sample areas of a 9 sq. ft. area.

1.04 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Monitor environmental conditioning throughout construction period. Notify owner if environmental conditions vary beyond minimum or maximum allowable conditions.
2. Dispose of by-products from cleaning and paint stripping operations by legal means and in manner which prevents damage to other surfaces.
3. Existing Conditions: Protect surrounding surfaces from damage resulting from chemical cleaning and paint stripping work.

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. Liquidtex, Inc.
www.liquidtex.com
11 Constitution Avenue
Piscataway, NJ 08855
888-422-7954

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. Protective Coating for Decorative Painting: Varnish designed specifically for finishing decorative paintings, such as "Soluvar" (Liquidtex, Inc.), or approved equal.
  1. Use a finish to match existing.
  2. Thin varnish with paint thinner - one part varnish to three parts thinner.
- B. Glaze Remover: 5 parts denatured alcohol, 3 parts paint thinner (such as mineral spirits or turpentine) and 1 part acetone. Denatured Alcohol:
  1. Other chemical or common names include Methylated spirit*.
  2. Potential hazards: TOXIC AND FLAMMABLE.
  3. Available from hardware store, paint store or printer's supply distributor.
  4. Denatured alcohol should be a satisfactory substitute for ethyl alcohol for stain removing purposes.
- C. Mineral Spirits:
  1. A petroleum distillate that is used especially as a paint or varnish thinner.
  2. Other chemical or common names include Benzine* (not Benzene); Naphtha*; Petroleum spirits*; Solvent naphtha*.
  3. Potential Hazards: TOXIC AND FLAMMABLE.
  4. Safety Precautions:
    - a. AVOID REPEATED OR PROLONGED SKIN CONTACT.
    - b. ALWAYS wear rubber gloves when handling mineral spirits.
    - c. If any chemical is splashed onto the skin, wash immediately with soap and water.

5. Available from construction specialties distributor, hardware store, paint store, or printer's supply distributor.

D. Turpentine:

1. Typically used as a solvent and thinner.
2. Potential Hazards: TOXIC AND FLAMMABLE.
3. Safety Precautions:
  - a. Work in a well ventilated area.
  - b. Observe safety rules as turpentine is flammable, and the fumes can trip an ionization smoke detection system.
  - c. Store soiled cloths in a metal safety container to guard against spontaneous combustion.
  - d. Available from hardware store or paint store.

E. Acetone(C_3H_6O):

1. A volatile fragrant flammable liquid ketone used chiefly as a solvent and in organic synthesis.
2. Other chemical or common names include Dimethyl ketone; Propanone
3. Potential Hazards: VOLATILE AND FLAMMABLE SOLVENT
4. Available from chemical supply house or hardware store.
5. Clean, soft cotton balls
6. Artist's paint to match existing

2.03 EQUIPMENT

- A. Paint brushes (artist type)

PART 3---EXECUTION

3.01 ERECTION, INSTALLATION, APPLICATION

- A. At locations indicated, clean and conserve existing decorative painting on existing plaster surfaces.
- B. Saturate a rolled cotton ball with glaze remover and squeeze out excess.
- C. Apply saturated cotton ball to surface and gently rub in a circular motion to remove glaze and accumulated dirt. Replace cotton ball frequently.
- D. Continue rubbing as required to produce effect established by mock-up in a uniform manner over entire surface.
- E. Paint-in damaged or missing portions of decorative painting with artist's paints to match existing.
- F. Apply two coats of protective coating to surface to comply with manufacturer's instructions.

3.02 ADJUSTING/CLEANING

- A. Upon completion of this work, all floors, walls, and other adjacent surfaces that are stained, marred, or otherwise damaged by work under this section shall be cleaned and repaired and the adjacent areas shall be left in clean and perfect condition.
- B. All completed work shall be adequately protected from damage by subsequent building operations and effects of weather. Protection shall be by methods recommended by the manufacturer of installed materials and as approved by the RHPO.

4.2.7 Patching hairline cracks in plaster (GSA 2015)

U.S. General Services Administration

Patching Hairline Cracks In Plaster

Procedure code:

921002S

Source:

Hspg Prepared For Nps - Sero

Division:

Finishes

Section:

Gypsum Plaster

Last Modified:

04/20/2015

PART 1---GENERAL

1.01 SUMMARY

- A. This procedure includes guidance on patching hairline cracks in plaster with reinforcing tape and joint compound.
- B. Cracks may be cyclical, opening and closing with seasonal variation in humidity which causes the lath to swell and shrink.
- 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).

1.02 PROJECT/SITE CONDITIONS

- A. Environmental Requirements:

1. Keep the room temperature above 55 degrees F until the plaster/joint compound has set.
2. Provide plenty of ventilation as the plaster dries.

PART 2---PRODUCTS

2.01 MANUFACTURERS

- A. USG Corporation www.usg.com
- B. TKO Waterproof Coatings, LLP www.tkocoatings.com

2.02 MATERIALS

- A. Joint compound such as "Sheetrock Setting-Type Joint Compound" (USG Corp.), "Krack-kote" (TKO Waterproof), or approved equal.
  1. "Krack-kote": Good for problem cracks that may break through the Sheetrock tape and compound.
    - a. It uses a pliable adhesive and a glass fiber reinforcing tape; it has more flexibility and strength than ordinary joint compound.
    - b. Available from large paint supply stores.
    - c. It is more expensive and more timely to apply than ordinary joint compounds.
- B. Reinforcing tape (cloth or paper): Cloth is better for flat surfaces because of its open-weave, but it is difficult to find in the U.S.
- C. Acrylic latex caulk

2.03 EQUIPMENT

- A. Wide joint knife (approximately 5-6 inches wide)
- B. Sponge or heavy-nap cloth
- C. Caulking gun
- D. Crack widener or triangular can opener
- E. Stiff bristle brushes or vacuum

PART 3---EXECUTION

3.01 EXAMINATION

- A. Types of plaster cracking include, map cracking, alligating, settlement cracks, hairline cracks, stress related cracks and cracks due to moisture.
- B. If a wall has an enormous number of cracks to be taped, consider replastering or canvassing the surface.

3.02 ERECTION, INSTALLATION, APPLICATION

- A. Slightly widen the crack with a sharp, pointed tool like a crack widener or a triangular can opener.

- B. Brush or vacuum surface to remove dust and debris.
- C. Apply joint compound with a wide joint knife; Butter the compound into the crack, spreading it about 3 inches on either side of the crack.
- D. Center mesh reinforcing tape over the crack, and force the tape down into the bed of the joint compound with the knife; Remove any excess compound by wiping with the joint knife.
- E. When the tape is bedded, cover surface with a thin layer of compound and smooth as much as possible by working with the joint knife.
- F. When the first coat has dried (at least 24 hours), smooth out any ridges by "wet sanding" with a damp sponge or a heavy-nap cloth folded flat or wrapped around a suitable block.
- G. Apply a second thin coat of joint compound and feather the edge at least 1 inch beyond the first coat.
- H. After the second coat has dried, wet-sand lightly and apply a thin finishing coat.
- I. Lightly sand the surface again, and clean off the area with damp sponge.
- J. After the surface has dried, brush off any plaster residue or dust.

NOTE: For gaps between plaster surfaces and surrounding woodwork, apply acrylic latex caulk using a caulking gun.

4.2.8 Patching small chips and cracks in plaster (GSA 2017c)

Patching Chips And Cracks In Ornamental Concrete Block

Procedure code:

422003S

Source:

Developed For Hspg (Nps - Sero)

Division:

Masonry

Section:

Concrete Unit Masonry

Last Modified:

04/17/2017

PART 1---GENERAL

1.01 SUMMARY

- A. This procedure includes guidance on repairing chips, cracks or holes in ornamental concrete block. Small areas may be patched using a mortar mixture; larger areas may require pins and mortar for additional reinforcement.
- 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)

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 REFERENCES

A. American Society for Testing and Materials (ASTM) www.astm.org

1.03 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Check manufacturer's literature for precautions and effects of products and procedures on adjacent building materials, components, and especially vegetation; Take appropriate protective measures as necessary.
2. Wet Weather: Do not apply or mix mortar on outside surfaces with standing water or outside during rain.
3. Do not proceed with patching under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation; Proceed with the work only when forecasted weather conditions are favorable for proper cure.
4. Cold Weather, winter construction is not allowed without consent of Regional Architect; Winter construction is defined as any time when surface temperature of masonry is below 50 degrees F. or air temperature is predicted to be below 40 degrees F. within 48 hours; Heat mortar materials to above 50 degrees F. if necessary.
5. Work must not be done at temperatures above 80 degrees F. unless shading and water-misted burlap over new work is provided. Mortar mixing should be done only in the shade; cover mortar in hot weather to reduce evaporation. Pointing work should be done in the shade. Work around the building during the day so that the fresh work will be shielded from direct sunlight to reduce evaporation rate.

PART 2---PRODUCTS

2.01 MATERIALS

- A. Clean, potable water
- B. Portland cement
- C. Hydrated lime
- D. Sand
- E. Epoxy cement
- F. Teflon or nylon pins with scored and threaded surface. (Stainless steel or bronze may be used if teflon or nylon are unavailable).

2.02 EQUIPMENT

- A. Stiff bristle brushes or vacuum
- B. Trowels
- C. Hawks
- D. Carbon-tipped masonry bit

PART 3---EXECUTION

3.01 ERECTION, INSTALLATION, APPLICATION

- A. Patching small cracks and holes with grout (a wetter version of mortar mix):
  - 1. Cut out the deteriorated area to a sound surface. Under-cut the edge where possible to create a "key".
  - 2. Brush or vacuum out all dirt or debris.
  - 3. Flush the area with clean, clear water. Be sure no standing water remains.
  - 4. Mix 1 part Portland cement, ASTM C150, Type I, part hydrated lime, and 2 to 3 parts sand
-OR-
1 part Portland cement Type P (lime pre-mixed), and 2 to 3 parts sand
NOTE: ADJUST MIX TO MATCH COLOR, TEXTURE AND PHYSICAL PROPERTIES OF THE ORIGINAL MORTAR.
  - 5. Thin mortar to a slushy batter consistency.
  - 6. Trowel apply mortar to damaged area in layers no more than 1 inch thick. Several layers may be required. DO NOT APPLY PATCHES OVER JOINTS.
- B. Patching large chips, holes or broken corners using pins and mortar:
  - 1. Using a stiff bristle brush, clean surfaces to be joined or patched.
  - 2. Using a carbon-tipped masonry bit, drill staggered rows of holes approximately 2 inches deep (no more than 4 times the pin diameter), 1-1/2 inch apart and 1/8 inch wider than the pin diameter.
  - 3. Again, brush debris from the surface.
  - 4. Fill the holes with mortar mix or epoxy cement.
  - 5. Set the pins in the holes.
  - 6. Trowel apply mortar to damaged area in layers no more than 1 inch thick. Several layers may be required. DO NOT APPLY PATCHES OVER JOINTS.
  - 7. To patch a chipped corner, fill the cavity with the concrete mix or bonding material, forcing it in and around the exposed pins, which will act to support and reinforce the patch.
- C. To rejoin two broken parts (such as a concrete baluster), coat both broken surfaces with epoxy adhesive and gently tap the parts together.

4.2.9 General maintenance for ceramic tile (GSA 2016c)

General Maintenance Guidelines For Ceramic Tile

Procedure code:

931001G

Source:

Hspg Prepared For Nps - Sero

Division:

Finishes

Section:

Ceramic Tile

Last Modified:

08/10/2016

This standard includes general guidelines for maintaining ceramic tile floors.

- In cleaning ceramic tile, keep in mind that there are two different surfaces, the tile and the grout.
  - Cement grout is considerably more porous than ceramic tile and more susceptible to the accumulation of dirt and stains.
  - Epoxy mortar grout is not as prone to soiling and staining.

Do's
Don'ts

• Dry clean ceramic tile by sweeping with a brush or dust mop or by vacuuming.	• Use oily sweeping compounds, alkaline cleaning compounds, sealers, polishes, and non-slip coatings are NOT recommended.
• Remove minor soils by mopping with water.	• DO NOT leave water or cleaning solution on the floor any longer than necessary.
• For excessive soiling, use a general-purpose, synthetic detergent mixed with warm water for washing the surface.	• DO NOT use abrasives or other gritty materials on GLAZED TILES.
• Rinse thoroughly and mop up rinse water, leaving the floor as dry as possible.	• DO NOT use acids on glazed tiles.

Do's
Don'ts

• Dirty grouting can be scrubbed with a stiff brush and a mild abrasive powder.	• Avoid using steel wool pads for scrubbing (they may leave rust spots).
• USE nylon abrasive pads for heavy duty cleaning.	• DO NOT use abrasive powders for scrubbing ceramic tile (it is messy and almost impossible to remove).

4.2.10 Stripping, staining, and polishing wood floors (GSA 2012)

Stripping, Staining And Polishing Wood Floors

Procedure code:

955002S

Source:

National Capitol Region Specifications

Division:

Finishes

Section:

Wood Flooring

Last Modified:

02/24/2012

STRIPPING, STAINING AND POLISHING WOOD FLOORS

PART 1---GENERAL

1.01 SUMMARY

A. This procedure includes guidance on stripping, staining and refinishing floors.

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)

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 PROJECT/SITE CONDITIONS

A. Existing Conditions: Determine that surfaces to which finishes are to be applied are even, smooth, sound, clean, dry and free from defects affecting proper application. Correct or report defective surfaces to Contracting Officer.

PART 2---PRODUCTS

2.01 MANUFACTURERS

A. Hillyard Chemical Company
800/365-1555

B. The Sherwin Williams Company
101 Prospect Ave. N.W.
Cleveland, OH 44101
216/566-2000

2.02 MATERIALS

A. Sealer: Penetrating type, pliable, wood-hardening finish/sealer such as "Penetrating Seal #21" (Hillyard Chemical Company), or approved equal.

B. Stain: Penetrating, permanent oil-based stain such as "Oil Stain" (Sherwin Williams), or approved equal, colored to match existing floor stain.

C. Clean, soft cloths

D. Fasteners: Nails and screws, select material, type, size and finish to match original installation.

E. Sandpaper: 3 grades, finest grade 00.

2.03 EQUIPMENT

A. Hand-held Orbital Sanders (NO ROTARY OR DISK SANDERS)

B. Machine belt or orbital sander (NO ROTARY OR DISK SANDERS)

C. Stiff bristle brushes

PART 3---EXECUTION

3.01 PREPARATION

A. Surface Preparation:

1. Carefully remove any floor mounted elements and store in location selected by the Contracting Officer.

2. Protect floor borders from damage during sanding and other floor refinishing operations.

3. Machine sand the wood floor to remove stains, indentations and old finish.

NOTE: BELT AND ORBITAL SANDERS SHOULD ONLY BE USED BY EXPERIENCED PERSONNEL. THEY WORK VERY QUICKLY AND IT IS EASY TO DAMAGE THE WOOD SUBSTRATE IF THEY ARE NOT USED CAREFULLY. For additional guidance on stripping wood floors and precautions to take when operating sanding equipment on wood, see 06300-02-R, 06400-10-R and 09910-01-S.

a. Sand floor in direction of wood grain. Remove only the amount of wood necessary to remove old finish but no more than 1/16" depth.

b. Use hand-held sanders at edges of floor.

c. Final sanding shall be with 00 grade sandpaper.

d. Vacuum clean, remove sanding dusted with tack cloth, and immediately apply stain finish.

e. Do not allow traffic on floor until final finishing is complete.

3.02 ERECTION, INSTALLATION, APPLICATION

A. Apply stain to wood floor to obtain a finish to match the original.

B. Apply floor sealer (two coats) in accordance with manufacturer's printed instructions, including machine buffing with steel wool as recommended by the manufacturer.

C. Reinstall floor mounted accessories in original locations. Protect wood flooring during reinstallation.

D. For guidance on cleaning and maintaining woodwork and wood floors, see 06400-02-P, 06400-01-R, and 06400-01-P.

4.2.11 Alteration guidelines for Interiors (GSA 2016d)

U.S. General Services Administration

GSA Alteration Guidelines For Interiors

Procedure code:

109120G

Source:

Maint, Rpr And Alteration Of Historic Bldgs - Gsa/Pbs

Division:

General Requirements

Section:

Reference Standards

Last Modified:

07/13/2016

This standard was extracted from GSA's Maintenance, Repair and Alteration of Historic Buildings reference document from 1981. The following information includes general GSA guidelines to consider when planning interior alterations to historic buildings.

Standard alteration techniques and solutions often will not preserve the architectural character of significant interiors. In general, alterations to such spaces should conceal necessary work, particularly electrical and mechanical equipment, behind the original finishes and within the original structure of the building.

The following design considerations will be helpful.

- Preserve all original finishes, trim and ornament of the room, and remove any existing later alterations or non-original elements.
- Repair or replace any missing original features to exact original design and appearance, budget permitting.
- Ensure that custodial work and routine maintenance are carried out with care and with only mild, dilute chemical cleaners, if any.
- Locate tenants in appropriate spaces. Organize heavy traffic to avoid damaging sensitive areas.
- Do not crowd rooms with furnishings that cover architectural detail.
- Carefully design and place any necessary electrical outlets or HVAC grilles to be unobtrusive and paint them to match adjacent finishes.
- Remove fluorescent lighting and use concealed uplighting for general illumination and individual task lights at work surfaces. Restore original fixtures, if possible, for general illumination.
- Alterations should be compatible with the original space and materials. Use materials and installations that are visually related to finishes and materials in the remainder of the building.
- Permit only changes or alterations to materials or finishes necessary for restoration.
- Investigate opportunities to conceal all electrical and mechanical equipment when budget permits. Exposed installations of mechanical systems must be laid out as unobtrusively as possible, and should not cover or obscure original elements.

- Do not make alterations that attach permanently to original elements of the room. When it is necessary to cover or obscure original elements with alterations, alterations should be easily removable without damage to permanent finishes.
- Retain original blinds whenever possible. [The large slat venetian blinds closely matching the period ones, are again being marketed and are regaining favor as a contemporary window treatment.] If an accurate restoration of sun control devices is infeasible, use an unobtrusive contemporary treatment (e.g., thin-line, horizontal blinds). DO NOT: paint over window glass; change clear glass to frosted or translucent glass; replace glass with solid filler panel; use vertical blinds of wall-to-wall drapery; cover decorative window surrounds with shades or blinds; use roller shades.
- Test ceiling for original colors and details and restore to exact original condition.
- Preserve, maintain and repair and match flooring wherepossible. If intensive use is damaging the flooring, install high quality carpeting or new protective coatings, but do not use adhesives or tacks in a way that will damage original floor.

NOTE: Contact your regional historic preservation officer (RHPO) for further guidance.

4.2.12 Excessive condensation in buildings (GSA 2016e)

U.S. General Services Administration

Recognizing Excessive Condensation in Buildings

Procedure code:

180005G

Source:

Chambers, J. H. Cyclical Maintenance for Historic Buildings. Washington, D.C.: National Park Service, Technical Preservation Services Division, 1976.

Division:

General Requirements

Section:

Maintenance

Last Modified:

08/05/2016

Preface

These guidelines provide information on how condensation develops and what can be done to recognize and reduce it in older buildings.

References

- Chambers, J. H. Cyclical Maintenance for Historic Buildings. Washington, D.C.: National Park Service, Technical Preservation Services Division, 1976.
- Park, S. C. "Preservation Brief 39: Holding the Line: Controlling Unwanted Moisture in Historic Buildings". Washington, D.C.: National Park Service, Technical Preservation Services Division, October 1996.

Introduction

Condensation is the process by which water vapor, a gas, changes to a liquid. There is always water vapor in the air; the amount depends upon the local climatic conditions. Within a building, the amount of water vapor depends upon the amount of vapor generated by the users, type and operation of HVAC, air and water leaks, etc. Air has the ability to hold water vapor in accordance with the temperature of the air. The higher the air temperature the more water vapor the air can hold; the lower the temperature, the less water vapor the air can hold. When the air is saturated it has reached the "dew point". If the temperature drops, the air can no longer hold all the water, so the excess is changes back into liquid form. Dew found on lawns and cars in the morning is formed because the air temperature went below the dew point the night before.

Surface condensation occurs on any building material whose temperature is lower than the dew point. This can often be seen on window glass in the winter and exposed cold water pipes in basements in the summer. Condensation is visible on surfaces which are nonabsorbent. When condensation takes place on bare wood or other porous material, the water is absorbed so that

it is not visible on the surface. Condensation can occur within walls and ceiling spaces; this is known as interstitial condensation. Condensation can be injurious to building materials, especially wood, because the moisture level can be raised to the point that biological attack occurs; it also damages insulation and reduces its performance.

Inspection for Condensation

Old buildings often are susceptible to moisture in spaces below ground level: basements, cellars, crawl spaces, root cellars, well pits, etc. A basement with condensation on water pipes shows a relative humidity of 100%. Where water pipes do not occur another telltale indicator is a peculiar musty or damp smell. The right way to find out the moisture content of the air is with a Humidity Gauge (accurate ones are not easy to find) or a Sling Hygrometer. Wood with a moisture content of over 20% is subject to biological attack. Reducing basement humidity can be accomplished either by ventilation or dehumidification. Ventilation requires that air be exhausted from the space and that drier outside air be brought into the space at the same time from a basement window or from upper floors. To be effective, air must be exhausted with a fan. When using a dehumidifier all openings should be closed while the dehumidifier is in operation. The effectiveness of each system should be checked by a humidity indicating device. Water collected from a dehumidifier is distilled water, a most valuable material for general cleaning, and should be saved.

Humidity Problems

Condensation on glass can be an annoyance and may cause trouble if the paint film on the sash and trim permits moisture penetration. If maintenance procedures are inadequate dirt can be washed down upon fabrics and wallpaper causing stains. To treat condensation on historic glass, see 08800-01-P. Winter condensation can occur in attic and roof spaces as moist air in the attic condenses on the cold roof surfaces. This sometimes can be detected by oval or brown spots on the ceilings of the upper story. By the time the spots are noticed the damage could be quite severe. An annual inspection of unheated attic spaces should be made during the coldest part of the year. An unsatisfactory condition should be reported to the Regional Historic Preservation Officer for restorative measures.

4.3 Preservation and rehabilitation guidelines for interior

According to the *Standards for Preservation and Guidelines for Preserving Historic Buildings* and *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 (Grimmer 2017).

The following recommendations for care of the historic interior features are to be thoroughly read and understood before a treatment is specified. The *Standards for Preservation and Guidelines for Preserving Historic Buildings* and *The Secretary of Interior's Standards for Rehabilitation*, should also be consulted to determine the appropriateness of any treatment.

The following recommendations for care of a historic interior are to be thoroughly read and understood before a treatment is specified. Table 1 (preservation) and Table 2 (rehabilitation) contain information excerpted from Grimmer (2017). Any related NPS or GSA guidelines should also be consulted to determine the appropriateness of any treatment.

Table 1. Preservation treatment for interior (Grimmer 2017, 60–62).

INTERIOR SPACES, FEATURES, AND FINISHES	
RECOMMENDED	NOT RECOMMENDED
Identifying, retaining, and preserving a floor plan or interior spaces, features, and finishes that are important in defining the overall historic character of the building. Significant spatial characteristics include the size, configuration, proportion, and relationship of rooms and corridors; the relationship of features to spaces; and the spaces themselves, such as lobbies, lodge halls, entrance halls, parlors, theaters, auditoriums, gymnasiums, and industrial and commercial interiors. Color, texture, and pattern are important characteristics of features and finishes, which can include such elements as columns, plaster walls and ceilings, flooring, trim, fireplaces and mantels, paneling, light fixtures, hardware, decorative radiators, ornamental grilles and registers, windows, doors, and transoms; plaster, paint, wallpaper and wall coverings, and special finishes, such as marbling and graining; and utilitarian (painted or unpainted) features, including wood, metal, or concrete exposed columns, beams, and trusses and exposed load-bearing brick, concrete, and wood walls.	Altering a floor plan, interior spaces (including individual rooms), features, or finishes which are important in defining the overall historic character of the building so that, as a result, the character is diminished. Replacing historic interior features and finishes instead of repairing or replacing only the deteriorated portion. Installing new material that obscures or damages character-defining interior features and finishes. Removing paint, plaster, or other finishes from historically-finished interior surfaces and leaving the features exposed (e.g., removing plaster to expose brick walls or a brick chimney breast, stripping paint from wood to stain or varnish it, or removing a plaster ceiling to expose unfinished beams). Applying paint, plaster, or other coatings to surfaces that have been unfinished historically, thereby changing their character. Changing the type of finish or its color, such as painting a historically-varnished wood feature, or removing paint from a historically-painted feature.
Stabilizing deteriorated or damaged interior features and finishes as a preliminary measure, when necessary, prior to undertaking preservation work.	Failing to stabilize a deteriorated or damaged interior feature or finish until additional work can be undertaken, thereby allowing further damage to occur to the interior.
Protecting and maintaining historic materials (including plaster, masonry, wood, and metals) which comprise interior features through appropriate surface treatments, such as cleaning, paint removal, and reapplication of protective coating systems. Protecting interior features and finishes against arson and vandalism before project work begins by erecting temporary fencing or by covering broken windows and open doorways, while ensuring adequate ventilation, and by installing alarm systems keyed into local protection agencies.	Failing to protect and maintain interior materials and finishes on a cyclical basis so that deterioration of interior features results. Leaving the building unprotected and subject to vandalism before work begins, thereby allowing the interior to be damaged if it can be accessed through unprotected openings.
Protecting interior features (such as a staircase, mantel, flooring, or decorative finishes) from damage during project work by covering them with plywood, heavy canvas, or plastic sheeting.	Failing to protect interior features and finishes when working on the interior.
Removing damaged or deteriorated paint and finishes only to the next sound layer using the gentlest method possible prior to repainting or refinishing using compatible paint or other coating systems.	Removing paint that is firmly adhered to interior materials and features.

(Table continues on next page.)

Removing damaged or deteriorated paint and finishes only to the next sound layer using the gentlest method possible prior to repainting or refinishing using compatible paint or other coating systems.	Removing paint that is firmly adhered to interior materials and features.
Using abrasive cleaning methods only on the interior of industrial or warehouse buildings with utilitarian, unplastered masonry walls and where wood features are not finished, molded, beaded, or worked by hand. Low-pressure abrasive cleaning (e.g., sand-blasting or other media blasting) should only be considered if test patches show no surface damage and after gentler methods have proven ineffective.	Using abrasive methods anywhere but utilitarian and industrial interior spaces or when there are other cleaning methods that are less likely to damage the surface of the material.
Evaluating the overall condition of the interior materials, features, and finishes to determine whether more than protection and maintenance, such as repairs to features and finishes, will be necessary.	Failing to undertake adequate measures to ensure the protection of interior materials, features, and finishes.
Repairing interior features and finishes by patching, splicing, consolidating, or otherwise reinforcing the materials using recognized preservation methods.	Removing interior features or finishes that could be stabilized, repaired, and conserved, or using untested consolidants, improper repair techniques, or untrained personnel, potentially causing further damage to historic materials.
<i>The following work is highlighted to indicate that it represents the greatest degree of intervention generally recommended within the treatment Preservation, and should only be considered after protection, stabilization, and repair concerns have been addressed.</i>	
Limited Replacement in Kind	
Replacing in kind extensively deteriorated or missing components of interior features when there are surviving prototypes (such as stairs, balustrades, wood paneling, columns, decorative wall finishes, and ornamental plaster or pressed-metal ceilings); or when the replacement can be based on documentary or physical evidence. The new work should match the old in material, design, scale, color, and finish.	Replacing an entire interior feature when limited replacement of deteriorated and missing components is appropriate. Using replacement material that does not match the historic interior feature or finish.

Table 2. Rehabilitation treatment for interior (Grimmer 2017, 128–136).

INTERIOR SPACES, FEATURES, AND FINISHES	
RECOMMENDED	NOT RECOMMENDED
Identifying, retaining, and preserving a floor plan or interior spaces, features, and finishes that are important in defining the overall historic character of the building. Significant spatial characteristics include the size, configuration, proportion, and relationship of rooms and corridors; the relationship of features to spaces; and the spaces themselves, such as lobbies, lodge halls, entrance halls, parlors, theaters, auditoriums, gymnasiums, and industrial and commercial interiors. Color, texture, and pattern are important characteristics of features and finishes, which can include such elements as columns, plaster walls and ceilings, flooring, trim, fireplaces and mantels, paneling, light fixtures, hardware, decorative radiators, ornamental grilles and registers, windows, doors, and transoms; plaster, paint, wallpaper and wall coverings, and special finishes, such as marbling and graining; and utilitarian (painted or unpainted) features, including wood, metal, or concrete exposed columns, beams, and trusses and exposed load-bearing brick, concrete, and wood walls.	Altering a floor plan, or interior spaces (including individual rooms), features, and finishes, which are important in defining the overall historic character of the building so that, as a result, the character is diminished. Altering the floor plan by demolishing principal walls and partitions for a new use. Altering or destroying significant interior spaces by inserting additional floors or lofts; cutting through floors to create lightwells, light courts, or atriums; lowering ceilings; or adding new walls or removing historic walls. Relocating an interior feature, such as a staircase, so that the circulation pattern and the historic relationship between features and spaces are altered. Installing new material that obscures or damages character-defining interior features or finishes. Removing paint, plaster, or other finishes from historically-finished interior surfaces to create a new appearance (e.g., removing plaster to expose brick walls or a brick chimney breast, stripping paint from wood to stain or varnish it, or removing a plaster ceiling to expose unfinished beams). Applying paint, plaster, or other coatings to surfaces that have been unfinished historically, thereby changing their character. Changing the type of finish or its color, such as painting a historically-varnished wood feature, or removing paint from a historically-painted feature.
Retaining decorative or other character-defining features or finishes that typify the showroom or interior of a historic store, such as a pressed-metal ceiling, a beaded-board ceiling, or wainscoting.	Removing decorative or other character-defining features or finishes that typify the showroom or interior of a historic store, such as a pressed-metal ceiling, a beaded-board ceiling, or wainscoting.
Protecting and maintaining historic materials (including plaster, masonry, wood, and metals) which comprise interior spaces through appropriate surface treatments, such as cleaning, paint removal, and reapplication of protective coating systems.	Failing to protect and maintain interior materials and finishes on a cyclical basis so that deterioration of interior features results.
Protecting interior features and finishes against arson and vandalism before project work begins by erecting temporary fencing or by covering broken windows and open doorways, while ensuring adequate ventilation, and by installing alarm systems keyed into local protection agencies.	Leaving the building unprotected and subject to vandalism before work begins, thereby allowing the interior to be damaged if it can be accessed through unprotected entrances.
Protecting interior features (such as a staircase, mantel, flooring, or decorative finishes) from damage during project work by covering them with plywood, heavy canvas, or plastic sheeting.	Failing to protect interior features and finishes when working on the interior.

(Table continues on next page.)

RECOMMENDED	NOT RECOMMENDED
Removing damaged or deteriorated paint and finishes only to the next sound layer using the gentlest method possible prior to repainting or refinishing using compatible paint or other coating systems.	Using potentially damaging methods, such as open-flame torches or abrasive techniques, to remove paint or other coatings.
Using abrasive cleaning methods only on the interior of industrial or warehouse buildings with utilitarian, unplastered masonry walls and where wood features are not finished, molded, beaded, or worked by hand. Low-pressure abrasive cleaning (e.g., sand-blasting or other media blasting) should only be considered if test patches show no surface damage and after gentler methods have proven ineffective.	Removing paint that is firmly adhered to interior surfaces.
Evaluating the overall condition of the interior materials, features, and finishes to determine whether more than protection and maintenance, such as repairs to features and finishes, will be necessary.	Using abrasive methods anywhere but utilitarian and industrial interior spaces or when there are other methods that are less likely to damage the surface of the material.
Repairing interior features and finishes by patching, splicing, consolidating, or otherwise reinforcing the materials using recognized preservation methods. Repairs may include the limited replacement in kind or with a compatible substitute material of those extensively deteriorated or missing parts of interior features when there are surviving prototypes, such as stairs, balustrades, wood paneling, columns, decorative wall finishes, and ornamental pressed-metal or plaster ceilings. Repairs should be physically and visually compatible.	Failing to undertake adequate measures to ensure the protection of interior materials, features, and finishes.
Replacing in kind an entire interior 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 wainscoting, window and door surrounds, or stairs. If using the same kind of material is not feasible, then a compatible substitute material may be considered.	Removing materials that could be repaired or using improper repair techniques.
	Replacing an entire interior feature (such as a staircase, mantel, or door surround) or a finish (such as a plaster) when repair of materials and limited replacement of deteriorated or missing components are feasible.
	Removing a character-defining interior feature that is unrepairable and not replacing it, or replacing it with a new feature or finish that does not match the historic feature.
	Using a substitute material for the replacement that does not convey the same appearance of the interior feature or that is physically incompatible.
	Using a substitute material for the replacement that does not convey the same appearance of the interior feature or that is physically incompatible.
<i>The following work is highlighted to indicate that it is specific to Rehabilitation projects and should only be considered after the preservation concerns have been addressed.</i>	
Designing the Replacement for Missing Historic Features	
Designing and installing a new interior feature or finish when the historic feature or finish is completely missing. This could include missing walls, stairs, mantels, wood trim, and plaster, or even entire rooms if the historic spaces, features, and finishes are missing or have been destroyed by inappropriate alterations. The design may be an accurate restoration based on documentary and physical evidence, but only when the feature or finish to be replaced coexisted with the features currently in the building. Or, it may be a new design that is compatible with the size, scale, material, and color of the historic building.	Creating an inaccurate appearance because the replacement for the missing feature is based upon insufficient physical or historic documentation; is not a compatible design; or because the feature did not coexist with the feature currently on the building.
	Introducing a new interior feature or finish that is incompatible in size, scale, material, color, and finish.
Alterations and Additions for a New Use	
Installing new or additional systems required for a new use for the building, such as bathrooms and mechanical equipment, in secondary spaces to preserve the historic character of the most significant interior spaces.	Subdividing primary spaces, lowering ceilings, or damaging or obscuring character-defining features (such as fireplaces, windows, or stairways) to accommodate a new use for the building.

(Table continues on next page.)

RECOMMENDED	NOT RECOMMENDED
Installing new mechanical and electrical systems and ducts, pipes, and cables in closets, service areas, and wall cavities to preserve the historic character of interior spaces, features, and finishes.	Installing ducts, pipes, and cables where they will obscure character-defining features or negatively impact the historic character of the interior.
Creating open work areas, when required by the new use, by selectively removing walls only in secondary spaces, less significant upper floors, or other less-visible locations to preserve primary public spaces and circulation systems.	
Retaining the configuration of corridors, particularly in buildings with multiple floors with repetitive plans (such as office and apartment buildings or hotels), where not only the floor plan is character defining, but also the width and the length of the corridor, doorways, transoms, trim, and other features, such as wainscoting and glazing.	Making extensive changes to the character of significant historic corridors by narrowing or radically shortening them, or removing their character-defining features.
Reusing decorative material or features that had to be removed as part of the rehabilitation work (including baseboards, door casing, paneled doors, and wainscoting) and reusing them in areas where these features are missing or are too deteriorated to repair.	Discarding historic material when it can be reused to replace missing or damaged features elsewhere in the building, or reusing material in a manner that may convey a false sense of history.
Installing permanent partitions in secondary, rather than primary, spaces whenever feasible. Removable partitions or partial-height walls that do not destroy the sense of space often may be installed in large character-defining spaces when required by a new use.	Installing partitions that abut windows and glazing or that damage or obscure character-defining spaces, features, or finishes.
Enclosing a character-defining interior stairway, when required by code, with fire-rated glass walls or large, hold-open doors so that the stairway remains visible and its historic character is retained.	Enclosing a character-defining interior stairway for safety or functional reasons in a manner that conceals it or destroys its character.
Locating new, code-required stairways or elevators in secondary and service areas of the historic building.	Making incompatible changes or damaging or destroying character-defining spaces, features, or finishes when adding new code-required stairways and elevators.
Creating an atrium, light court, or lightwell to provide natural light when required for a new use only when it can be done in a manner that preserves significant interior spaces, features, and finishes or important exterior elevations.	Destroying or damaging character-defining interior spaces, features, or finishes, or damaging the structural system to create an atrium, light court, or lightwell.
Inserting a new floor, mezzanine, or loft when required for a new use if it does not damage or destroy significant interior features and finishes and is not visible from the exterior of the building.	Inserting a new floor, mezzanine, or loft that damages or destroys significant interior features or abuts window glazing and is visible from the exterior of the building, and, thus, negatively impacts its historic character.
Inserting a new floor, when necessary for a new use, only in large assembly spaces that are secondary to another assembly space in the building; in a space that has been greatly altered; or where character-defining features have been lost or are too deteriorated to repair.	Inserting a new floor in significant, large assembly spaces with distinctive features and finishes, which negatively impacts their historic character.
Installing exposed ductwork in a finished space when necessary to protect and preserve decorative or other features (such as column capitals, ornamental plaster or pressed-metal ceilings, coffers, or beams) that is designed, painted, and appropriately located so that it will have minimal impact on the historic character of the space.	Installing exposed ductwork in a finished space when necessary to protect and preserve decorative or other features that is not painted, or is located where it will negatively impact the historic character of the space.
Lowering ceilings, installing a dropped ceiling, or constructing soffits to conceal ductwork in a finished space when they will not result in extensive loss or damage to historic materials or decorative and other features, and will not change the overall character of the space or the exterior appearance of the building (i.e., lowered ceilings or soffits visible through window glazing).	Lowering ceilings, installing a dropped ceiling, or constructing soffits to conceal ductwork in a finished space in a manner that results in extensive loss or damage to historic materials or decorative and other features, and will change the overall character of the space or the exterior appearance of the building.
Installing a split system mechanical unit in a manner that will have minimal impact on the historic character of the interior and will result in minimal loss of historic building material.	Installing a split system mechanical unit without considering its impact on the historic character of the interior or the potential loss of historic building material.

4.4 Maintenance / management for interior

All building materials deteriorate with age and exposure to the weather. Through routine inspection and cyclical maintenance, the useful life span of a building and its historic fabric will be greatly increased. Preventative maintenance involves regular inspection of those parts of the building that are most likely to get out of working order. It is advised to have a checklist per USMMA building to help the USMMA CRM and maintenance department identify and keep an accurate record or inventory of the building's problems to facilitate systematic repair and maintenance.

Repair, renovation, and replacement of character-defining features to the contributing features to the USMMA historic district **MUST** be coordinated with the NY SHPO. If a character-defining feature has been previously removed or replaced on the contributing building prior to this report, and as future renovations occur, these need to be replaced with elements that replicate the original character-defining features of that building. Historic photographs found in *Character-Defining Features of Contributing Buildings and Structures in the United States Merchant Marine Academy Historic District* report (Smith, Enscoe, and Adams 2014) will help guide this process, in coordination with the NY SHPO.

Historic features that characterize a building should always be protected from damage during rehabilitation work. The following steps should be taken for preservation of historic interiors:

- Monitor interior walls for moisture or other potential problems. Look for movement in cracks, joints, and around windows and doors, and then try to establish whether the movement is seasonal in nature (e.g., related to shrinkage of wood during dry weather) or is a sign of an ongoing problem.
- Prevent accelerated deterioration of mechanical systems by providing adequate ventilation of attics, crawlspaces, and cellars so that moisture problems are avoided.
- Improve the energy efficiency of existing mechanical systems to help reduce the need for elaborate new equipment. As appropriate, consideration should be given to installing storm windows, insulating attic crawl spaces, or adding awnings.

- Inspect the historic flooring materials for wear and tear. Repair as needed following the Standards and Guidelines.
- Inspect plaster walls and ceilings for deterioration. Repair as needed following the Standards and Guidelines.
- Inspect woodwork finishes for deterioration. Repair as needed following the Standards and Guidelines.
- Check windows for broken glass, sash ropes, and spring balances. Look for signs of condensation on windows. Repair as needed following the Standards and Guidelines.
- Check doors for proper operation. Repair as needed following the Standards and Guidelines.

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14. ABSTRACT The U.S. Merchant Marine Academy is located in Kings Point, New York. The Academy is listed on the National Register of Historic Places (#14000538). The historic district contains contributing mansions constructed during the Gold Coast Era and the Academy buildings constructed in 1942 to 1969. All buildings require regular planned maintenance and repair. The most notable cause of historic building element failure and/or decay is not because the historic building is old, but rather it is caused by an incorrect or inappropriate repair and/or basic neglect of the historic building fabric. This document is a maintenance manual compiled with as-is conditions of building materials at the Academy. The Secretary of the Interior's Standards for the Treatment of Historic Properties on Preservation, Rehabilitation, and Repair are discussed per material. This 8-volume report includes an overview volume plus volumes on each of the following elements: concrete, wood, brick, metal, roofing, stucco, and mechanical systems. All mentioned repair procedures are from the U.S. General Services Administration (GSA): Historic Preservation Technical Procedures and/or the National Park Service's series of Preservation Briefs. This report satisfies Section 110 of the National Historic Preservation Act (NHPA) of 1966, as amended.					
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