South Carolina
Historic Preservation Conference
The Value of History: Recognizing, Preserving, Protecting, an Promoting Your Historic Assets

Lime Putty and Historic Masonry

D. Shawn Beckwith
Preservation Coordinator/Restoration Specialist

Culture & Heritage Museums

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CENTENNIAL PRESERVATION GROUP

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Masonry Restoration

Historical Background

Brick section completed in 1843
Included in Brattonsville Historic District 1971
Culture & Heritage Museum acquired 2001
Historic Structures report 2004-2007
Funding appropriated Engineers start 2012
Campbell Meek & Associates drawings 2012
Project bid Summer 2013

085.tif

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Masonry Restoration

What next?

Historical Background

803-422-7803

The Palmetto Trust for Historic Preservation

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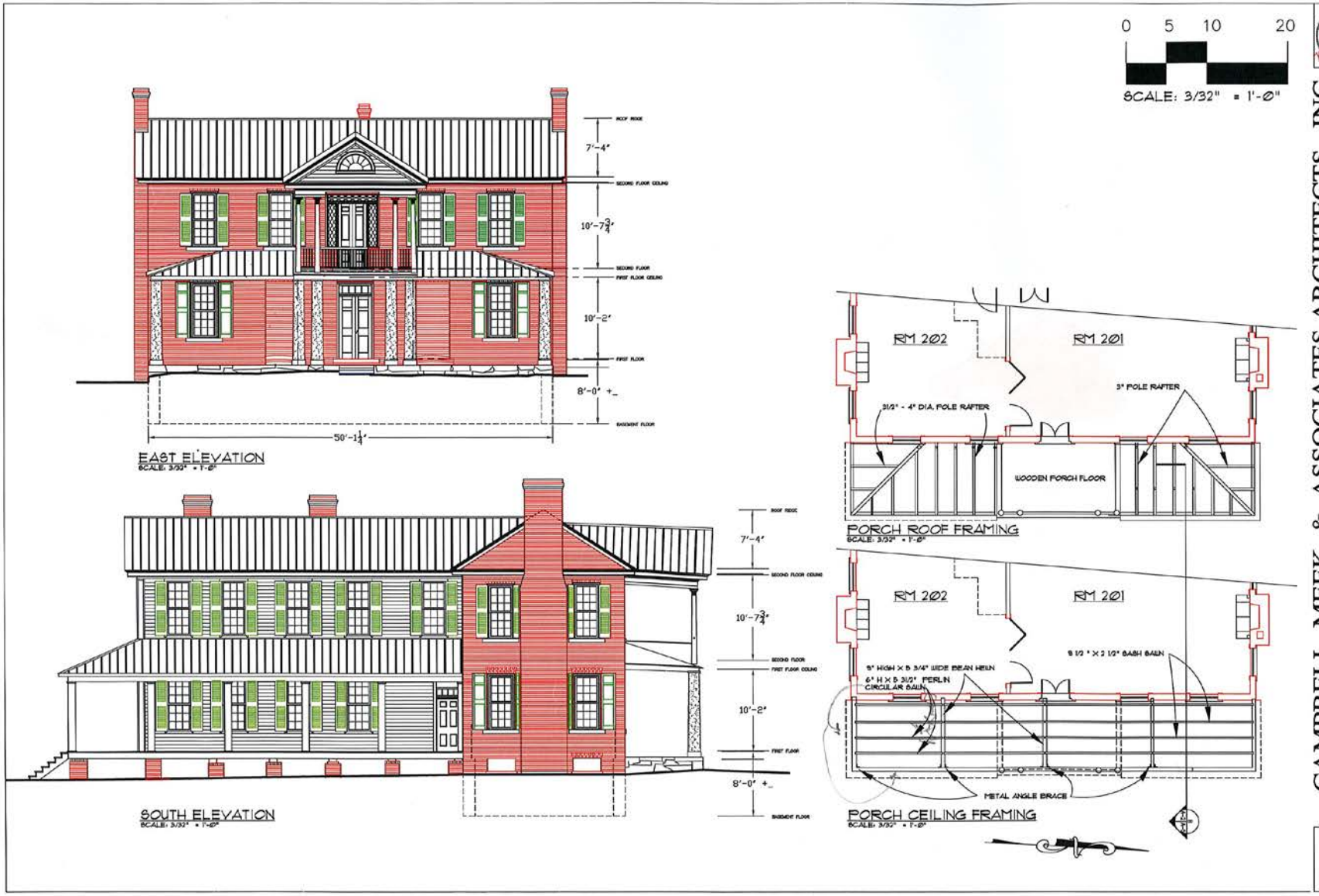
Historical Background



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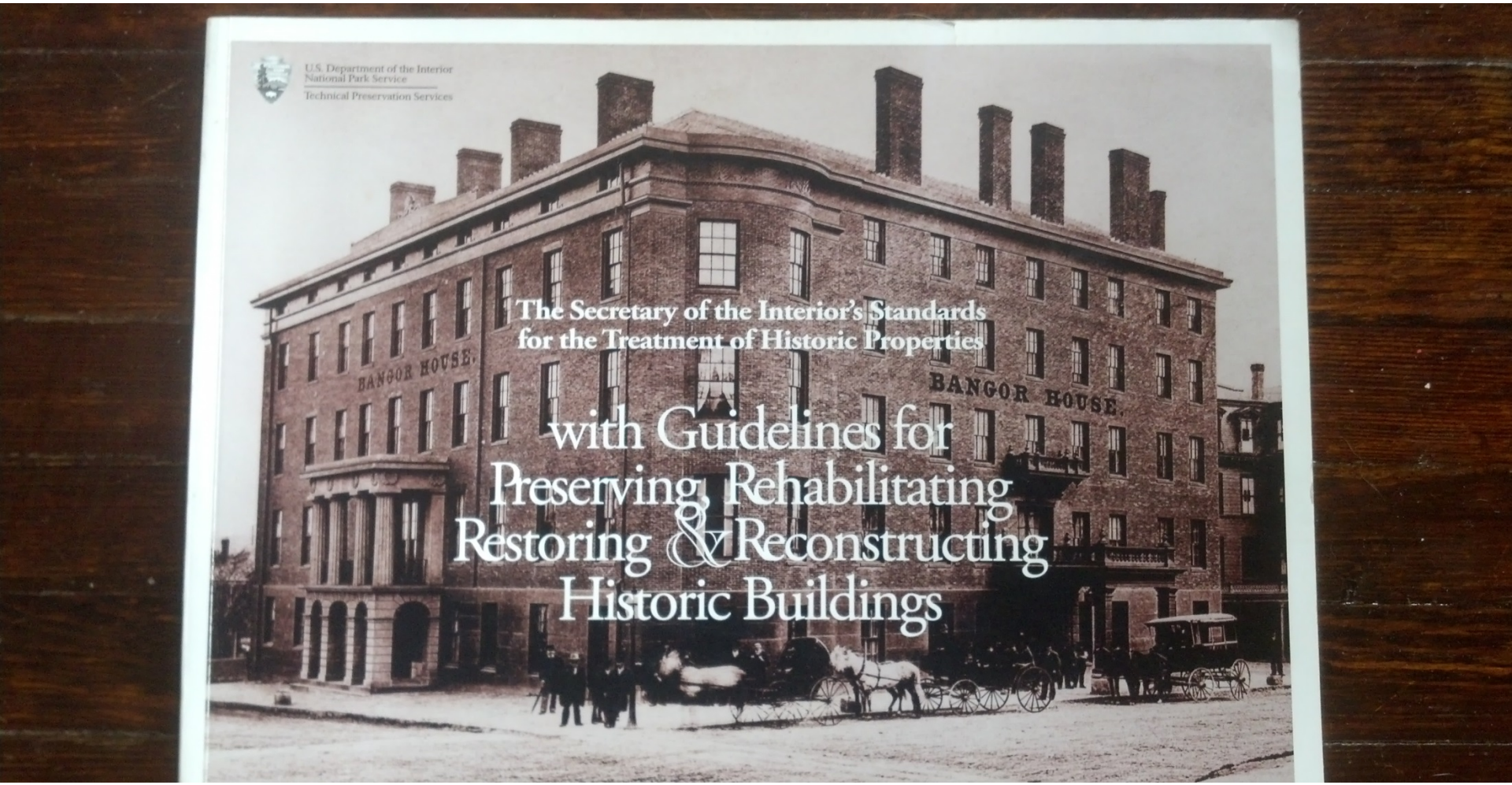
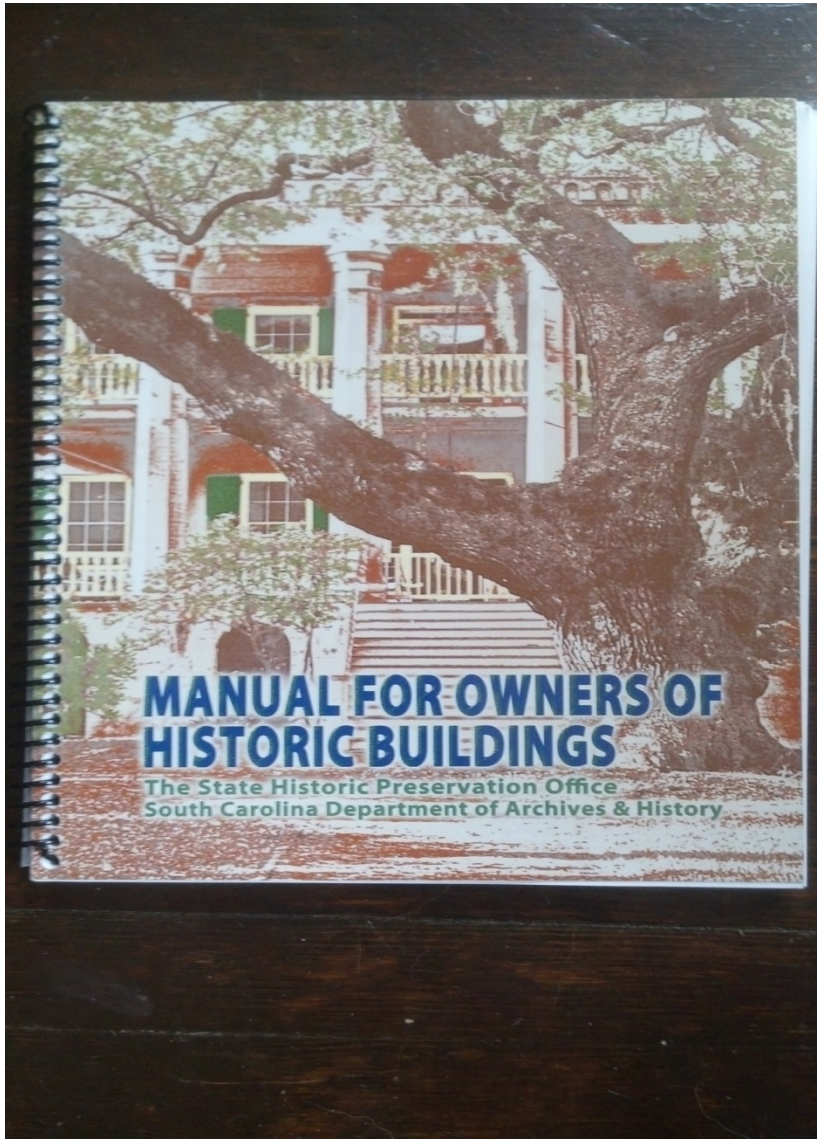
Historical Background



SCDAH Reference



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Masonry Restoration

Historical Background

NPS Brief #2

2 Preservation Briefs

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

Repointing Mortar Joints in Historic Masonry Buildings

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

»Historical Background
Identifying the Problem Before Repointing

»Finding an Appropriate Mortar Match
»Properties of Mortar
»Mortar Analysis
»Components of Mortar
»Mortar Type and Mix
»Budgeting and Scheduling
»Contractor Selection
»Execution of the Work
»Visually Examining the Mortar and the Masonry Units
»Summary
»Conclusion
»Selected Reading

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

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

The purpose of this Brief is to provide general guidance on appropriate materials and methods for repointing historic masonry buildings and it is intended to benefit building owners, architects, and contractors. The Brief should serve as a guide to prepare specifications for repointing historic masonry buildings. It should also help develop sensitivity to the particular needs of historic masonry, and to assist historic building owners in working cooperatively with architects, architectural conservators and historic preservation consultants, and contractors. Although specifically intended for historic buildings, the guidance is appropriate for other masonry buildings as well. This

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Historical Background

NPS Brief #47

47 PRESERVATION BRIEFS

Maintaining the Exteriors of Small and Medium Size Historic Buildings

Sharon C. Park, FAIA

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

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."[1]

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

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SHEET TITLE
MASONRY REPAIR

A-907
SHEET 19 OF 39

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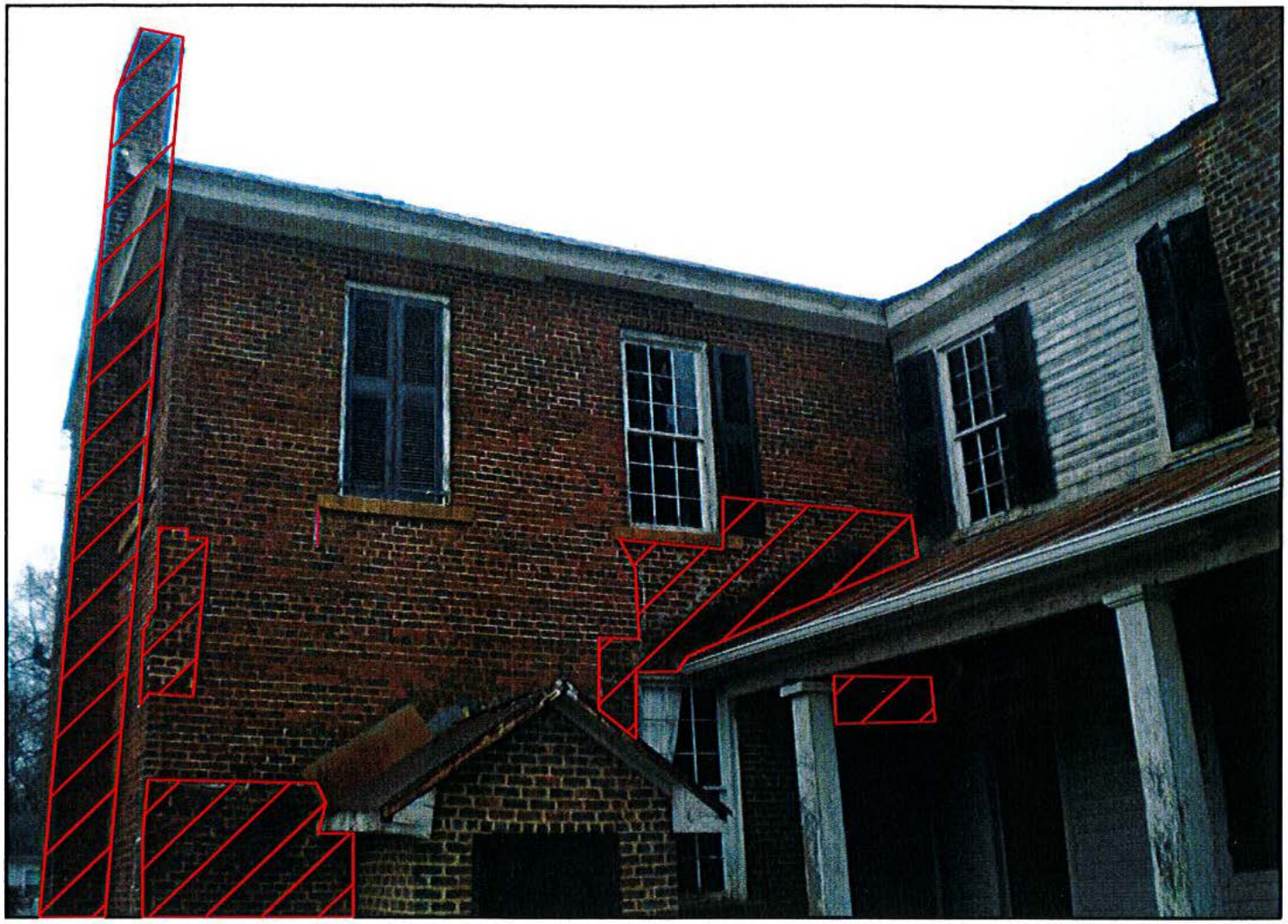

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Masonry Restoration

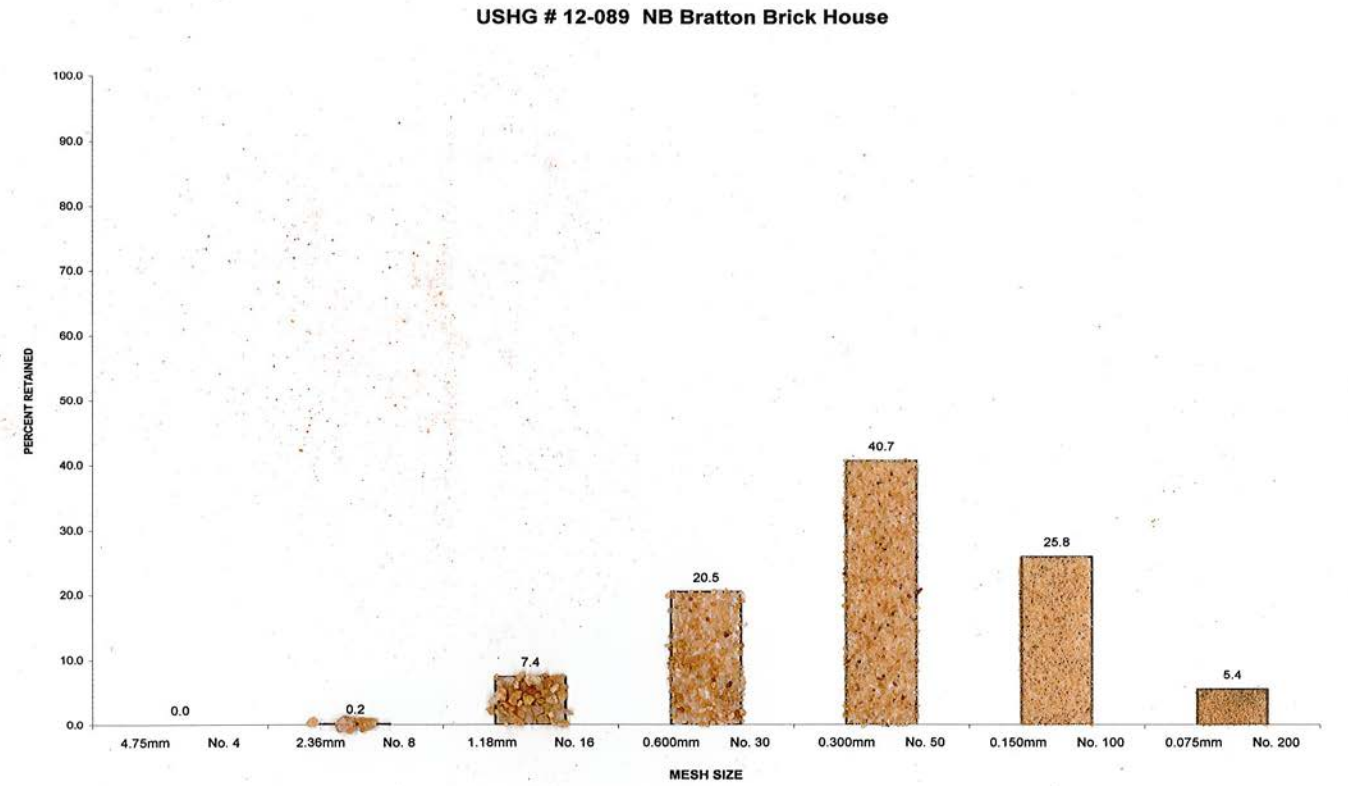
Mortar

Analysis

US

Heritage

Group



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Mortar match

Masonry Restoration

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Masonry Restoration

Introduction

1

Overview of historic masonry restoration

- Historical Background
- Mortar Comparison
- Mortar Properties
- Components of Mortar
- Mortar Type and Mix
- Problem Identification
- Matching Mortar
- Application
- Conclusion

Masonry Restoration

Historical Background

Masonry is found on nearly every historic building.

- Brick
- Stone
- Terra cotta
- Concrete block

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Historical Background

- 4

Massachusetts Hall, Harvard University. Built in 1720.
Mortar never replaced.

Masonry Restoration

Historical Background

1

Mortar made of lime and sand was used on masonry structures for thousands of years.

- **Quicklime** or lime is limestone fired at approximately 1800° F.
- Lime or quicklime delivered to site and mixed with water.
- Wet lime putty left to mature in pit or wooden box. (or used as hot mix)
- **Traditional mortar**: 1 part lime putty and 3 parts local sand.
- Other ingredients: crushed shells, brick dust, clay or even animal hair.

1

Hydraulic lime and Natural Cement

- Hydraulic Lime never used in this country as bagged mix- possibly as hot mix.
- Impure limestone discovered 1756 by English engineer.
- Contains clay and is fired with clay.
  - •Hydraulic Lime at Lower Temperature
  - •Natural Cement at higher Temperature
- Will set-up and maintain integrity under water (hydraulic).
- Natural Cement used on canals, the Brooklyn Bridge and Statue of Liberty, many homes and public structures

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Historical Background

Portland Cement patented in Great Britain 1824.

- Named for stone in Portland in Dorset, England.
- Fast-curing, hardens under water.

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Historical Background

First[1] manufactured in U.S. 1871.
From 1873-1930, mortar in masonry structures ranged from pure lime and sand mix to a variety of lime, portland cement and sand combinations.

As time went on, the proportion of PC grew. The product was **harder**, allowing **faster construction** and **taller buildings**. This was believed to be better.

Masonry Restoration

Historical Background

Masonry Cement –
pre-blended mortar mix purchased in stores.

Ingredients:

- Portland Cement
- Ground lime stone
- Air entrainment (soap)
  - Makes mortar creamy and workable.
  - Helps mortar resist the freeze/thaw cycle.

By 1950's, nearly everything was built with masonry cement.

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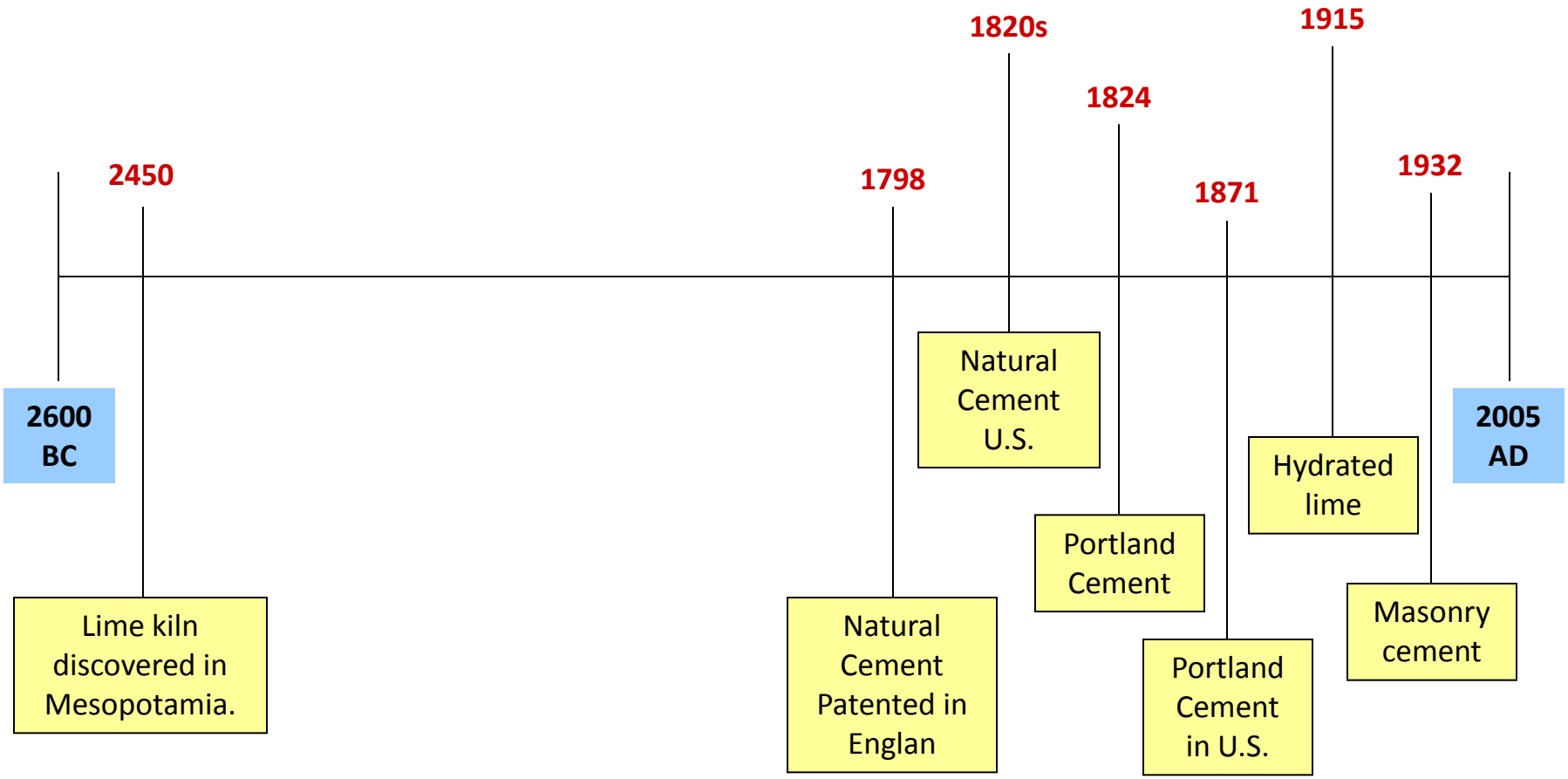
Historical Background

1



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Mortar Comparison

1

Lime Mortar

- Low compression strength
- Higher bond strength
- High flexural strength
- Vapor permeable
- More water tight
- Self-healing

Portland Cement Mortar

- High compression strength
- Lower bond strength
- Lower flexural strength
- Less vapor permeable
- Less water tight
- Does not self-heal

Masonry Restoration

Mortar Properties

Mortar can relieve stresses within the wall caused by:

- expansion
- contraction
- moisture migration
- settlement

Masonry Restoration

Mortar Properties

1

Mortar with stronger compression strength than the masonry units (brick or stone) will not “give.”

- Stresses relieved through the brick or stone.
- Permanent damage: cracking and spalling.
- Separation between mortar and the brick or stone.
- Water penetration through hairline cracks.

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Mortar Properties

1

Permeability –
the rate of vapor transmission, is critical.

- historically, moisture migrated through mortar joints
- **efflorescence** – harmless salt deposits on surface
- **subflorescence** – salt deposits below the surface which cause pressure leading to spalling or delamination

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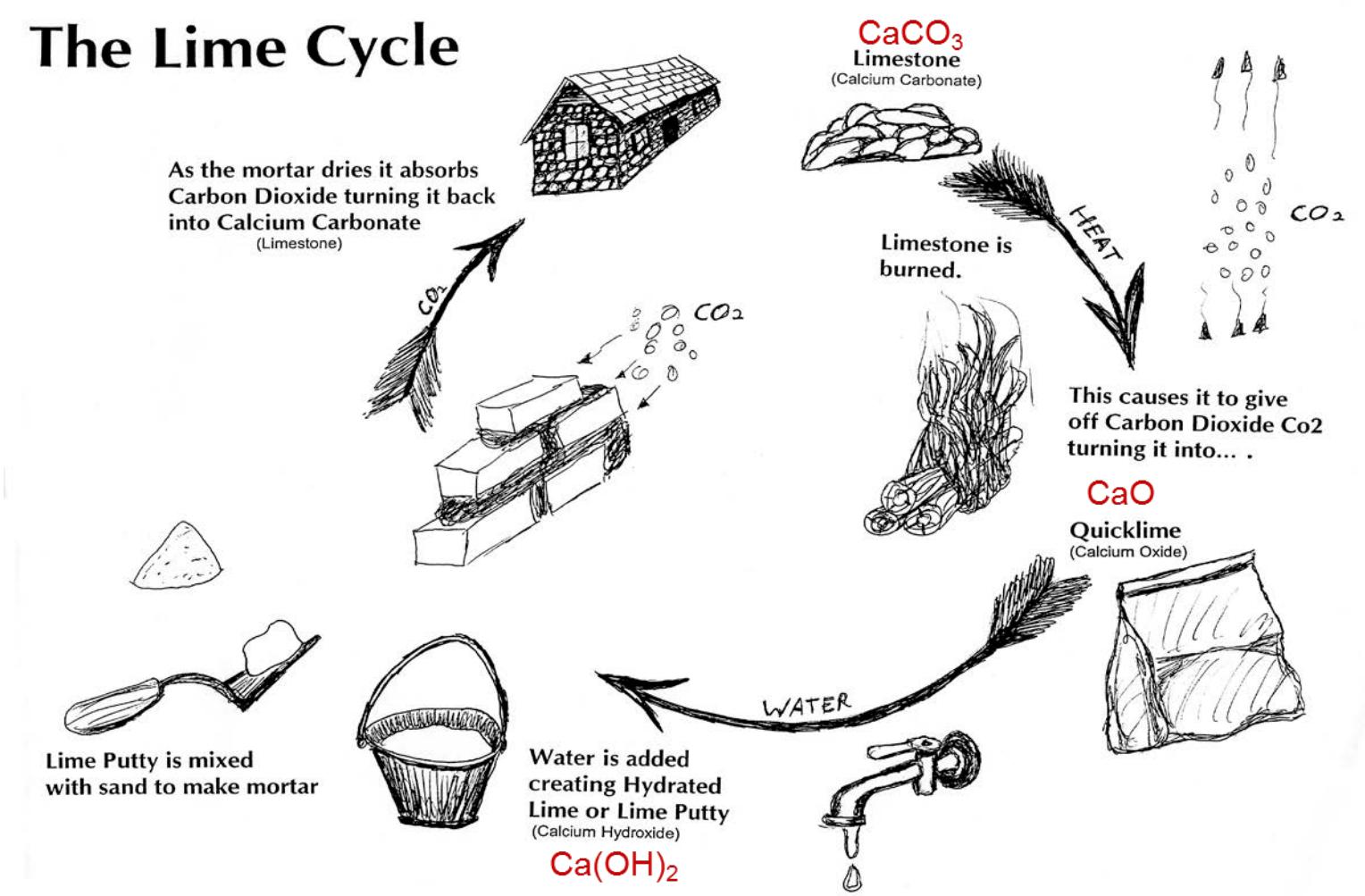
1



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Components of Mortar

-

Sand –
the largest component, gives mortar its distinctive color, texture and cohesiveness.

- Mortar requires distribution of large to small particles for good performance – bell curve with most particles in the middle.
- Small spaces are filled with binder (cement/lime combination).
- Called “void ratio” – important for correct binder/sand ratio.
- Sand shape

Masonry Restoration

Mortar Type and Mix

1

Two ways to specify mortar:

1. Physical characteristics
2. Proportion

American Society for Testing and Materials (ASTM) sets standards for **manufactured** masonry cement.

- Type M: 2,500 psi
- Type S: 1,800 psi
- Type N: 750 psi
- Type O: 350 psi
- Type K: 75 psi

Masonry Restoration

Mortar Type and Mix

1

Two ways to specify mortar:

1. Physical characteristics
2. Proportion

Portland and lime are binders.

Ratio: Binder 1:3 Sand

- Type M: 2,500 psi
- Type S: 1,800 psi
- Type N: 750 psi →
- Type O: 350 psi
- Type K: 75 psi →

PC = 1
Lime = 1
Sand = 6

PC = 1
Lime = 3
Sand = 10

Masonry Restoration

Mortar Type and Mix

Mortars for repointing historic buildings should be custom mixed for proper physical and visual qualities.

Mortar strength varies:

- Higher proportion of portland cement means harder mortar.
- More lime means softer, more plastic and workable mortar.
- A wall with soft bricks and high permeability requires a soft, high lime content mortar.

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Problem Identification

1

Replacing mortar joints is a natural process.

Requires repointing – removing deteriorated mortar from joints of masonry wall and replacing with new mortar.

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Problem Identification

1

Each building needs to be analyzed.

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Problem Identification

1

Obvious signs of deterioration:

- disintegrating mortar
- cracks in mortar joints
- loose bricks or stones
- damp walls
- damaged plasterwork
- Disintegrating brick or stone
- efflorescence

Masonry Restoration

Problem Identification

[1] **The root cause may include:**

- leaking roofs or gutters
- settlement of the building
- capillary action causing rising damp
- extreme weather exposure
- improper or incomplete repair materials
- drainage problems
- vegetation
- other changes in the structure

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Matching Mortar

1

Ensure repointing work is physically and visually appropriate. Determine:

- Relative strength and permeability of masonry and mortar.
- Appropriate mortar mix and application techniques.

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Matching Mortar

1

New mortar must match the historic mortar in:
color, texture and tooling.

- Sand should match the sand in historic mortar.
- New mortar must be as vapor permeable and as soft or softer than the historic mortar.

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Masonry Restoration

Application

1

A long-lasting job requires:

- The right mortar – matched to the building (compatibility)
- A balanced, well-proportioned mix
- Joints properly prepared
- Mortar applied properly and packed well
- Mortar properly cured in the wall
- Workmanship & understanding of historic materials are as important as using the proper materials

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Masonry Restoration

Application

1

Other considerations when working on historic buildings:

- Never sand blast historic brick.
- Remove old mortar carefully to avoid damaging joints and masonry.
- Use water repellant sparingly and only as a last resort.
- All repairs must be able to breath.
- Avoid painting.
- Careful analysis and planning

Buildings work as systems, not individual units.

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Masonry Restoration

1

- A good repointing job should last as long as the original mortar, or longer.
- Good repointing guarantees the long life of the mortar joint, the wall and the historic structure.

Masonry Restoration

Application

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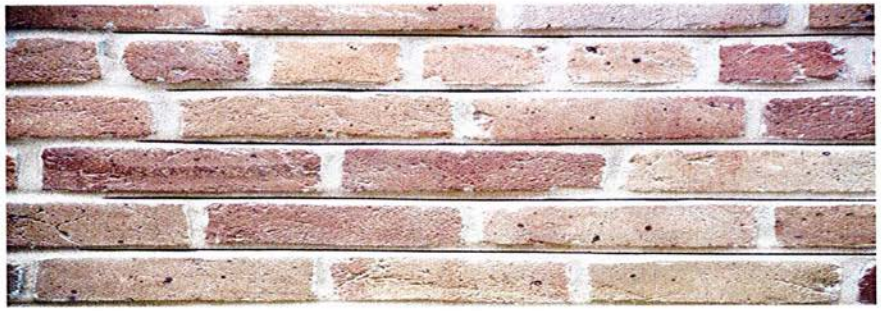
Preserving America's Historic Masonry

MASONRY RESTORATION
Repointing Guide

1.0 Mortar Repointing Preparation

1.1 Gather recommended tools for preparing mortar joints for repointing.



1.2 The Center-Cut Technique. The mason must cut the center of the joint **without touching** the edges of the brick.

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Application

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Repointing Guide

1.3 Cut the upper portion of the joint by hand using masonry chisels.

1.4 Clean out the lower portion of the joint by hand or with a pneumatic carving tool.

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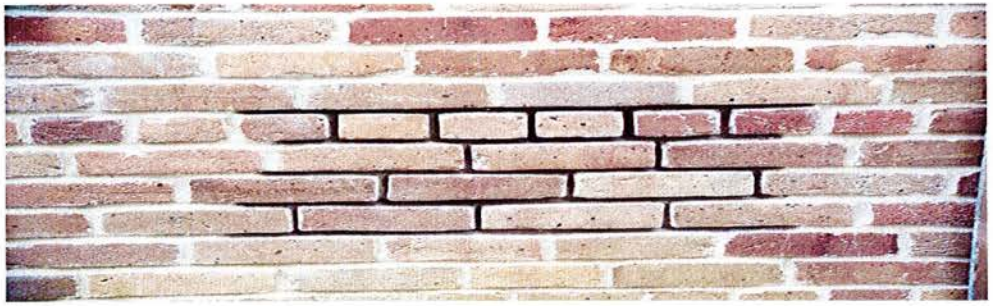
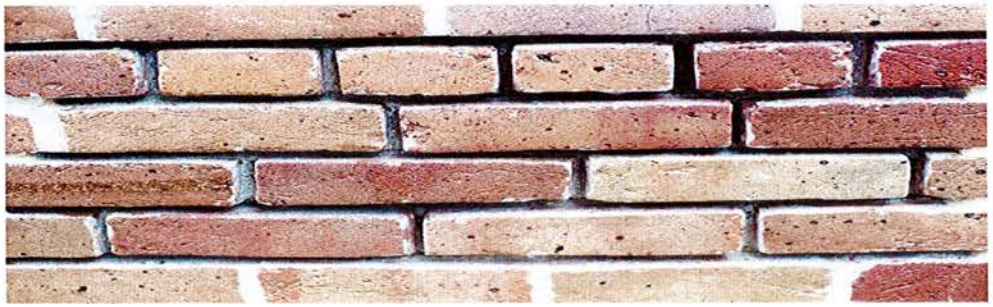


1.5 Mortar joints prepared for repointing.



Close-up of mortar joints prepared for repointing.

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1.6 Verify the width of the joint.

Verify the depth of the joint.

Proceed to **The Mortar Installation Process**.

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2.0 The Mortar Installation Process

2.1 Gather recommended tools for mortar joint tooling and repointing.

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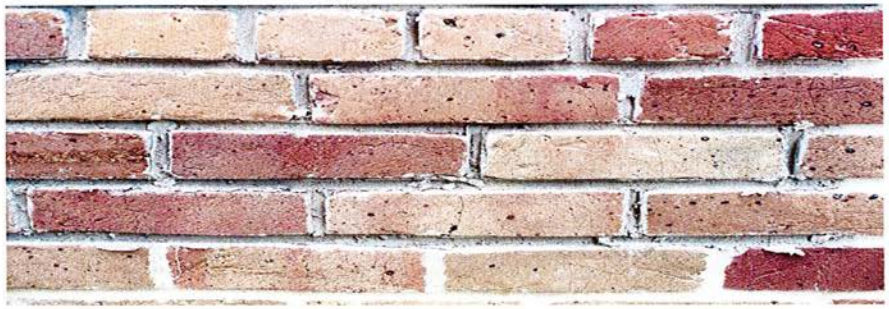
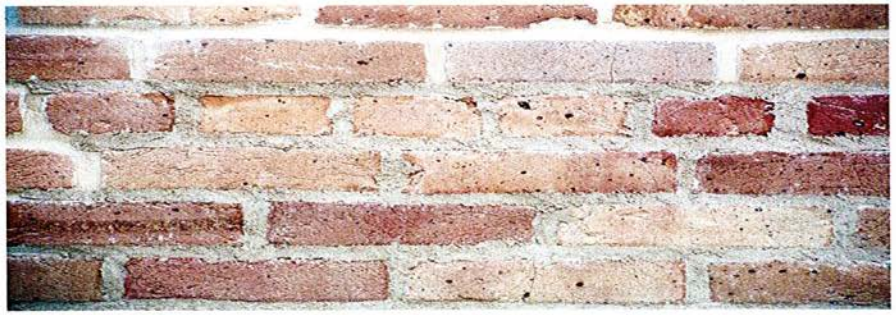


2.2 Inspect joints following placement of the first lift of mortar.



2.3 Inspect joints following final mortar placement.

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Review repointed mortar joints.

2.4 SAllow sufficient time for mortar to cure or dry.

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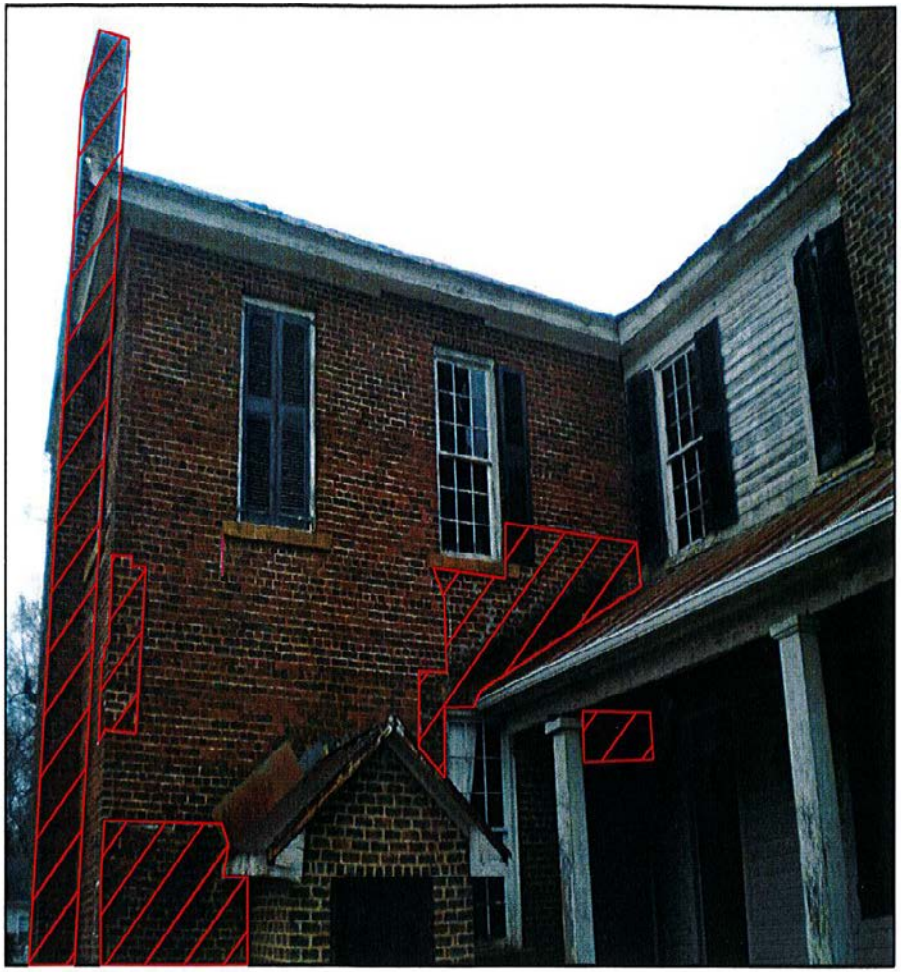

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The Bratton Brick House