Fall 2014

Mable House

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Mable Family ca. the late nineteenth-early twentieth century

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EXECUTIVE SUMMARY

The Mable House property is located at 5239 Floyd Road SW, Mableton, Ga., 30126, and consists of the main house, smokehouse, kitchen house, corn crib, blacksmith shop, sweet potato house, garden, and cemetery for the Mable family and their slaves. The main house is a Plantation Plain type structure consisting of six finished rooms (four on first floor and two on second floor). The first and second floors contain a central hallway. Presently, the property is owned by descendants of the Mable family and leased to the Cobb County Parks, Recreation and Cultural Affairs Department.

The main house, smokehouse, and kitchen were constructed under the supervision of Robert Mable in 1843. This site was listed on the National Register of Historic Places in 1988, and on the Cobb County Register of Historic Places the following year. This report addresses the history, conditions, treatment, and recommendations for the main house.

The treatment recommendation for the main house is a Rehabilitation, which is the process of enabling a compatible use for a property through repair, alterations, and additions while preserving portions or features that convey its historical, cultural, and architectural values. Recommendations for treatment of the main house can be found starting on page 113. Overall, the building remains in good condition. However, there are significant issues that require attention. Many of the building’s problems stem from water intrusion into the basement. A gutter system, including downspouts and splash blocks should be installed to move water away from the building.

Moisture is also present in the interior. The air conditioning unit should be run periodically and the temperature throughout the main house must be controlled. The chimneys are capped with cement, which could be trapping moisture in the house. The secretary desk in room 102 should be moved away from the air conditioning vent, as this is blocking air from circulating throughout the building. In addition, it is recommended that the Mable House have an energy audit conducted to measure the energy efficiency and output of the building. All repairs and maintenance should be performed in accordance with the Secretary of the Interior’s Standards for the Treatment of Historic Properties (See Appendix F).

Currently, the house’s interpretation does not focus on one specific time period. Interpretation should be based on themes surrounding the Mable family, such as how the family earned its living and what activities took place on the property. Interpretative details, such as
discussing the Georgia Gold Land Lottery of 1832 and its relevance to the Mable family, could be emphasized. Highlighting the schoolhouse, which was located in a log cabin originally on the site, would address the Mable’s contribution to educating the surrounding community. The Land Lottery, the sawmill and farming are topics that would address the Mable family’s livelihood. These themes should be connected to the visitor experience by asking questions about how certain practices, such as storing food, are done in the visitors’ lives. Resources like ‘Teaching with Historic Places’ on the National Park Service website should be consulted for further insight.3

3 A Plantation Plain Type house is defined by the Georgia State Historic Preservation Office (SHPO) as having “a two-story block at the front, with either a central hallway or hall parlor plan, and a one-story range of rooms at the rear, consisting of either three rooms or, more commonly, a short rear hallway flanked by a pair of rooms. The rear section is typically shed-roofed, the two-story block is usually gabled, and there is most often a full-width, one-story porch.”


Figure 1. (Photo 1) Looking southwest: Kitchen house (foreground), garden, main house (center building), smokehouse

Figure 2. (Photo 2) Looking west, L to R: smokehouse, main house, kitchen house
Background and Acknowledgements

The Historic Structure Report (HSR) for the Mable Historic Site was produced by students in the Conservation of Historic Building Materials Class within the Masters of Heritage Preservation Program at Georgia State University. The purpose of the HSR is to provide thorough documentation of the Mable House history, development, and present conditions to assist the Cobb County Parks, Recreation and Cultural Affairs Department and the Friends of the Mable House in determining the most effective options for treatment, ongoing maintenance, and interpretation. This will benefit visitors by providing an experience that is historically accurate while preserving the property for years to come.

The Mable House property is situated on sixteen acres in Mableton, Cobb County, Georgia, approximately fifteen miles northwest of Atlanta. Mableton is a low-density suburban area with a population of approximately 37,000. The main house is oriented towards the west, facing Floyd Road. Floyd Road is a main thoroughfare that runs north and south along the property and contains various commercial businesses. The site consists of the historic main house, the historic smokehouse, the rebuilt and relocated kitchen house, relocated corn crib, relocated sweet potato house, well, and the cemetery for the Mable family and their slaves. There is also a hearthstone near the southwest corner of the house that marks where the Mable’s log cabin once stood. The site’s modern structures include a well house and a modern-built replica of a blacksmith shop. This HSR focuses on the documentation and recommended treatment of the main house. A Conditions Assessment Report was previously completed on the smokehouse. The remaining outbuildings have been relocated, substantially rehabilitated, or are new constructions that lack historic integrity; they are not documented in this report.

This report includes the history of the Mable House Historic Site, a history of the Mable Family, a physical description, analysis of current conditions, recommendations for repairs, treatment and interpretation, and routine maintenance. The class divided into groups tasked with writing and documenting different portions of the report.

The Developmental History group researched the archives at the Mable main house, the Cobb County Census, genealogy documents, and other primary and secondary sources. (See Bibliography in Appendix H). A chronology of the property’s development, local history,
and background of the Mable family history was investigated for this section.

The team charged with the physical description took exterior and interior measurements of the main house. The measurements were used to create floor plans of the basement, first, and second floors that included the length and width of each room, as well as the measurements of each fireplace and the exterior facades. Diagrams of the floor plans and site map were created using AutoCAD.

The Conditions Assessment team investigated and documented areas of deterioration throughout the interior and exterior, while the Treatment and Interpretation team drafted methods to address the conditions and worked with the Friends of the Mable House to determine a more accurate interpretation plan. The Maintenance Plan team developed a list of ongoing maintenance procedures.

Two photographers used digital cameras to document the overall site, facades, and interior rooms. The Appendices team compiled plans and drawings keyed to photographs, along with maintenance schedules, historic photographs, the Secretary of the Interior's Standards for Treatment of Historic Properties, a glossary, and the bibliography. The Graphics team was charged with the layout of the report, along with the photograph arrangement on each page.

Primary, non-invasive investigations took place on October 25 and November 8, 2014. Additional investigation occurred on November 22, 2014.

Special thanks are extended to: Cobb County Preservation Planner Mandy Elliott for her insight on the Mable House history; the Mable Family; Tom Little, architect from Surber, Barber, Choate & Hertlien for his structural and conditions analysis; Maryellen Higginbotham and Jean Spencer for providing the paint analyses; Barbara Hollis and Mary Hill for sharing their knowledge on the Mable family history and the site's interpretation program; the Georgia State University Department of Anthropology for allowing the use of their Geometries magnetometer; Vince Macek of TRC Solutions Corporation for his valuable assistance with the Site Plan and Elevation Drawings; the Friends of the Mable House and Cobb County Parks, Recreation and Cultural Affairs Department for the opportunity to document and provide feedback on the preservation and future use of this historic site.

**Summary of Recommendations**

Moisture and imprecise interpretation are critical issues for the Mable house. The following is a summary of recommendations that will be further explored within this report:

- Install gutters, downspouts, and splash blocks that are removable and do not detract from the historic integrity of the building. Extension leaders to move water further from the foundation should also be considered.
• Check the grade surrounding the house. Water flooding in the basement is creating moisture problems for the entire house. Fill in any low spots to establish 6" of fall within the first 10' surrounding the house.
• Conduct an energy audit on the house through a company such as Southface Energy Institute, to determine its energy consumption and ways to increase its environmental sustainability.
• Replace the furnace in the attic (room 204), above room 101B (see floor plan, page XX). The evaporation pan designed to collect water from condensation has previously been filled and then overflowed.
• Remove the cement covering chimney top openings and install vented chimney caps to all chimneys. Vented, low-profile chimney caps should be selected.
• Address the two major bulges in the foundation on the west facade as soon as possible. These areas are collecting water and creating further damage to surrounding materials.
• Ensure the foundation grilles are adequate for ventilation in the basement.
• Trim back or remove shrubs and trees along all facades as these are trapping moisture near the house.
• Remove and reposition the handicap rail to eliminate further damage to the historic siding.
• Determine the frequency with which the HVAC systems should run. Certain temperature and humidity levels are contributing to moisture problems on the interior. To mitigate moisture in the house, a climate control system could be installed that activates the furnace or air conditioner when the house reaches a certain relative humidity level.

Interpretation of Main House/Overall Site

• Maintain all objects in main house that reflect the agreed-upon interpretation year. Make them the focus of the interpretation.
• Install interpretive panels throughout property to describe what each structure’s purpose was and where each building came from (if it is not original to the property).
• Highlight location of the log cabin and its hearthstone using appropriate landscaping.
• Base interpretation on themes such as the Gold Rush, farming, slavery, the schoolhouse, and tenant farming (all of which can connect the site with the community of Mableton).
• Relate the Mable family’s experience to visitor experience (especially for school field trips). For example, when discussing Mable kitchen house, involve students in the preparation of dinner in the manner the Mable family slaves would have prepared it.

All recommendations and repairs must adhere to the Secretary of the Interior’s Standards for the Treatment of Historic Buildings (See Appendix H).
Historical Background

The first contact between Native Americans and European explorers in north Georgia occurred in 1540. Between that time and the early 1800s, the area of modern day Cobb County, including Mableton, were occupied by the Creek and Cherokee Tribes. Two Native American villages, Sweet Water Town and Nickajack, were located in what is today south Cobb County. Sweet Water Town, a Cherokee village named for Chief Sweet Water, was located on a high hill on the east side of Sweetwater Creek, near the junction of Old Alabama Road, Cardell Road and Maxham Road.4

The Cherokee and Creek both claimed land in south Cobb County. The two tribes did not fight over this territory, however, because the area was so swampy – especially along Sweetwater and Nickajack Creeks. Supposedly, both tribes brought their sick to Deer Lick (Bowden Lithia Springs) and Gunpowder Springs (Powders Springs) to drink the waters, which were believed to have healing powers. Legend has it that at a “ball play” between the two nations ownership of south Cobb County land was wagered on the outcome of the game, which was won by the Cherokee.5

In 1827, the criminal jurisdiction of DeKalb County was extended over today’s Cobb County territory. In 1828, this territory was added to DeKalb and the laws of the State of Georgia extended over it. In 1829, a survey was completed and south Cobb County was declared to be Creek Indian Territory, belonging to the State of Georgia according to a 1739 treaty between Georgia and the Creek Nation. However, in 1830, it was declared to be half Creek and half Cherokee territory, with the Creek half belonging to the State of Georgia. Later in 1830, the state ordered another survey and in 1831 the land in question became part of the Cherokee County.

Gold was first discovered in north Georgia in the summer of 1829. No one knows for certain who made the first discovery, but it was noted in a Milledgeville newspaper that the gold region of North and South Carolina seemed to extend into Georgia.6 By late 1829 north Georgia was still part of the Cherokee Nation. Northeast Georgia was flooded by thousands of prospectors in search of gold. Gold mining took place throughout the region and even extended into portions of Cobb County. Niles’ Register reported in the spring of 1830 that there were four thousand miners working along Yahoola Creek alone.7 The sudden influx of miners into
the Cherokee Nation was known as the Great Intrusion. One writer in the *Cherokee Phoenix* noted, "Our neighbors who regard no law and pay no respects to the laws of humanity are now reaping a plentiful harvest... We are an abused people." But there was little the Cherokees could do.8

When a national mint went into operation in the North Georgia community of Dahlonega in 1838, many saw it as a national confirmation of Georgia's efforts over the preceding decade. To the area's residents, this federal establishment was a seal of approval and a promise of future prosperity.9 But it was a prosperity that was to be denied the native Cherokees. Between 1805 and 1832 the state of Georgia held lotteries to distribute land seized from the Cherokees and Creeks. Nearly three quarters of the land in Georgia was allocated by the lottery system, opening up the area, including Cobb County, to white settlement.10 Finally, the U.S. Army drove the Cherokees northwestward to Indian Territory in present-day Oklahoma. Deprived of proper food and clothing, at least 4,000—one-fifth of the entire Cherokee population—died on the journey. The forced migration became known as the Trail of Tears.11

Robert Mable (1803 – 1885) purchased 300 acres of land in the Coxes District from Denson C. Melton on September 11, 1843, in Land Lots 33, 34, 39, 40, 106, 112, 177, and 185 of the Seventeenth District.12 He is recorded as having received title to Land Lot 176 in the Seventeenth District of Cobb County on July 2, 1845. By 1850, Robert Mable owned at least 400 acres in the Mableton area.13

Prior to purchasing the land, Mable first moved to the property in the late 1830s, renting a two-room log cabin from Denson Melton on land to the west of where his plantation house now stands. When his antebellum plantation house was completed in 1843, the old log cabin became the Mable School where two of his daughters were teachers. It was a private school that charged students 10 cents a week when it first
Robert Mable helped construct various mills around the Mableton area during the nineteenth century, including Ruff’s Mill located near the covered bridge off Concord Road, and the Concord Woolen Mill, which burned during the Civil War. He built his own sawmill across from his house on present day Floyd Road (see aerial photo on opposite page). In addition to being a millwright, he was listed in census records as a farmer, owning a 470-acre plantation. His primary crop was cotton but he also grew corn, potatoes, and sorghum. The sorghum was refined to make syrup in one of the mills on his property. Mable was a slave owner and owned between eleven and forty-eight slaves by 1860.

In July of 1864, the Union Army occupied the Mable House as they passed through

Figure 4. 1960s aerial photograph showing the location of Mable House property and Robert Mable’s original sawmill.


opened, though Cobb County records indicate teacher pay was subsidized by tax money for the last few years of its operation. The school remained open until it burned down around 1900. Ruth Mable, Robert’s daughter, taught at the Mable School and other schools in Mableton until her death in 1942.
Mableton on their way to Atlanta. The first floor was used as a hospital and the second floor remained the living quarters of Mrs. Mable and her children. (Robert Mable had absconded to South Georgia.) Two soldiers died in the home during its time as a hospital and are buried in an unmarked location across Floyd Road from the Mable House.  

After the Civil War, there were sharecroppers and tenant farmers on the Mable property; some were former slaves or descendants of former slaves. This continued through the early part of the twentieth century. Crops grown were similar to those grown before the war, including corn, potatoes, and sorghum. Cotton was grown on the property until the boll weevil blight began in 1915.  

In 1881, the Chief Engineer of the Georgia Pacific Railway boarded in the home while the railroad depot was being built on the south side of the railroad tracks on the corner of Bankhead Highway and Lowe (present-day Church) Street. Much of the land the railroad ran across in Mableton belonged to Robert Mable. The Chief Engineer erected a sign on the north side of the depot reading “Mableton,” named for Mable. The first train from Atlanta reached town just before Christmas of 1881.  

On June 28, 1882, the Mableton Post Office was established with W.N. Pace as postmaster. Mableton was an incorporated town from 1912 to 1916 with a population of roughly 200. Dr. H.A. Glorre served as the first mayor of Mableton.  

Development of Property  

When Robert died in 1885, his sons Alexander and Joel executed his will. Sections of the Mable Plantation farm passed to each of his children. Upon her death in 1942, Ruth Mable, Robert’s daughter, set aside the Mable House and grounds in a trust under the supervision of Felton Barns, Eugene Ruff, and John Ruff. The house then was the home of Mrs. Lucy Mable Ruff, Robert Mable’s granddaughter, through the 1960s. In the 1940s, many modernizations were made to the home including the installation of an indoor kitchen and bathroom on the first floor. The National Register of Historic Places nomination form photographs taken in 1986 show the location of the bathroom in the main house (photo in Appendix E). The walls were painted and electricity was added in 1942. The cookhouse was no longer used for its historic purpose after the installation of the indoor kitchen in the 1940s. Part of the historic cookhouse burned in the 1950s, and it was rented to a gardener, “Old Man Green,” in the 1960s. He lived in the house and took care of the grounds. The smokehouse was used for storage during this time. Lucy Mable Ruff died in 1968 and her son, J. M. Ruff, then rented the house as a private residence to the principal of Mable Elementary, Millard Jones, and his friend, Joe J. Lyons.  

The house underwent changes on the exterior during this era, as well. A newspaper
article dated September 13, 1969 shows contemporary diamond-shaped shingles on the roof—likely asphalt or asbestos (see Appendix E). Before this time, the roof was constructed of slate tiles (possibly original to the structure). The current roof, synthetic faux slate shingles, was installed in the most recent renovation after the Arts Center opened in 1999. The 1969 photo also shows the front porch screened-in. The porch remained screened in until at least 1981, when a report for the South Cobb Improvement Association recommended its removal.

The South Cobb Improvement Association was formed in 1981 by a group of South Cobb citizens with the assistance of then-State Senator Roy Barnes. Barnes’ family lived across Floyd Road from the Mable House during the 1920s. The group leased the Mable House for use as the association’s headquarters. A state grant of $10,000 from the Department of Natural Resources in 1981 was used to rebuild the kitchen interior, build a fence around the cemetery, and provide maintenance of the property and house. The South Cobb Development Authority was formed in 1982 and a 20-year lease was formed for the property.

In 1984, the South Cobb Arts Alliance opened the Sweet Water Arts Gallery in the Mable House. In 1987, the South Cobb Development Authority acquired a new 99-year lease from the trustees of the Mable Estate. The house and 16 acres of land belong to the Mable Family while the Cobb County Department of Parks, Recreation, and Cultural Affairs holds the lease. The Mable House was listed on the National Register for Historic Places on July 22, 1988, and listed in the Cobb County Register of Historic Places on April 11, 1989. During the 1990s the house was also used for meetings, a tearoom, and as a small community center. New plumbing, wiring, heating, air conditioning, storm windows, and roofing were installed during this time.

The National Register of Historic Places registration form from 1988 lists additions to the house since it was built in 1843. In addition to the indoor bathroom and kitchen, the attic space was added, and the four chimneys were stuccoed (the exact dates are not mentioned). The original kitchen was turned into an art studio.

The sweet potato house, constructed in 1920, was moved from the Williams’ farm in 1990. The Williams’ farm was located next door to the Mable House during the 1900s. The corncrib was moved to the property from a farm on Concord Road in Smyrna, and was moved to the property in 2004-2005. A. F. Daniell established the Daniell Blacksmith Shop in Mableton in 1883. The blacksmith shop was constructed on the property to replicate the Daniell blacksmith shop.

State government funding was used for repairs and maintenance during the late 1990s, and to remove the 1940s bathroom and kitchen. The South Cobb Arts Alliance and the Arts Center staff moved to the new Arts Center when it opened in 1999. In 2000, Governor Roy Barnes wanted to provide Mableton with an outdoor amphitheater, and helped develop one
on the Mable property along with the Cobb County Board of Commissioners. Employees of the Cobb Parks Recreation and Cultural Affairs Department oversee the property. The Friends of the Mable House hosts a Storytelling Festival, school field trips, tours, and summer heritage camps on the site.34

Mable Family History

The owner of the Mable Plantation property, Robert Mable, was born in Clifton Court, Scotland in 1803 to John Mable (d. 1834) and Agnes Stevenson (d. 1826). He was the eldest of five children. His siblings were Mary (1804-1869), Janet (1806-1872), James (1812-1896), and Alexander (1810-1898).35 In 1820, Robert violated the Scottish Game Law of 1772 by trapping white rabbits.36 At the time, poaching was a very serious offence and the family quickly decided to immigrate to America. They first landed in Quebec, Canada then traveled to Delhi, New York.

Against his father’s wishes, Robert ventured on his own down the Delaware River to New York City and eventually sailed to Savannah, GA. As a result, Robert’s father removed him from his will.37 In Savannah Robert worked at Fort Pulaski under head engineer Robert E. Lee.38 It was there that he learned the trade of millwright and began amassing a wealth by building various types of mills across Georgia and South Carolina.

On December 14, 1837 Robert Mable married Pheriby Lane Aycock in Covington, Ga.39 Together, Robert and Pheriby had seven children whose birth and death dates can be found in the family Bible: Nancy (1838-1865), Joel (1841-1907), John (1843-1911), Margaret (1845-1923), Alexander (1847-1936), Robert (1850-1857) and Pheriby Lane (1851-1889).29

Robert’s first wife died as a result of complications with the birth of Pheriby Lane.41 On March 8, 1855, he remarried Almeda Aycock Hodge, first cousin of Pheriby.42 Almeda is listed as being a seamstress in the 1860 census.43 She already had two children from a prior marriage and they accompanied her to the Mable household.44 Together, Almeda and Robert had three more children: James (1859-1930), Ruth (1857-1942) and Sarah (whose name may have been later changed to Sallie)45 (1863-1921).46 Ruth was the last of Robert’s children to live in the house.47 She did so with her niece Margaret, who is listed as postmaster general.48 The last of the Mable line to reside in the house was Lucy Mable-Ruff.49

When Robert died in 1885, his sons Alexander and Joel executed his will. It appears that pieces of the Mable Plantation farm passed to each of his children.50 Alexander also owned almost 200 acres adjacent the plantation, upon which he grew pecans, peaches, and sorghum, and operated a sorghum syrup mill.51 Tenant farmers grew cotton, potatoes and corn on the land they rented from Alexander.52 The 1900 census lists Alexander as a farmer.53 Upon his death in 1936, his son Robert and eldest daughter Ruth executed the will until 1939.54
The Mables were a family highly concerned with education. The 1880 census found Joel to be teaching in Douglasville, Georgia and John in Irvine, Georgia. Joel was also at one time a teacher and the principal of the first grammar school in Atlanta. Margaret and Ruth both taught at the Mable log cabin school.

Robert Mable was a Presbyterian, and was instrumental in the formation of two area Presbyterian churches. He was also responsible for building wooden benches for a local Baptist church.

According to the 1860 Cobb County Census, five children from the Petty Family resided at the Mable house. They are listed by their initial, age, and sex: GH, male, 8 years old; I (or J) S, male, 7 years old; MM, female, 6 years old; NP, female, 4 years old; EA, female, 1 year old. There is no known relation between the Petty and Mable Families.

Two of Robert’s sons fought for the Confederate cause during the Civil War. Joel was a sergeant major. Alex, who joined up at age 17, worked at Andersonville prison. During the war, Robert Mable hid out in south Georgia, taking some of the older children with him. Almeda and the younger children remained living in the second story of the house while Union forces occupied and used the first floor as a hospital. One of the trusted Mable family slaves, Ike, was left in charge of taking care of the family.

Slavery on the Mable Plantation

Most records indicate that Robert Mable owned between 11 and 48 slaves. One of the slaves, Celia, was believed to be inherited by Pheriby Aycock from her brother. Another, Mary, belonged to Robert’s second wife Almeda. The slaves most likely lived just to the east of the cemetery. Georgia slaves in the mid-19th century usually occupied one or two-room log and daub cabins with dirt floors. It was said that Robert freed his slaves even before the government ordered him to do so. Oral interviews indicate that he was a fair and kind master and that he educated the younger slaves alongside his own children. They also attended the same church services. Against customs that prevailed well into the 20th century, nine of his former slaves are buried in their own section of the family cemetery. Additionally, a few remained on the property and on Alexander’s property as sharecroppers after the emancipation. One of them was Drew Mathis, whose postbellum shack still stands on Alex Mable’s property. John Mathis, likely a relative of Ike and Drew, worked as a servant for Alex Mable for at least 20 years. Births of the slaves were listed in the family Bible. During the war, Ike Mathis hid out in a barn on the property and shot Union soldiers that were attempting to search for Confederates on the property.
4. L. Harold Glore, “Bicentennial History of South Cobb County” [ca. 1976], Mable House Collection, Mableton, Georgia. 1
5. Ibid, 1
7. Ibid, 12
8. Ibid, 21
9. Ibid, 105
10. Ibid, 107
11. Ibid, 115-116
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13. Ibid
14. Glore, “History of Mableton, Georgia”, 15
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17. Conflicting information between personal interview/ various other sources and the 1860 census records.
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19. Ibid.
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21. L. Harold Glore, “Bicentennial History of South Cobb County” [ca. 1976], Mable House Collection, Mableton, Georgia, 6
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26. Barbara Hollis and Mary Hill, interview by Rick Dreger, Julia Lorenc, and Ashley Shares, November 8, 2014.
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33. Jaeger/Rayburn Inc.
34. Rosemary Clarke, Ed. Genealogy of the Mable Family: Information From James Mable of Delhi in a Letter to his Cousin Miss Margaret Mable of Georgia, 1897, Mable House Collection, Unpublished, 1.
38. Rosemary Clarke, Ed. 3.
39. “Family Tree,” Mable Family Bible, Mable House Collection, Unpublished.
40. Cemetery records indicate her death as one day following her daughter’s birth.

Harold L. Glore, "Local History Excerpts." 3.

1870 Census lists Sarah, but later documents conflict.

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Ibid.

Christopher A. Wade, 5.

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Christopher A. Wade, "Interview with Edith Emelene Mable Cole," *Cobb County Oral History Series*, [1984], 4.


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Christopher A. Wade, 4.

Harold L. Glore, "Local History Excerpts" 4.

All oral histories, Mable Bible records, as well as the 1850 slave schedule indicate 11. The 1860 slaves schedule indicates 48.


Ibid.


Christopher A. Wade, 4.

Barbara Holllis and Mary Hill, interview by Rick Dreger, Julia Lorenc, and Ashley Shares, November 8, 2014.

He is listed in both the 1910 and 1930 census as being a servant.

Harold L. Glore, "Local History Excerpts." 4.
PART THREE:

PHYSICAL DESCRIPTION

Setting and Site

Landscape

Located in the unincorporated community of Mableton, Cobb County, Georgia (Figure 5), the Mable House property on the east side of the road at 5239 Floyd Road includes: the 1843 Plantation Plain house; the smokehouse; the relocated and rebuilt kitchen; the cemetery; the original well covered in a modern brick housing and a modern well house; the relocated sweet potato house; the modern replica blacksmith shop; relocated corn crib; and hearthstone from the demolished log cabin. The property is part of a 16-acre tract of land located along highly traveled Floyd Road that comprises the Mable House complex, the Arts Center and Barnes Amphitheatre. Surrounding land uses are predominantly commercial, with housing to the north and south (Figure 6). With all of these changes to the original 300-acre farm, the Mable House property does not truly convey its historic agricultural setting, which featured fields, orchards, and woodlots.

The lot itself gently slopes away from the house in all directions, with mature trees to the west and north (Figure 8, Photo 3). A small tree line separates the Mable House property from the Amphitheatre to the east (Figure 9, Photo 4). When the overall purpose of the site changed from agricultural and residential to educational and recreational, the vegetation along the southern portion of the Mable House property was removed and paved parking added (Figure 10, Photo 5). The house itself is located approximately 100 feet east of Floyd Road. The domestic supporting structures of kitchen and well are located in the immediate vicinity of the house, approximately 40' northeast and 27' north, respectively. The smokehouse is located approximately 36'-6" south of the house (Figure 11, Photo 6). Three supporting agricultural buildings—the sweet potato house (not original to the site), modern replica blacksmith shop (constructed on site), and corn crib (not original to the site)—are located between 90' and 170' east and northeast of the east facade of the house (Figure 12, Photo 7). The family cemetery, including a section for slaves, is located 106' east of the house in the southeast corner of the property (Figure 13, Photo 8).

The hearthstone from the demolished log cabin is located 31'-1½" to the southwest of the southwest corner of the main house (Figure 14, Photo 9). Now in two pieces, the stone was originally one large piece of fieldstone measuring 1'-9 ¾" wide x 2'-5 ½" long. The stone
runs in a southwest-northeast direction. A Geometrics magnetometer was used to determine the possible location of the burned structure that extends to the northwest as shown on (Figure 14, Photo 9).

Figure 5. Location of Cobb County in Georgia (left); Cobb County with Incorporated Areas in Grey and Mableton Highlighted in Red (Source: http://en.wikipedia.org/wiki/Mableton,_Georgia)

Figure 6. Location of Mable House property in relation to surrounding buildings (source: Google Earth)
Figure 8. (Photo 3) View of Mable House and outbuildings through mature trees from northwest corner of property, looking south

Figure 9. (Photo 4) View of tree line separating Mable House property (to west) from Barnes Amphitheater (to east); looking south for north end of property
Figure 10. (Photo 5). View from parking lot at southern border of property with Smokehouse on the right.

Figure 11. (Photo 6). View of the Main House west façade from across Floyd Road.

Figure 12. (Photo 7). View of west façades of outbuildings from Main House; from left to right: sweet potato house, blacksmith shop, corn crib and garden.

Figure 13. (Photo 8). Mable family cemetery from east side of property looking west; Mable House and outbuildings visible in background.
Figure 14. (Photo 9) View of cracked hearthstone, looking southeast

Figure 15. Results of magnetometer study of demolished log cabin site. Solid red line delineates the hearthstone location and dashed line shows possible outline of foundation based on changes in soil density and composition.

**Outbuildings**

There are several outbuildings on the property and are not addressed in terms of conditions. The smokehouse, located southeast of the Mable House is the only outbuilding on the site in its original location. As such, a separate conditions assessment was conducted for this building. The kitchen was once located directly behind the house and was later connected to the east facade entrance by a covered lattice walkway. It was relocated and rebuilt. Other outbuildings and structures include the original well, which is covered in a modern brick housing and sheltered by the modern well house; the relocated sweet potato house; the relocated corncrib; and a blacksmith shop that was rebuilt on the site.
PART FOUR:
ARCHITECTURAL DESCRIPTION

Architectural Summary

Set on a parged brick foundation, the 1843 Plantation Plain-type house is of wood-frame construction with a central-hall plan. The exterior is covered with weatherboard siding with a 5" to 5-1/2" reveal and fastened with machine cut nails, common in the mid-nineteenth century. The two-story section of the house has a 7:12 pitched roof clad with modern faux slate. The one-story section of the house, which extends off the rear façade to the east, has a 5:12 pitched shed roof. There are four exterior parged brick chimneys located at the gable ends of the south and north facades that are centrally placed along the north and south facades of the one story extension. The tops of all four chimneys have been capped with concrete coping. There are three entrances to the first story of the building: double-leaf doors on the west and east facades and a single-leaf entrance on the south facade. A sloped wall entrance on the north facade provides access to the basement. Each of the first-story entrances are sheltered by porches supported by tapered posts with carved panels.

Figure 16. (Photo 10) Mable House front, west façade looking from southwest corner of property
Figure 17. (Photo 11) View of architectural shingle on ridgeline and east slope of roof

Figure 18. (Photo 12) View of concrete cap on northwest chimney
Exterior Description

**Foundation**

The load-bearing brick foundation is three wythes thick (averaging at 12'-3/4") and set above a granite damp course. On the exterior the brick is parged with Portland cement based stucco and averages from 1' to 1'-6" above ground. Along the west and east walls are four 16" openings for ventilation that have historic wood strips nailed into the sill above and notched board below with machine cut nails on the interior, intended to keep larger animals out of the basement. In the twentieth century, these openings were infilled with a one wythe thick course of modern cored brick. Working metal vents were also added. The porches on the west and south facades are historic and the foundation extends outwards to support the deck. The porch on the east facade is not historic, and the 10'-7-⅛" opening along the foundation has been filled in with concrete masonry units.

![Figure 19. (Photo 13) View of foundation](image-url)
West Façade

The west façade features the primary entrance, accessed by the porch with pedimented front-gable roof. The central double-leaf doors are topped by a six-light transom and flanked by six-light sidelights with recessed panel. The tapered porch supports have Tuscan caps and have recessed panels with curved details. On either side of the entrance are replacement nine-over-six vinyl sash windows with square surrounds and drip molding on the lintel. The second story features fixed nine-light wood windows, likely replacing pivot windows at an unknown date.

Figure 20. (Photo 14) View of west façade
Figure 21. West elevation
South Façade

The south façade faces the parking lot of the Mable House site. A concrete sidewalk lined with shrubbery leads up to an entrance into room 102. The entrance has a shed roof and tapered posts that are similar in design but on a smaller scale than the west façade. The windows on the two-story section are replacement nine-over-six vinyl sash on the first story and replacement six-over-six vinyl sash on the second story. A parged brick chimney that is not fully attached to the building separates the windows.

The south façade extends at a 5:12 pitch from the two-story section of the house to the one-story section on the rear. The window on this section of the façade is six-over-six replacement wood sash. A similar parged brick chimney separates the window from the shed-roofed porch. The southwest chimney is $\frac{3}{4}$" over 4' out of plumb to the south at the base. The flue encasement is $\frac{3}{4}$" over 4' out of plumb to the south. The southeast chimney is $\frac{3}{4}$" out of plumb to the south at the base and the flue encasement $\frac{1}{4}$" over 4' out of plumb to the east.

Figure 22. (Photo 15) View of south façade
Figure 23. South elevation
East Façade

The east façade of the building coincides with the one-story unit of the house. The width of the façade is two rooms wide divided by the central hallway. At one point a single-leaf door, the entrance to the central hallway has modern replacement double-leaf doors and six-light transom to replicate entrance on the west facade. A modern shed-roofed porch provides a third access to the building and is connected to a handicap ramp leading to the southwest corner. Two Goodman air conditioning condensers are located north of the porch and enclosed with a picket fence. The windows are six-over-six replacement wood sash.

Figure 24. (Photo 16) View of east façade
Figure 25. East elevation
North Façade

The north façade contains the entrance to the basement accessed by the standing-seam metal, double-leaf door on a sloped-wall foundation. Like the south façade, the windows on the two-story section are replacement nine-over-six vinyl sash on the first story and two replacement six-over-six vinyl sash on the second story. A parged brick chimney that is not fully attached to the building separates the windows.

The north façade extends at a 5:12 pitch from the two-story section of the house to the one-story section on the rear. The window on this section of the façade is six-over-six replacement wood sash. A similar parged brick chimney is located on the rear (east) section and the previously mentioned entrance to the dugout cellar is in between the two chimneys. The northwest chimney is ¾” out of plumb over 4’ to the north at the base. The flue encasement is ¾” out of plumb over 4’ to the west. The northeast chimney is 1’-1/8” of plumb to the north at the base and the flue encasement is square. A louvered wood vent is located in the attic section adjacent to the chimney on the rear (east) section.

Figure 26. (Photo 17) View of north façade
Figure 27. North elevation
Roof

The house has a side-gable roof clad with faux slate shingles and changes from a 7:12 pitch to a 5:12 pitch over the one-story portion. The boxed cornice features overhanging eaves and returns with cyma recta-profiled crown molding. The chimneys abut the edges of the roof, but are not attached to the building along the roofline and the tops have been sealed closed with concrete caps.

Figure 28. (Photo 18) View of architectural shingle on ridgeline and east slope of roof

Figure 29. (Photo 19) View of Cornice Return

Figure 30. (Photo 20) View of concrete cap on northwest chimney
Interior Description

**Basement**

The majority of the Mable House sits over a dirt crawlspace approximately 22" tall. The basement of the house is a dugout room beneath the northwest corner of the building, measuring 19' x 15' 3", with a small alcove measuring 6'8" x 5' 9".

The entrance to the basement is on the north façade. The steps leading into the basement are natural stones set into the ground. The floor and majority of the basement walls are also earth. The height of the basement at its entrance is 5' ¾". At its tallest point, the basement room is 7' ¾".

The north and west walls of the dugout basement feature masonry walls composed of field stone and capped in historic brick. The north wall is approximately 4' 3" tall. The west

![Figure 31. (Photo 21) North and west walls of dugout basement, constructed with field stone and historic brick and previously whitewashed](image)
wall is shorter, approximately 3' 10 3/4". The walls have been previously whitewashed, indicating use as a functional space, likely food storage as a root cellar (Figure 31, Photo 21).

The structure is supported by various means throughout the basement and crawlspace. Historic brick piers with evidence of whitewash support a large hand hewn beam (11 1/2" x 9 3/4") that runs north to south in the center of the structure. Modern 6" x 6" wood posts on modern concrete footers support floor joists in the dug out portion of the basement. Elsewhere in the crawlspace, wood posts support the structure with only thin metal sheets separating the posts from the ground (Figure 32, Photo 22). The crawlspace also contains piers of modern cement masonry units. Visibility of the extant structure is severely limited by the HVAC ductwork and modern insulation that lies on the ground throughout the crawlspace.

The framing for the first floor is exposed and visible in the basement. Hand-hewn sills (11 1/2" x 9 3/4") sit atop the brick pier foundation (Figure 33, Photo 23). Primary joists (9 3/4" x 4 1/2") and reciprocating sawn secondary joists (9 3/4" x 2") extend from the center beam and run east to west. The joists are spaced approximately 24" on center. There is no subfloor; the flooring above sits directly on the joists.

All of the modern systems are present in the basement. A water line enters the house under the foundation on the west façade and connects directly to the sprinkler system. A copper water line is also evident, supplying the spigot on the east exterior.

A 100,000 BTU Rheem gas furnace sits directly on the ground in the southeast corner of the dugout portion of the basement, and services the first floor of the building. Steel gas lines run from the southwest corner of the building to the furnace. Insulated ductwork runs from the unit throughout the crawlspace. The condensate and coolant lines run from the furnace unit through a vent in the foundation of the east wall to the Goodman cooling units on the exterior.

A sump pump has been placed at the low point of the basement floor to remove water from the basement. This investigation did not occur during any periods of rainfall, however, an extensive
amount of moisture is evidenced by staining on the pipe that carries water from the sump pump to the exterior of the building (Figure 34, Photo 24)
An electrical service panel is attached to a wood support posts near the furnace and sump pump. There are two keyless lights in the basement, one on a switch at the door, one on a pull chain in the center of the room. Modern electrical wiring in aluminum-sheathed conduit runs throughout.

**Interior Summary**

The interior of the Mable House follows the traditional Plantation Plain-type, with one room on either side of a central hall on both floors, with a one-story shed portion with rooms to the rear of the house. Robert Mable, the original owner of the house, was the owner of a lumber mill as well as a joiner. He and his slaves carried out much of the work when constructing the house.

The Mable House features tongue and groove heart pine floors, as well as tongue and groove board walls and ceilings, with boards measuring approximately 5 ¾” - 6”. The first floor includes paneled wainscoting measuring approximately 31” in height. The house has plain wood baseboards measuring approximately 5” in the rooms where wainscoting is not present. The walls, ceilings, wainscot and paneling, are currently painted beige and white in all rooms except for room 103 which is being interpreted as a parlor, and features green trim, wainscoting and a fireplace. None of these elements were painted until the 1940s, however paint analysis provides evidence of ochre paint on the floor when vent grates were removed. The interior of the double doors on the west facade (D1) also shows evidence of graining. The interior doors are four paneled, tongue and groove, wood doors, typical of the house’s period of construction and Greek Revival style.

*Please refer to door and window schedules in Appendix D.*

**Floors, Walls and Ceilings**

The Mable House’s flooring consists of heart pine boards, each measuring approximately 5 ¾” - 6” wide, with tongue and groove joinery. Because Mable was a joiner in addition to owning a lumber mill, it is possible that he joined these boards himself. The flooring throughout the Mable House is consistent from room to room with the exception of the finish.

Like the flooring, the walls are constructed out of heart pine using tongue and groove joinery. The walls in several of the rooms including 103, 102, and partially 104 and 105, also feature a paneled wainscot measuring approximately 31” from the floor with the top edge measuring 1” deep.

The ceilings in the Mable House also consist of tongue and groove, heart pine boards with a painted finish.

**Doors and Windows**
The Mable House features four-panel, mortise and tenon doors (Figure 37, Photo 26) with the exception of the central hall and access to the attic space. These doors, seen in rooms 105, 103, 102, and 104, as well as 202 and 203 on the second floor, are typical of the Greek Revival style and are consistent with the time of the house’s construction. The doors measure approximately 34” wide.

The first floor central hall (room 101) features two sets of double doors. One features the same mortise and tenon assembly seen throughout the Mable House, however, the double doors on the east side of the hall are modern. The west doors (D1) have recessed panels

Figure 36 (Photo 25) Room 105 door viewed from inside the room.

Figure 37 (Photo 26) The mortise and tenon construction method is visible on the door’s edge, as seen in the photo to right.

Figure 38. Room 101 facing east showing where bathroom was once installed but later removed, photo by James R. Lockhart in 1986
The windows of the Mable House are modern replacements, installed at an unknown time. The first floor features double-hung windows with either nine-over-six (seen on the west wall of room 103) or six-over-six lights. The second floor windows differ from the first floor with tier inclusion of nine-light, fixed windows that are flush with the floor. Historically, these windows would have possibly been pivot casement windows to allow for ventilation on the second floor. It is possible that these extant nine-light windows were the original sashes for the historic first floor windows. The second floor also features six over six, double hung vinyl sash, replacement windows.

Doors and windows are surrounded by similar trim with the exception of the upstairs windows, where a piece of shoe molding has been added (Figure 39, Photo 27). The door and window trim measure approximately 4” wide and ½” deep.

**Hardware**

Hardware in the Mable House includes doorknobs, rim locks, light fixtures and other accessories related to the house’s fire suppression, electrical, HVAC and security systems.

A number of the interior doors feature rectangular rim locks and agatewear (ceramic) or metal (possibly brass) doorknobs (Figure 40, Photo 28 and Figure 41, Photo 29), with the exception of D2, which has only a doorbabar on the interior side. The doors swing on modern hinges, and exterior doors such as D3 have modern hardware including a deadbolt lock.
The rooms of the Mable House are illuminated by modern metal and glass light fixtures, possibly meant to convey a historic aesthetic (Figure 42, Photo 30 and Figure 43, Photo 31).

The floors, walls and ceilings have modern plastic or metal switch-plates, electrical outlets, vents, sprinkler heads and motion detectors.
Mantels

The fireplace surrounds and mantels in the all of the rooms are typical for early nineteenth century modest houses in that they consists of vernacular, plain surrounds and pilaster elements which stem from classical architecture (Figure 44, Photo 32). The fireplaces and mantels differ in sizes depending on their location in the house. Both of the front rooms, Room 102 and 103, have the largest fireplace surrounds and mantels, while Rooms 104 and 105 located in the back of the house are smaller in execution (Figure 45, Photo 33). However, all of them retain the same design elements.

Room 102 is the only Fireplace surround to be altered; a thin wood frame was added to the front of the brick firebox (Figure 46, Photo 34). Rooms 102, 104 and 202 are the only fireplaces that have brick fireboxes; all the others have been sealed off. Another key difference is that the fireplace surrounds and mantels on the second floor in Rooms 202 and 203 are the smallest out of all the others in the house. They also have thinner and simpler mantels and pilasters that are missing the sprouting capitals found on the other fireplace surrounds (Figure 47, Photo 35).

*See molding profiles in Appendix C.*

Finishes

One of the most interesting discoveries is that, at one point in time, trompe l’oeil or “trick of the eye” decorative painting, very popular during the period in which the house was built, was employed on some of the architectural elements. The front door and the mantels in both Room 102 and 103 (parlor) are believed to have used a wood-grain finish that would have imitated a richer, more expensive and colorful type of wood. According to Maryellen Higginbotham’s Paint Analysis, (see Appendix F) the doors to these rooms were grained and/or varnished and the mantels were painted black and grained or varnished before the walls were painted. This is a common practice for households in the nineteenth century: to paint the mantels black in order to hide smoke discoloration. A less in-depth paint analysis was done for room 104, room 105, and the second floor. This revealed that both the doors and mantels in room 104 and 105 received the same treatment as the previously mentioned room, however, the second floor did not; neither the doors nor mantels were grained or varnished. In the future, a more in-depth analysis should done for room 105, which was the former kitchen, room 104 and room 101b, where the bathroom was, to see if any significant and interesting developmental changes in the finishing for these room could be uncovered.

Unfortunately, all of the faux painting discussed has since been covered over. Currently, the architectural elements of the house such as the mantels, fireplace surrounds, window and door trims, doors, wainscoting and baseboards have been painted white, except for the parlor, room 103, which has been painted a lime green (Figure 49, Photo 37). The wainscot for
Figure 48. (Photo 36) Room 102, an example of the painted white architectural elements of the house.

Figure 49. (Photo 37) In room 103, architectural elements are painted green.
rooms 103 and 102 featured an original tan paint color. Room 103 was later painted a light blue-gray before it became lime green. The ceiling is also painted white throughout the house; however, the walls in each room are given varying colors of peach, yellow or white.

The floor is currently stained an amber color in all of the rooms except for those at the back of the house, rooms 104 and 105 and those on the second, rooms 202 and 203; those have been painted a dark brown (Figure 50, Photo 38 and Figure 51, Photo 39). The interior of the house, however, remained unpainted until 1942. There is a “witness” panel that demonstrates what the house looked like before it was painted. (Figure 52, Photo 40). Also evident from the interior of the staircase closet, the floor was most possible once painted an ochre color (Figure 53, Photo 41).

First Floor

Room 101 (Central Hall)

Room 101 is the central hallway of the house; it measures approximately 31’ x 11’, including the staircase (Figure 54, Photo 42). The front portion of the central hall and both Rooms 102 and 103 have a ceiling height of 10’-6 ¾” while the rear end of hall, where the shed roof begins, has a height of 7’-0-½”. The door trims, like the doors themselves, are simple in design and execution. Both the staircase and door casing design are typical for modest houses built in the 1840s.

There are six doors in room 101: D1 is the front entry door, which leads out to the front porch, on the west wall (Figure 55, Photo 43); D2, the back door on the east wall, leads to the back porch and the handicap ramp (Figure 56, Photo 44); D6, to the left of the front entry door, leads to room 103 which is the formal parlor; D5 sits directly across from the third door and leads to room
Figure 54. (photo 42) Room 101, central hall.

Figure 55. (photo 43) Front entry doors on west wall, room 101

Figure 56. (photo 44) Back doors on east wall, room 101.
102, a bedroom; D7, to left of the back door leads to room 105; and D8 leads to a broom closet that resides under the staircase on the south wall.

D1 has a rim lock and a brown agate-ware knob, typical of the period of the Mable House's construction (Figure 57, Photo 45). However, the hinges of the double doors are modern — this is visible by examining the larger footprint left behind by the historic hinges. Other modern pieces added to the front entry doors are a security system on the left door, a door jam, and weather stripping. D8 is a four-paneled door has the same knob and lock system and is of mortise and tenon construction similar to D1, however, it has more unrefined finish on the inside of the door.

The central hall features heart pine wood tongue and groove ceiling, floor, and walls. The heart pine floorboards vary between 5 ¾” and 6” in width and run horizontally from the north wall to the south wall. Some quarter sawn wood floorboards are visible, which have possibly hand-headed nails. There is also evidence that some of the boards were replaced at one point in time. Where the floor and the wall intersect is an off-white, wide beaded baseboard that measures 10 ¼” in width and runs throughout the entire room except for the stair-
case which has shorter beaded baseboard of 6 3/8” that may have been a later addition (Figure 58, Photo 46).

The walls are painted white in the central hall; however, a paint analysis done behind a light switch revealed that the wallboards in the past were painted a yellow color (Figure 59, Photo 47). On the ceiling are three sprinklers from the house’s fire suppression system, a security system, two electric lights that are non-historic, and cloth wiring above the back entry doors. Ghost marks of the bathroom (installed in 1942 and removed later when the building was turned into a house museum) can be seen near the same back door. Marks from a 6” beam reveal that the bathroom wall was about 7’ wide and 5’ long and stopped at the beginning of the bedroom door on the north wall. The same 1986 National Register of Historic Places nomination photograph of the Mable House showed a single back entry door on the east wall.

**Room 102 (Bedroom)**

Room 102 is entered from the right of the front entry doors in the central hall (Room 101) and is approximately 19’ x 19’ (Figure 60, Photo 48). The heart pine tongue and groove flooring, ceiling, and wallboards are the same width as the central hall. D5, the four paneled mortise and tenon door that leads into the room, has a brass knob and rim lock. Residing on the south wall, is D3, another four-paneled door that leads outside; it has a modern doorknob with a deadbolt and alarm system sensor.

*Figure 60. (Photo 48) Room 102, bedroom.*
Instead of having beaded baseboards like those found in the central hall, this room has white painted, wood paneled wainscoting of a height of 31” with a 2’ trim. The ceiling was done in white as well; it has a modern brass light fixture that is not original to the building. The wallboards of this room have the same thickness as those in the central hall and were painted a peach color at a later date.

The room contains four windows: W1 and W2 can be found on the west wall and W13 is on the south wall near the fireplace. There is a fireplace situated between a window and the side entry door on the south wall. The chimney for this fireplace surround and mantel is completely open: there is no damper. Accompanying the fireplace is a stone hearth.

**Room 103 (Parlor)**

The room in the northwest corner of the Mable House, immediately to the left of the main entrance (D1) is currently interpreted as a parlor and includes a number of Mable family pieces including a an Empire style sofa. This room displays the similar wainscoting, flooring, walls and ceiling as other rooms in the Mable House.

Leading from the entrance hall into room 105 is a four-panel door (D6) with a fired clay doorknob (Figure 61, Photo 49). The flooring in room 103 consists of the same tongue and groove wood boards seen throughout the Mable House, with openings for the modern HVAC system.

The walls of room 103 are similar to the other interior walls in the first floor of the Mable House, with beige painted tongue and groove boards and a paneled wainscot along all walls. However the trim and wainscot in room 103 are painted green as a part of the room’s interpretation as a parlor, rather than white as seen in other rooms (Figure 62, Photo 50).
Figure 62. (Photo 50) Room 103, Parlor

Figure 63. (Photo 51) Looking south, from room 103 into rooms 101 and 102
Room 103 also features the same wood, tongue and groove, board ceiling seen throughout the Mable House.

Along the north wall of room 103, between two windows, is a fireplace consisting of white washed masonry firebox and pilaster surround similar to those seen in 105 and 102. The surround and mantel in the parlor are painted green to match the trim and wainscot. This room features four windows, which are visible on the west and north facades, W3 and W4. All four windows are dressed with lace, “glass” curtains as a part of the interpretation of the room (LB took photo—on camera”). All four windows are also surrounded by trim molding, and meet the wainscot on the lower edge.

Room 104 (Office)

This room can be entered through Room 102 and measures approximately 11’ x 19’ with a ceiling height of 8’-3-61/64” (Figure 64, Photo 52). The room is currently being interpreted as an office and a display area for miscellaneous educational and historical Mable House items. D4, the mortise and tenon door which leads into this room, is a raised four-paneled door instead of recessed like the others; it also has a rim lock with a brass knob. Unlike Room 102, the wallboards in Room 104 are painted yellow while the ceiling maintains the white color found throughout the house. The ceiling and walls show modern fixtures such as power outlets, a light switch and three brass ceiling lights.

Figure 64. (Photo 52) Room 104, office
The white paneled wainscoting exists on all the walls in the room except for the north and west walls that have a wide baseboard instead (Figure 65, Photo 53). There are three windows in Room 104: W12 resides on the south wall near the fireplace and W10 and W11 on the east wall. The fireplace has the same simple surround as Room 102; however, it has been sealed off and not investigated for this report. Accompanying the fireplace is a painted stone hearth.

**Room 105 (Bedroom)**

Room 105 of the Mable House is located in the northeast corner of the house, on the left side of the central hall (101) when entering from the front door (D1). The room is currently being interpreted as a bedroom. (Figure 66, Photo 54)

The flooring in room 105 consists of tongue and groove wood boards that are seen throughout the Mable House. The boards are currently painted brown, but there is evidence of ochre paint
where the top layers of paint were removed. It is unknown when the floor was painted this color. Several vents and an electrical outlet are visible.

The walls of room 105 are comprised of the painted tongue and groove boards seen throughout the house as well as paneled wainscoting. However, the paneled wainscoting is only seen on the west and north walls. The east and south walls feature similar baseboards as seen in the central hall. Although the interior is believed to be unpainted until 1930, the crown molding, wainscoting, baseboards, and all wall features are now painted in beige and white. In addition to modern light switch panels, the wall also has a motion detector mounted in the southeast corner as part of the Mable House's security system.

Like the other rooms of the Mable House, room 105 has a painted tongue and groove wood board ceiling.

Figure 67. (Photo 55) Room 105, pilaster mantle with sealed opening
Figure 68. (Photo 56) Room 105, East window

Figure 69. (Photo 57) Room 105, agateware doorknob
Figure 70. First Floor Floorplan
Room 105 features a similar pilaster mantel as seen in room 102. Rather than the open fireplace seen in room 103, the opening in room 105 is sealed off from the exterior with a board. (Figure 67, Photo 55)

Room 105 features three windows, one on the north wall, and two on the east wall. All window trim is painted white and the windows are dressed with sheer panel curtains (Figure 68, Photo 56).
Figure 72. (Photo 59) From room 201 looking west, up stairs to room 201

Figure 73. (Photo 60) Turned detail on newel post
The historic door (D7) between the entrance hall (101) and room 105 is secured with a metal rim lock and agatewear doorknob (Figure 69, Photo 57).

**Stairs**

The Mable House stairs are constructed out of wood with trim on the edges of the treads, including the outer string. They have 9 ½” rise over 11” run. The treads, risers, and rounded handrail are painted green-gray, while the balusters and newel post are painted white, as is the outer string to match the wall. Like the railing visible in room 201, the handrail is supported by squared balusters and turned newel posts.

**Second Floor**

**Room 201 (Upstairs Central Hall)**

The upstairs central hall is currently being used for storage and does not serve as a part of the house’s interpretation. Room 201 has brown stained tongue and groove flooring, walls, and ceiling consistent with those seen in the rest of the Mable House, and features no windows. This room also shows a section of unpainted wall space, where a large piece of built-in furniture likely once stood. This section of unpainted boards demonstrates what the walls looked like before the 1942 when they were first painted.

Room 201 includes three doors, leading to 202 and 203 as well as access to the attic space in room 204. Access to the attic, room 301, is provided through the ceiling of room 201. Seen at left when ascending the stairs, leading to room 202 is D11 (Figure 74, Photo 61). On the north wall of the hall, is the entry to room 203 (D10). For access to the room 204, there is a small door on the east wall of the hall (D12) consisting of a single panel. Like the other doors, this door also features trim molding on the top and sides (Figure 75, Photo 62)

There is railing in the southeast corner of the upstairs central hall to separate the second
East Facade

Thick moss grows where the foundation extends beyond the wood siding on the southeast corner. This small ledge is catching and holding moisture, thereby allowing the moss to continue to grow. The earth is damp all along the foundation behind the accessibility ramp (Figure 114, photo 97). The east façade normally receives a high amount of sun exposure, however, the accessibility ramp and vegetation prohibit sunlight from reaching the ground, foundation, and siding behind them. A shrub on the southeast corner of the house also prevents airflow between the ramp and the building (figure 115, Photo 98). The presence of mildew directly coincides with shadows cast by the ramp and does not extend above the ramp.

North of the back porch is a fenced area that houses two HVAC systems and the only operational water spigot on the house. Moisture is also a concern for this area due to an accumulation of leaves as well as shade from the fence. A terracotta drainage hole is immediately north of the porch; this may have been used in an earlier drainage system (Figure 166, Photo 99). The corresponding corner to the south of the porch was inspected as well, but no remnants of a similar system were found.

A six-inch hole is located at the base of the foundation on the northern corner, and cold air can be felt coming up from the basement (figure 117, photo 100).

The wood elements of the back porch are in poor condition. The base of the northern column is severely deteriorated, especially on the east and south sides of the column that are most exposed to the sun. (Figure 118, Photo 101). The southern column is similarly deteriorated, though not to the extent of the northern column. Algae is growing on the porch edge and wood stairs directly beneath the drip edge of the roof. The porch floorboards and cornice returns of the porch roof are slightly angled down and towards the house, leading water toward the house.

All four windows along the east façade have been replaced with modern windows. Historic wood surrounds are intact, but modern vinyl and wood frames have replaced historic
Figure 115. (Photo 98) Microclimate behind accessibility ramp and bush on southeast corner of structure; foundation extends past siding, creating an opportunity for water to enter the building

Figure 116. (Photo 99) Terracotta drainage hole on east facade

Figure 117. (Photo 100) Hole on northeast corner of east facade that opens to the basement
Figure 75. (Photo 62) Room 201, Southeast corner with door to 204

Figure 76. (Photo 63) Room 201, staircase along south wall showing simple square ballistrades and turned detail on newel post
Figure 77. (Photo 64) painted ceilings slope on the east and west sides, allowing for the pitch of the roof, but is flat in the center

tative height of 7'-8-13/32” then it angles out at 40 degrees for 4'-10 3/8” to a height of 4'-9 5/8” at the top of the partially revealed plate (Figure 78, Photo 65). D11, the entry door, has a rim lock with a black knob. There are four windows in the room: residing on either side of the fireplace on the north wall is W18 and W19, and on the east wall are W20 and W21 which are flush with the floor (Figure 79, Photo 66).

The wall under the plate is 4'-3 3/4” in height from the floor to the bottom of the plate. The ceiling has been painted white and contains four sprinklers in each corner and one brass light fixture, all of which are modern additions. The wall is painted yellow and also has a mod-
Figure 78. (Photo 65) Room 202, looking south

Figure 79. (Photo 66) W20 and W21 on east wall are set directly in contact with the floor
ern light switch. Like room 103, the fireplace has also been sealed off, and was not accessible for investigation. Accompanying the fireplace is a painted stone hearth.

**Room 203 (North Room)**

Located in the northwest corner of the second floor, room 203 is of similar design as 202 on the other side of the central hall. Like 202 and 201, this room is also currently being used as storage, rather than interpretation, and is not open to the public.

Like the other rooms in the Mable House, this room has tongue and groove flooring, walls, and ceiling. The entry into room 203 is a four-panel door with a glass doorknob (Figure 80, Photo 67) and metal rim lock, similar to the locks seen on the first floor.

On the west wall of room 203 are two fixed windows (W14 and W15), which are directly on the flooring, as seen in room 202. The two double hung windows on either side of the north wall (W16 and W17) are surrounded by white painted trim and are dressed with single curtain panels. (Figure 81, Photo 68). It is unknown when these modern windows were installed.

The fireplace of this room features a wood pilaster surround, stone hearth, and is closed to the exterior with a board (Figure 82, Photo 69).

The painted, board ceiling slopes on the east and west sides, while remaining flat in the center, as seen in room 201, the upstairs central hall. The ceiling shows two sprinklers and a modern light fixture.

*Figure 80. (Photo 67) Glass doorknob entering room 203 from 201*

*Figure 81. (Photo 68) The two double hung windows on either side of the north wall (W16 and W17) are surrounded by white painted trim and are dressed with single curtain panels*
Figure 82. (Photo 69) Room 203, currently being used as storage

Figure 83. (Photo 70) From room 203, looking south, into rooms 201 and 202
Room 204

Room 204, an unfinished attic space, is accessed through a small paneled door on the east wall of Room 201. This space sits above the shed-roofed portion of the house. The room provides an excellent opportunity to study the underlying structure of the building, which can provide corroborating evidence for its era of construction. Through the access door, one must step down, as the ceiling joists for the shed-roofed portion of the first floor are lower than the joists in the two-story portion of the house. (This corresponds to the dropped ceiling height in Room 101.)

The framing is exposed in Room 204, allowing for an understanding of how the building was put together. Large studs (4" x 6" and 7 ¾" x 9 ¾") support the floor and ceiling joists, which are joined with pegged mortise and tenon (Figure 84, Photo 71). These features are indicative of brace frame construction, a variation of traditional timber frame construction.73

Figure 84. (Photo 71) First floor ceiling joists visible from room 204, Large studs support the floor and ceiling joists, which are joined with pegged mortise and tenon
Figure 85. (Photo 72) Louvered vent and exposed weatherboard on the north gabled end house appears to be historic.

Figure 86. (Photo 73) Weatherboards on the south gabled end appear to be modern replacements.
Figure 87. Second Floor Floorplan
The first floor ceiling joists are exposed in Room 204. The wood joists (9 ½” x 2”) sit on the top plates of the first floor walls. The wood rafters (3 ¾” x 2”) form a 5:12 pitch. There are vertical braces of varying dimensions supporting the rafters. A louvered vent sits in the north gabled end of the house. The exposed siding on the north gabled end appears to be historic (Figure 85, Photo 72), while several weatherboards on the south gabled end appear to be modern replacements (Figure 86, Photo 73).

Loose fill fiberglass insulation has been added in the joist bays. A 100,000 BTU Carrier gas furnace sits on a plywood platform directly in front of the door. There is a pull-chain, single keyless fixture and an electrical service panel opposite the furnace. There are two roof penetrations for furnace ventilation.

**Room 301: Attic**

The attic space above the two-story portion of the house, room 301, is accessed through a scuttle hole in the ceiling of room 201. The attic runs the full length of the house. (See floor plan for 301) The weatherboard siding is visible at the north and south gabled ends. The height of the attic is 31”.

The roof system is easily accessed and visible in the space. Modern plywood is visible on top of wide planked-decking (7½” – 8½” width). The decking sits on historic rafters (3 ¾” x 2¾”). There is no ridge board at the peak of the rafters, nor is

Figure 88. (Photo 74) Looking south, Rafters in room 301; no ridge board or joinery at peak
Figure 89. Attic Floorplan
there any joinery or fasters where the rafters meet; they are mitered and simply rest upon each other (Figure 88, Photo 74). The main roof is a 7:12 pitch. There are two modern vents penetrating the east side of the roof.

Where the rafters meet the ceiling joists, a variety of joinery is evident. Some rafters rest upon the top of the joists, others have lap joints, while others are toenailed. The ceiling joists are 2" x 6". The ceiling boards are attached to the joists from below. Both the rafters and joists have reciprocating saw marks, indicative of early sawmills in the first half of the 19th century.

The attic space has 1"-1½" of blown-in fiberglass insulation in the joist bays. Aluminum sheathed electrical conduit runs throughout the attic, as does the sprinkler system.

**Systems**

The Mable House is wired for modern electricity in all areas, except for room 301. The

![Image of attic with insulation and electrical conduit](image-url)

*Figure 90. (Photo 75) Sprinkler system, modern electrical conduit, and fiberglass insulation visible in room 301.*

north-west

via overhead lines. All visible wiring in the attic and basement is aluminum-sheathed conduit. All rooms feature an overhead light and grounded outlets. There are two service panels — one in the attic and one in the basement.

A pressurized fire suppression sprinkler system runs throughout the building, connecting to the municipal water supply in the basement. From the basement the orange PVC piping runs through a chase built into the corner of room 103, in the joist bays between the
first and second floors, and in both attic spaces, 204 and 301 (Figure 89, Photo 75). Each room has multiple sprinkler heads installed through the ceiling, as does the basement. There are smoke alarms on both floors of the building — none of which were functioning. There is no plumbing for water or sewer on the interior of the house. Only one exterior spigot, on the east façade, is functioning.

There are HVAC systems for each floor of the house, including two furnace units: one in the attic space (room 204) and one in the basement. The attic furnace is a Carrier 100,000 BTU gas furnace (Figure 91, Photo 76). According to the serial number, this furnace was manufactured in September 1984. This unit serves the second floor, with a digital thermostat on the wall of room 201. Its coolant lines run to the basement via a chase in room 105. The basement furnace is a Rheem 100,000 BTU gas furnace, manufactured in July 2010. Its supplies heat to the first floor of the house, with a manual thermostat on the wall of room 101. The condensers for the air conditioning units sit outside on the east side of the building, to the north of the porch.

![Old furnace in room 204, servicing the second floor.](Photo 76)

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70 The foundation and chimneys are parged with a Portland cement based stucco.
58 According to Elizabeth Cromley, a professor of architectural history at Northeastern University and author of *The Food Axis: Cooking, Eating, and the Architecture of American Houses*, more than 400 books instructed 19th-century Americans on how to plan a functional house with outbuildings, larder and basement root cellar.
59 Lisa Holly Robbins, writing in *Smokehouses and Root Cellars: Vernacular Architecture in Appalachia*, notes, "These utilitarian structures were vital to the survival, success, and maintenance of a farm. These basic structures are found on nearly every farmstead, regardless of race or wealth of the landowner or renter."
60 Timber framing came to North America by way of Europe, where it had been in practice since medieval times. Timber frame buildings consist of large timbers, traditionally hand hewn and squared, that were held together with joinery rather than mechanical fasteners. The frame carries all of the weight of the structure. This method of framing requires a lot of raw material and highly skilled labor. It is also very labor intensive.

A transitional framing style developed in the Northeast (although it spread throughout the country) called braced framing. This evolution from timber framing included diagonal braces at corner posts and reduced dimensions for some of the framing members. The use of hand wrought nails is also common. The hand hewn sills and beams visible in the basement are indicative of these methods, as is the intricate joinery visible in the attic.

These methods were common during the middle of the 1800s, as modern framing techniques — which relied on mass produced standardized lumber and machine cut nails — were just coming into vogue in the Midwest.
PART FIVE:
CONDITONS ASSESSMENT

Exterior Conditions

Summary

The foundation is composed of a combination of historic and replacement brick that has been covered with cement stucco. The stucco is breaking away from the foundation in areas on all four sides of the building, leaving the brick foundation exposed. The foundation line is uneven with the exterior walls of the building. Areas on the east and west sides have pushed away from the structure, extending past the wood siding in some sections. There is a variation in footing of stucco where foundation meets the ground — in some sections the stucco stops at ground level; in others, the stucco creates an 'L' shaped lip extending just below the surface (Figure 92, Photo 77).

All eight ventilation grates are in working condition, but in some cases the protective screens behind the grates have been torn open. Shrubs and other vegetation are growing around the foundation, and in some areas are in physical contact. Pine straw used for landscaping is holding moisture against the foundation. There are cracks in the stucco on all four chimneys. The bricks at the tops of all the chimneys are clearly more modern; they can be distinguished from historic bricks by their difference in color and size. The newer bricks have been used to replace original bricks as deterioration has occurred over the years (Figure 93, Photo 78). The vertical corners of the chimneys are the most cracked, and the stucco can easily be broken off. Where the stucco has failed, bricks are left exposed (Figure 94, Photo 79). Lightning rod fasteners for
the cables that once ran down the chimneys can be seen along the length of all four chimneys (Figure 95, Photo 80). The tops of all four chimneys have been covered over with cement stucco. This could be trapping moisture within the chimney and the house.

Paint is uneven throughout the main house’s exterior, evident by many paint layers. The wood siding is soft around the foundation line along all four facades. There is alligatoring of the paint on all four facades but it is most apparent on the west façade (Figure 96, Photo 81). All windows on the first floor have been replaced with modern windows. The four windows on the second floor of the west façade are historic, though not original. It is possible that these windows are original to the house, however, they would not have been in their current location. Muntins on these second floor windows have been sloppily re-glazed on numerous occasions and show signs of weathering (Figure 97, Photo 82).
Facades

West Facade

Screening behind the ventilation grates on the south side of the west façade has detached (Figure 98, Photo 83). The spigot on the north side of the west facade is fully intact but non-operational. The water spigot located on the south corner of the west facade is extremely loose and is non-operational. (Figure 99, Photo 84).

The stucco along the porch has largely failed. The northwest corner of the front porch foundation is missing and the historic brick foundation shows through — no remaining mortar can be seen between bricks (Figure 100, Photo 85). More cracks are visible in the stucco on the south side of the porch. To the south of the front porch, the stucco on the foundation protrudes further than the siding. This is a spot where water running down the siding can enter the building (Figure 101, Photo 86). This area corresponds with bad peeling and deterioration in the southeast corner of room 102 (see page 100).

Weatherboards are severely deteriorated to the north of the front porch and the wood is saturated with water and shows signs of rot. Putty has been placed on top of the rotten wood in an attempt to cover the damage, but it does not address the cause of the damage: a shrub that grows too close to the house and rubs against the wood. The shrub had been pruned prior to the investigation, but vegetation growing too closely to the building is responsible for a shady microclimate between the bushes and the exterior walls of the building (Figure 102, Photo 87). As a result, mildew is growing on the weatherboarding between the foundation, just below the window line. Architect Tom Little commented that this severe deterioration could present a structural issue.
Figure 99. (Photo 84) Grounding wire attached to nonfunctioning spigot on west façade

Figure 100. (Photo 85) Lack of mortar and unattached wood on northwest porch corner

Figure 101. (Photo 86) West façade lip

Figure 102. (Photo 87) Vegetation too close to structure on west façade, north of the porch
There is an open hole in the weatherboarding south of the porch with a diameter of approximately one inch.

The front doors are historic and have modern metal protective strips at the bottom. The sidelights and transom window around the doors are historic. The muntins have been painted over many times. (Figure 103, Photo 88). The sidelights and transom are historic. Much of the glass in the sidelights is wavy, a characteristic of historic glass.

The porch floor is modern and composed of unpainted wood planks. Only the porch columns are known to be historic. Ghost marks in the west facade on either side of the front door show where rails once connected the original porch rail to the exterior wall (Figure 104, Photo 89).
Figure 105: West Façade Conditions Elevation

West Façade

1. Severe deterioration from vegetation rubbing against facade, and lack of gutters.
2. Small hole from deterioration of weatherboard.
3. Lip from foundation bulging past weatherboard, creating interior and exterior moisture damage.
4. Bare brick foundation exposed, no remaining mortar.
5. Lip from foundation bulging past weatherboard, allowing algae to grow
South Facade

The stucco on the western chimney is thickest at the base and becomes thinner moving up the chimney towards the stacks (Figure 106, photo 190). Individual bricks are visible through the eroded stucco where the chimneys extend above the roofline. A large crack in the lower half of the western chimney shows evidence of previous repairs. There is greater evidence of patching in the stucco along the edges where the western chimney connects to the building (Figure 107, Photo 91). Where patching has occurred, the stucco is much darker in color, indicating a difference in material. This difference will exacerbate the failing of the older cement stucco. The southwest chimney cover has a chipped corner, exposing the brick underneath. This reveal shows the stucco to be about an inch thick. The cement stucco was made with a thick aggregate; chunks of rocks can be seen (Figure 108, photo 92).

The eastern chimney is pulling away from the house. It appears that attempts were made to correct this by filling the space between the chimney and the wood siding with more stucco, or possibly cement of a similar color. The southeast chimney cricket is also deteriorating, and needs repair (Figure 109, Photo 93). The top six courses of brick are exposed at the top of the eastern chimney stack, and individual bricks can be distinguished because the mortar lines are visible (Figure 110, Photo 94).

Telephone system boxes are left open and exposed to the weather on the southwest corner of the structure. Exposed wires present a safety hazard (Figure 111, Photo 95).

Weatherboard has been replaced in the area between the chimneys and where the side door porch connects to the exterior wall. Newer weatherboards are smaller in size and, in some cases, unpainted. Several squirrel holes on the east side provide the rodents entry to room 204 (the attic). Wood is deteriorating in these areas. The corner posts show sun damage and have been gnawed by squirrels. The southeastern corner post shows inactive termite damage, which has been painted over. Algae is present on the top steps, as well as the porch floor from lack of a gutter system.

All windows are in good condition. The two upper windows are modern replacements and are in better condition than the bottom windows because drip caps have been added above the upper windows.

A dogwood tree is growing approximately three feet from the building at the southwest corner. This tree is creating a microclimate, creating excessive dampness due to a lack of sunlight, causing deterioration of the siding (Figure 112, Photo 96).
Figure 106. (Photo 90) Thinning stucco on chimneys

Figure 107. (Photo 91) Patched stucco on south west chimney

Figure 108. (Photo 92) Rocky cement stucco chimney cover
Figure 109. (Photo 93) Deteriorated southeast chimney cricket

Figure 110. (Photo 94) Exposed bricks on south eastern chimney

Figure 111. (Photo 95) Hazardous exposed wires on south facade

Figure 112. (Photo 96) Dogwood tree on southeast corner
South Facade

1. Open and exposed hazardous wiring.
2. Failing stucco.
3. Squirrel hole.
4. Failed chimney cricket.
5. Shrub preventing airflow behind accessibility ramp.
frames. The windows are in fair condition, and vinyl muntins have weathered well. Paint is peeling from the wood rails on all four windows and mildew is growing on the window frames on the two windows south of the porch (Figure 119, Photo 102). None of the windows fit their frame properly; all four have a gap approximately $\frac{1}{4}$" in the bottom right corners at the sills (Figure 120, Photo 103 & Figure 121, photo 104). Though small, these gaps could enable water to enter the building and should be monitored on all first floor windows.

Wood weatherboard appears newer as it is smoother on the east façade than other facades.

The double doors on the east façade are not historic and have no exterior hardware (Figure 122, Photo 105).
Figure 120. (Photo 103) None of the east facade windows fits the frame

Figure 121. (Photo 104) Close up of 1/2" gap between east facade window and frame

Figure 122. (Photo 105) East facade entrance
Figure 123: East Façade Conditions Elevation

East Facade

1. Microbial growth and deterioration of weatherboard behind accessibility ramp.
2. Windows sitting ajar in their frames, allowing moisture to collect and enter structure.
3. Lack of gutters, microbial growth along soffit.
4. Severely sun damaged and weathered column base.
5. Six inch hole that opens to basement, allowing water to drain into cellar.
The north side of the house is shaded by tall trees and receives limited sunlight. Mildew is growing along the corner of the west chimney where its east side meets the wood siding (Figure 124, Photo 106). Both northern chimneys display erosion, cracking and patching similar to the southern chimneys, but individual bricks are more visible here (Figure 125, photo 107). The northeast chimney cricket is deteriorating and needs repair (Figure 126, Photo 108). There is an open hole in the wall leading from the attic (room 301) to the exterior, behind the northwest chimney. Squirrels were seen entering and exiting the attic through this hole (Figure 127, Photo 109).

The entrance to the dugout basement is built into the foundation (Figure 128, Photo 110). The west corner of the basement entrance has little remaining stucco, which appears to have been about two inches thick (Figure 129, Photo 111). The east side of the basement entrance shows the stucco breaking away from the brick. The edge where the cellar opening meets the house is one of the only areas on the entire structure that has a gutter, but water is not directed away from the house (Figure 130, Photo 112).

Mildew is growing on lower weatherboards near the foundation line.

A camellia tree is growing approximately three feet from the building on the northwest corner (Figure 131, Photo 113). Built-up paint along the corner post suggests that a scupper may have been located here. Old electrical insulators and hooks for an electrical service entrance can be seen on the corner post as well.

The siding appears to be older on this façade,
Figure 127. (Photo 109) Squirrel hole on north facade

Figure 128. (Photo 110) North Façade Cellar Entrance

Figure 129. (Photo 111) Failed stucco along basement entrance

Figure 130. (Photo 112) Gutter system above cellar on north facade
and a historic attic ventilation grate is visible on the second floor (room 204). It has been painted over so thickly that paint covers the gaps between the wood slats, thus limiting it from acting as a vent (Figure 132, Photo 114). The windows are in similar condition to those on the other facades. The second floor win-

**Figure 131. (Photo 113) Camellia tree near northwest corner**

**Figure 132. (Photo 114) paint covered vent on north facade**
North Facade

1. Failing chimney cricket.
2. Failing chimney cricket.
3. Gutter above cellar draining water directly into corner, failing stucco.
4. Camellia tree growing too close to structure.
dows are modern replacements and have the same drip caps as the south facade.

Roof

The faux slate tile roofing is in excellent condition with two exceptions. First, some of the ridge tiles have been chewed on by squirrels (Figure 134, Photo 115). This is particularly true at the north end of the house. Second, the shed roof on the east (back) porch has the faux slate tile roofing. The thickness in material combined with the shallow-pitched shed roof does not shed rainwater adequately. The tiles

Figure 134. (Photo 115) Animal damage on ridge tiles

Figure 136. (Photo 117) Collection of debris on shed roof

Figure 135. (Photo 116) Algae growth under roofing tiles

Figure 137. (Photo 118) Mold and mildew build up on eastern porch roof
Lack of gutters has led to growth of mold and mildew along the beam, fascia and soffit of the back porch roof, as well (Figure 137, Photo 118). There are no gutters along the roofline.

## Interior Conditions

### Basement

The basement is not regularly shown to the public but is an important access point for monitoring conditions and maintaining systems of the Mable House. Treatments such as added support and a sump pump have been added to the building to ensure structural stability and to respond to moisture and flooding problems (Figure 138, Photo 119 and Figure 139, Photo 120). Such treatments, although modern, are in some cases critical to the safety of Mable House’s contemporary uses and to the structure’s longevity. Character-defining features such as hand-hewn wood beams, mortise and tenon joinery and historic bricks are, in many cases, in good condition and should be retained and protected. There is evidence of termites and powder post beetles, but these pests are currently inactive.

Most elements of deterioration in the basement are due to insufficient water and moisture management. Evidence of moisture damage is extensive: brick spalling and loss of mortar on the northwest chimney foundation; markings on the floor where water has risen; the presence of a modern sump pump (Figure 140, Photo 121 and Figure 141, Photo 122). The lack of appropriate roof and ground drainage plays a significant role in the moisture problems throughout the house.

The vents around the crawlspace appear to be in good condition but have been infilled with modern brick (Figure 140, Photo 123).
121). It is believed that if the majority of water were directed away from the basement (by establishing a positive grade at all foundations and by installing a gutter system to collect and direct water away from the building), water that did reach the basement would pose little threat to the historic assets found in the basement and to the stability of the entire house. Presently closed vents, on the other hand, trap moisture in the basement, as there is not adequate airflow. Furthermore, fiberglass insulation in the basement can hold excess moisture against the floor joists. Water trapped in the basement under these conditions can rise by capillary action, also known as rising damp, into the first floor of the
house, especially because a single piece of wood doubles as the ceiling of the basement and the flooring in the house (as opposed to being two separate elements.)

The furnace and ductwork are sitting on the bare ground. Unused items and discarded materials litter the space and may perpetuate soiling as the area becomes attractive to pests (Figure 143, Photo 124).

**Interior Conditions Summary**

Paint failure is prevalent throughout the house. As many as 14 paint layers have been detected; the most recent layer having been applied just prior to the first inspection visit. Paint specialist Jean Spencer suspects that paint failure can be attributed to a combination of dirt, mildew and soot that may have accumulated on the wood prior to painting, as well as the climate when the paint was first applied. The presence of these particulates or cold weather may have prevented the initial paint layers from adhering to the wood. For a more detailed explanation, as well as a discussion of other potential causes, Ms. Spencer's evaluation has been included in this document in Appendix E.

Moisture damage is also extant throughout the house. Further paint analysis may help determine the extent to which paint failure can be attributed to moisture or other potential causes. Flooring is in good condition. There are some cases of inactive termite damage. Scat was found in a few rooms indicating the presence of rats or mice.

*Figure 144. (Photo 125) Multiple paint layers around ventilation grate*

*Figure 145. (Photo 126) Darker paint color on accents than walls*
First Floor

101 (Display Area)

Different paint colors and layers, can be seen where the baseboard meets the floor on the south wall, as well as underneath lip of the ventilation grate where variations in floor stains are also evident (Figure 144, Photo 125). Many paint layers can be observed in this room. Paint on accents — baseboards, window framing and door framing — is slightly darker than color on the walls (Figure 145, Photo 126).

The left door has an alarm system monitor located on the top right corner, but it is turned off (Figure 146, Photo 127). Historic lock hardware is used on the exterior door (Figure 147, photo 128). Modern door hinges are used (Figure 148, Photo 129). A large display case that sits in front of the door significantly covers features of the historic door and likely detracts from the opportunity to feature the door as a unique historic asset.

101 (Dining Area)

The weather stripping under the right door has come off, and approximately 1/2" of space is left open beneath the door.

The area on the painted ceiling, where the shed roof slope changes and the stairs end, is stained and wood is damaged (Figure 149, Photo 129). Water overflow from the furnace in the attic above (room 204) has created this damage. Four covered holes exist in the ceiling.
Figure 149. (Photo 130) Staining and damaged ceiling boards in room 101 (dining area)

Figure 150. (Photo 131) Electrical Remnant in room 101 (dining area)

Figure 151. (Photo 132) Traces of previous framing for bathroom on ceiling in room 101

Figure 152. (Photo 133) Witness board in Room 101
indicating where earlier light fixtures were installed. There is electrical wiring remnant on the eastern wall, above the door (Figure 150, Photo 131). There are also traces of framing on ceiling, showing where the bathroom was added (and then later removed) in the 20th century (Figure 151, Photo 131).

A witness board has been left unpainted above the door to room 105, on the east side (Figure 152, Photo 132). Rectangular headed nails that are visible in witness board are cut nails (Figure 153, Photo 133). The witness board and rectangular headed nails are in fair condition and should be maintained as pieces of historic evidence.

**101 (Hall Closet)**

The threshold under the door and the floor inside of closet are of lighter color than the sur-
rounding floor; it is a remnant of the ochre paint that the entire hall floor was once covered with (Figure 154, Photo 135). An empty dirt dauber nest is located directly above the closet door opening on the interior. Cleaning supplies are kept in this closet (Figure 155, Photo 1136).

102 (Front Bedroom)

The most significant deterioration in this room can be found on the southwestern corner and likely coincides with moisture entering the building where the foundation protrudes past the weatherboard on the west facade. A secretary located against the interior west wall in the southwestern corner of the room has trapped airflow and moisture coming from the HVAC vent, located in the floor. Paint is peeling off in large layers and mold is present (Figure 156, Photo 137). The wall area located above the secretary shows bubbling paint, which will eventually peel. Inactive termite channels have been painted over on the left side of the southwestern windowsill.

Paint is peeling from the wood framing surrounding the fireplace. Dirt has fallen in through the chimney, and the bricks and mortar have eroded and deteriorated. Bricks inside the chimney are blackened and have physical irregularities from years of use (Figure 157, Photo 138). The outer facing sides of brick surrounding the fireplace opening seem to have been painted white at some point, but only traces of this paint remain (Figure 158, Photo 139). Looking up into the chimney, one can see wires and insulation (Figure 159, Photo 140). Framework around the mantel and window, along the southern wall, is moving as evidenced by severely cracked paint and a small gap next to the wall (Figure 160, Photo 141).
Figure 159. (Photo 140) Wires and insulation in fireplace of room 102

Figure 160. (Photo 141) Cracked paint behind fireplace in room 102

Figure 161. (Photo 142) Cracked paint behind fireplace in room 102
103 (Parlor)

Black mold is growing on the west wall at the corner of the northwest window molding (Figure 162, Photo 143). Inactive termite damage is located on the 3rd, 4th, and 5th floor-boards away from the western wall, with channels that run against the grain for a length of approximately 3'. A considerable amount of paint is peeling in this room and can be seen around windows and all walls, particularly the north wall. The peeling paint could be evidence of improper painting preparation and/or moisture damage.

The bricks on the floor, in front of the fireplace, have settled unevenly. A heavy amount of mortar has settled from the fireplace opening (Figure 163, Photo 144). Loose insulation can be seen along all three edges of the fireplace opening. Similar to the fireplace in room 102, traces of white paint on the outermost edges of bricks exist along the opening.

Figure 162. (Photo 143) Black mold on west wall, at the corner of the northwest window molding in room 103
Figure 163. (Photo 144) Settled mortar from chimney in room 103

Figure 164. (Photo 145) Scat on floor of chasing in room 103
All accents in this room — wainscot wood panels, window frames, baseboards and mantel — are painted light green. A protruding chase in the southeast corner of room 103 has a removable panel for access to the sprinkler system. Rodent activity is indicated by a large amount of scat on the floor (Figure 164, Photo 145). The baseboards at the corner covered by this construction are painted the same green, suggesting that the box construction was a later addition to the room, corresponding with the installation of the sprinkler system.

104 (Office)

This room is currently a repository for artifacts and documents. Whereas paint in other rooms had been scraped and reapplied, renovations were not done to this room and paint can be seen peeling away in large layers from the ceiling and walls. The peeling is so severe that all paint layers are coming off exposing the bare wood underneath (Figure 165, Photo 146). Where paint has not begun to peel from the ceiling, discoloration indicates moisture as the cause paint deterioration. One water stain runs beneath the light switch (Figure 166, Photo 147). The main frame for the alarm system is located on the western wall of the room behind the door (Figure 167, Photo 148). The fireplace has been enclosed with a metal sheet (Figure 168, Photo 149).
A “witness” board is exposed on the eastern wall, between the two windows.

105 (Back Bedroom)

The floor has been painted a brown color in this room. Old termite damage is visible on eastern wall (Figure 169, Photo 150). The fireplace opening has been covered with a painted, metal sheet from which paint is now peeling. A layer of blue paint can be seen under the top cream layer on the mantle and baseboards (Figure 170, Photo 151).

The middle of the southernmost wall has a protruding wood chase that runs the height of the wall (Figure 171, Photo 152). This covers piping that continues up to the crawl space in the attic (room 204). The ceiling, wall, and floor around this construction exhibit paint discoloration and softness in wood (Figure 172, Photo 153). This damage is most likely a continuation of the problem in room 101 B, from the overflow of the furnace.
Second Floor

201 (Second Floor Hallway)

The wood walls of this room, unpainted until the 1930s, are now painted white except for a section on the north wall that has been left unpainted for display purposes. The floors are unpainted. Paint on the west wall of the upstairs hallway is peeling, indicating moisture damage or improper paint preparation (Figure 173, Photo 154). Paint is also peeling on the south wall of the room over the stairs. In addition, water stains are present on the unpainted section of wood on the north wall of the room (Figure 174, Photo 155). The attic door (to room 204), located on the east wall adjacent to the stairs, has been chewed along the bottom of the door by an animal (Figure 175, Photo 156).

202 (South Room)

The south second floor room has also been painted off-white and the floor has been painted brown and the ceiling white. The fireplace opening has not been sealed, and the mantel has been painted white. Outward facing brick has been painted white. Four sprinkler heads hang from overhead. The two nine-light windows on the west wall and two six-over-six windows on the south wall appear to be in good condition with the exception of the lower right piece of glass in the northernmost window, which is cracked (Figure 176, Photo 157). Paint is peeling along the west wall, indicating possible moisture damage or improper painting preparation (Figure 177, Photo 158). Paint is also peeling above the fireplace on the south wall (Figure 178, Photo 159). It was difficult to view the east side of this room at the
times of investigation, as storage materials packed the room floor to ceiling. These items should cleared out in order to better assess the conditions of the room and particularly the extent of paint peeling.

Figure 176. (Photo 157) Cracked window glass, north window on west wall of room 202

Figure 177. (Photo 158) Peeling paint on west wall of room 202

Figure 178. (Photo 159) Paint peeling above fireplace on south wall of room 202

203 (North Room)

The north room of the second floor, historically unpainted, has been painted with the same color scheme as room 202 — off-white walls, a white painted ceiling, and brown painted floor. A fireplace centered on the north wall has been sealed and is also painted. A vent on the east wall has mold on it, but there does not appear to be mold on the walls near the vent (Figure 179, Photo 160). Paint is peeling significantly in this room, particularly along the west and north walls (Figure 180, Photo 161 and Figure 181, Photo 162). Water has also damaged the window muntins on the northernmost window of the west wall (Figure 182, Photo 163). Droppings in the southeast corner of the room indicate the presence of rodents. In the northeast quadrant of the room, a brown water stain on the ceiling corresponds with a brown water stain on the floor, indicating a small leak (Figure 183, Photo 164 and Figure 184, Photo 165).
Figure 178. (Photo 159) Mold on vent on East wall, near southeast corner of room 203.

Figure 179. (Photo 160) Peeling paint on north wall at northwest corner of room 203.

Figure 180. (Photo 161) Peeling paint on west wall at northwest corner of room 203.

Figure 181. (Photo 162) Water damage on window muntins, north window on west wall.

Figure 182. (Photo 163) & Figure 183. (Photo 164): Water stains in room 203, ceiling (left) and floor (right) respectively.
204 (Lower Attic)

The lower attic runs the length of the house on the second floor. It is accessible through a small wood door to the north to the stairs in room 201. This door to the attic has been chewed and scratched by an animal, and there are rodent droppings in several areas throughout room 204, including a noticeable concentration on the furnace (Figure 184, Photo 165). The north wall of the attic has evidence of water staining near the historic louvered vent (Figure 185, Photo 166). Both the vent and wood siding appear historic, if not original to the house, though these areas were difficult to access. Wood has been replaced on the south wall and appears modern. It is possible that the south wall may have also had a vent that, in conjunction with the vent on the north wall, would allow airflow through room 204. This investigation has not uncovered evidence to support this hypothesis but the absence of a second vent may be holding excess moisture in the building.

Some of the ductwork in the attic, to the right of the furnace, has been torn (Figure 184).
A metal pipe running up through the attic from room 105 and out through the roof has inadequate flashing on the exterior of the roof, allowing moisture into the attic. This could be responsible for water stains in room 105. The furnace has leaked onto the ceiling boards beneath it, causing water damage (Figure 187, Photo 168). Though there is no evidence that the sprinklers are leaking or are faulty, regular testing should be done to protect this area and the lower level from water damage.

Squirrel holes were discovered at both the north and south gable ends behind the chimneys (Figure 188, Photo 169 and Figure 189, Photo 170).
The attic is located above the entire second floor, with the exception of room 204. It can be accessed from room 201 by a ladder through a scuttle hole. A former door for the hatch in the attic shows animal chew marks along the outer edges (Figure 190, Photo 171). The attic otherwise appears to be in good condition. Wood rafters, joists and siding appear to be stable, with no evidence of water intrusion. There is an inadequate amount of loose cellulose insulation in this attic (Figure 191, Photo 172).

**Systems Conditions**

The air conditioning units located within the white fenced in area on the east facade are relatively new, but are located in a cluttered area. There are multiple garden hoses sprawled out on the ground surrounding the HVAC units instead of being stored properly (Figure 192, Photo 173 and Figure 193, Photo 174). Two condensation pipes exit the foundation into the fenced in HVAC area. One pipe, made of PVC, exits the foundation and immediately runs parallel to the foundation. There is a small microclimate of moss on the foundation where the PVC pipe releases condensation from the interior (Figure 194, Photo 175). A larger metal pipe exits a vent on the foundation and releases condensation into the bushes in front of the condenser units (Figure 195, Photo 176). Humidity related to the HVAC system is likely contributing to the peeling of paint on the interior of the house.

Electricity and water run to the external kitchen, as well as water spigots on either side of the west facade’s porch (Figure 196, Photo 177). These spigots are not functional. There is a telephone junction box located on the southwest corner of the struc-
ture that is exposed to the weather (Figure 197, Photo 178). Conduit on the exterior of the building carries electricity to the second floor. These pipes are intact. In the basement, old breaker switches from the basement electrical box are laying on the foundation of the basement. The furnace is located directly on the floor, and ductwork is laying directly on the foundation of the basement behind the furnace. The Rheem furnace in the basement is from 2010 and in good condition, however, raising the system off the ground and away from the water is a critical need (Figure 198, Photo 179). The 1984 Carrier furnace has caused leaks into room 101 and should be replacement.

There is a security system installed in the house that does not work. None of the extant smoke alarms functioned when tested. The fire suppression sprinkler system needs to be routinely checked to maintain and ensure functionality.
Treatment Philosophy

The Mable House is currently used as a house museum. At this time, it does not display a clear time period of interpretation. Therefore, the most appropriate treatment for the Mable House is rehabilitation for contemporary use as a house museum. According to the Secretary of the Interior's Standards for the Treatment of Historic Properties: “Rehabilitation emphasizes the retention and repair of historic materials, though some latitude is provided for replacement. Focus on the preservation of those materials, features, finishes, spaces, and spatial relationships that give a property its historic character,” (see Appendix H).

Treatment Recommendation

Site

1. Due to the historic nature of the hearthstone and its deteriorating condition, it is recommended that landscaping be installed around it to deter visitors from standing on it. Further interpretation outlining the log cabin footprint could be installed (e.g., plantings showing the outline of the cabin, signage).

2. Repair the historic bell located in the back yard. The bell could be used in interpretation of plantation life. A ringing bell typically meant signified the end of the day's work and also when food was ready.

3. Perform archaeology on the site to determine location of slave quarters, barn, and other outbuildings.

House

1. Installation of a gutter system. Drainage of water away from the building through gutters and round down spouts is of utmost importance. The style of gutter system most appropriate for the Mable House is half-round gutters and round downspouts. Selecting white as the color for both the gutter and downspouts is highly recommended, as it is less obtrusive. Moving water even further away from the house by using splash blocks and/or round extension leaders is also necessary. Splash blocks go directly under each downspout, and should direct water at least three feet away from the building. Again, selecting a color that will blend in with the surroundings is encouraged. If the grade around the foundation is not
steep enough, then a flexible downspout leader is recommended. Since there is no historic evidence of gutters on the house, making these additions as inconspicuous as possible is important. A minimalist approach should be taken for fastening the gutters, downspouts and leaders. Hidden brackets are recommended for the gutters and plain, flush-mount brackets for the downspouts. Determining the appropriate gutter and downspout sizes is a factor of the roof watershed and average rainfall density. Located in the appendices are directions on calculating the appropriate gutter and downspout size.

2. Check the grade surrounding the house, and fill in low spots. Try to obtain 6" of fall in the first 10' surrounding building foundation. Re-grade and install a positive subsurface collection system with gravel, or waterproof sheeting and perimeter drains.

3. Have an energy audit performed, (Southface [www.southface.org] is recommended). The audit will promote a sustainable preservation program for the house. After the audit, install insulation in both attics. It is best to limit insulation to attics and basements where it can be installed with minimal damage to the historic building. See tips for insulation in the appendix.

4. Furnace in attic, above room 101B should be replaced. The evaporation pan designed to collect water from condensation has previously filled and overflowed. This could mean the system was run for too long or is not working properly. This system is thirty years old and should be replaced as soon as possible.

5. Remove cement stucco covering chimney top openings, and install vented chimney caps to all chimneys. Vented, low-profile chimney caps should be selected. These are non-obtrusive. If this cannot be done, continue to properly maintain the current cement coverings. Clean out debris and dirt (mortar) that has fallen within the interior of the chimney. Install insulation under all flues that allows moisture to escape.

6. Control vapor diffusion of crawlspace moisture. Add polyethylene vapor barrier (heavy construction grade or Mylar) to exposed dirt in the entire crawlspace. Get the furnace and ductwork off of the bare ground. Remove extant floor insulation, as it is holding moisture against historic building materials. Check ductwork for leaks. Replace insulation if it is determined the basement can remain dry.

7. The shed roof on the east (back) porch has the faux slate shingle roofing. This type of roofing is too thick and textured for such a shallow-pitched roof. We were unable to measure the pitch of this porch roof, but it was very low-pitched, probably about 1/12 — much too low for a slate or shingle roof to shed rainwater adequately. It is strongly recommended that the current faux slate shingles be removed from this section of the roof. Asphalt roll roofing should be installed (over an underlayment of asphalt saturated felt) to ensure proper drainage of storm water off the roof.
8. The two major bulges on the west facade should be addressed as soon as possible. These areas are collecting water, and creating further damage to surrounding boards. The stucco needs to be removed, slowly chipping it away to see what is underneath. The weatherboard should extend past the foundation, thus preventing collection of water.

9. Check foundation grilles for adequate ventilation. Vents should be kept open to allow adequate airflow and control trapped moisture.

10. Install lightning rods. A properly installed and maintained lightning protection system, consisting of cables and cable fasteners, connectors, air terminals (the industry-preferred term for the rooftop rods), and at least two grounding rods sunk deep into the earth, can save a house. A lightning rod system does not repel nor attract lightning; it merely facilitates the travel of electricity to the earth providing a network of low-resistance paths for lightning current to follow. Have a UL-certified installer put the system in; then, a third party UL inspector will come to the site to make sure everything is to code, and issue a certificate stating the system’s compliance.

11. Trim shrubs and trees back along all four facades. The dogwood and camellia trees are of great concern as they continue to grow. A minimum of two to three feet should be kept between vegetation and the exterior of the house. Use of pine straw should also be kept at the same limitation.

12. Remove and reposition handicap rail to eliminate further damage to historic siding. The goal in selecting an appropriate solution is to provide a high level of accessibility without compromising significant features or the overall character of the property. Expanding the distance between the ramp and the building, or redesigning the ramp to a ‘z’ shape should be considered. A less extensive option would be to make the main entrance, on the south facade, accessible by ramp.

13. Decide when, and for how long to run HVAC systems. The need for modern mechanical systems is one of the most common reasons to undertake work on historic buildings. Temperature settings can lead to moisture issues. Humidity from HVAC (or lack of its use) contributes to the paint issues throughout the house. A climate control system with humidification and dehumidification capabilities could be installed to allow the furnace or air conditioner to run when the relative humidity is too low or too high. Moisture introduced into the building as part of a new system migrates into historic materials and causes deterioration. For more information see National Park Service (NPS) Brief 24 (URL? http://www.nps.gov/tps/how-to-preserve/briefs/24-heat-vent-cool.htm).

14. Move the secretary in room 102 away from a wall, and away from HVAC vents. This large piece of furniture combined with failing foundation and condensation from the vent has made this a problem area.
15. While removal of all paint in the house would be preferred, it is prohibitively expensive. 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. A professional paint analysis is recommended. As peeling persists, sand the area with the gentlest means possible. Once the surface is smooth and even again, another coat of paint may be applied. For more information see NPS Brief 28. (http://www.nps.gov/tps/how-to-preserve/briefs/28-painting-interiors.htm)

16. Never use the fireplaces. Exposed wiring is in the chimneys, and the tops are closed off.

17. Remove random debris and trash from cellar and consolidate materials throughout the entire house. Room 104 should not be used as a collection area for historic materials and documents. An archive could be created on the second floor if this space is not to be interpreted as an office. Although the upstairs is off limits to tours, the rooms should still be fully accessible for foot traffic.

18. Evidence of unwanted, after-hours visitors was found on the east facade. Empty beer cans and cigarette packages were hidden in the shrubs. For this reason, as well as for overall building safety, the alarm system should be re-engaged. The house is wired for it, and it should be utilized.

Interpretation Recommendation

Site: Landscape and Outbuildings

The treatment recommendation for the house and property is rehabilitation, which would entail preserving and improving the existing site and structure. The historic character of this property should be retained while making necessary repairs to the house and property. Different parts of the house and property are defined to different time periods and ways of life. Important themes and events are interpreted from the middle to late 1800s to the early to middle 1900s. The house and outbuildings should be interpreted to display and highlight the Mable family’s daily lives on the property, including how they earned a living. Other themes that are important to the property include farming, the gold rush, slavery, the railroad, and the development of the town of Mableton.

The Mable House site was once 460 acres, and today it is approximately 16 acres located in the unincorporated town of Mableton on Floyd Road historically known as land lot forty of the Seventeenth District of the 1832 land lottery. The house, smokehouse, kitchen, cemetery and well are original to the property. The property also consists of a historic sweet potato house and corn crib that were brought to the Mable property at different times, and blacksmith shop that was built on site reflect life in the late 1800s to early 1900s. The house and property are primarily used for school field trips, tours, and festivals. It is recommended that
the house and property display a clear and organized interpretation focusing on the Mable's lives on the property.

The smokehouse is original to the property, and was used to smoke and cure meat from hogs that were raised and butchered on the farm in the fall. The current interpretation for the smokehouse is a sign above the door (Figure 199, Photo 180). It is recommended that the sign be taken down and replaced with a waterproof interpretive panel near the entrance to the smokehouse. The panel should be low-key, not taking attention away from the building. The panel should also describe the smokehouse by giving the approximate dates of its construction and a brief description on the process of smoking meat.

The other buildings on the property do not have any information readily available for visitors. Weatherproof interpretive panels, including photographs and historic information can be displayed outside the buildings explaining where the building came from (if it is not original to the property) and what its purpose was. There is a brochure that is handed out for field trips (Figures 200 and 201). An updated brochure is recommended to supply information on all of the outbuildings as an alternative to the interpretive panels.

**Main House Interior**

Panels are mounted throughout the rooms with text and photographs, recounting the history of the Mable family and describing their daily lives and how they interacted in each room (Figure 202, Photo 101). These panels are intrusive, distract from the historic appearance of the house, and should be removed. The furniture that is original to the house, and that relates to the time period when the Mable family lived at the house should remain in order focus the interpretation. The rooms that seem unclear and disorganized should be arranged to re-
Reflect the function the room served.

The house is a plantation plain with six rooms, four downstairs, and two upstairs, and two central hallways. The house did not have electricity until 1942. Before that time light was furnished with candles and kerosene lamps, and heat was supplied from the fireplaces. The well was used for the farm, washing, and cooking, and was the Mable’s main source of water. Outhouses would have been used for bathrooms since indoor plumbing was not installed until the 20th century.

Room 101 A currently holds a Native American exhibit in display cases (Figure 203, photo 182). Room 101 B is the hallway interpreted as the Mable family’s dining room (Figure 204, photo 183), and slaves brought food through the back double doors from the kitchen house. The doors are modern. The previous door was a single door at the north edge of the east wall of room 101 B. The table, chairs, and sideboard are from the 1900s Figure 205, Photo (Photo 184) Interpretive table
The pie safe is a period piece of furniture, which was used to store food.

Room 102 is interpreted as the master bedroom, and there is a rope bed that is original to the house (Figure 206, Photo 185). There is a yarn winder, flax wheel, and a spinning wheel (Figure 207, Photo 208). Flax is used to make linen, and wool and cotton were spun on the wheel to make cloth for the farmers. Flax, wool, and cotton were grown on the farm. The quilt cabinet in the bedroom is an original piece of furniture built by Robert Mable and his son, Alexander, and was stained with ox blood (Figure 208, Photo 187).

Room 103 is being interpreted as the parlor. The parlor was used to entertain guests, and children were not allowed in this room (Figure 209, Photo 188). The furniture in this room is indicative of the 1800s and early 1900s.

Room 104 is presented as an office/museum, and there is no clear idea of what this room would have been. There are some family photos and informational plaques, the family Bible and books on the bookshelf. The
Current Uses by Visitors

The Mable House and site are shown on tours and during school field trips. Barbara Hollis and Mary Hill from The Friends of the Mable House explained that field trips are limited to districts closer to the historic house, and typically take place during the fall months. In the past, field trips happened frequently, however they are more sporadic now. A brochure is handed out for elementary school field trips, which gives a brief history of the house, information on who coordinates
The field trip activities, and lists topics that will be covered during the trip (refer to figure 200 on page 117).

The field trips are a full day experience and are heavily based on storytelling. Groups are split up and stories about Native Americans including the history of the land, the Underground Railroad, and the history of toys and games are told. The history of the actual house with descriptions about the use of the rooms and furniture are explained. Stories about the Mables are told to the children including how hogs were killed and smoked in the smokehouse.

Few tours of the Mable House are conducted currently. However, there is a Farmer’s Market that takes place in the parking lot of the Mable House, and the house is open during these times. The Friends of The Mable House have noticed that the market brings more visitors.

Festivals also bring attention to the historic site and are very popular. The Mable House and site are popular during the storytelling festival — a free festival that draws people from diverse populations and different communities. Members of the Mable family have also been known to attend the festivals throughout the years.

In the summer, the Arts Center hosts historic workshops and Heritage Summer Camps. The camps focus on 19th century living, Native Americans, games and arts and crafts. The camps are nonprofit and fundraisers are conducted to offset their costs. Repairs of the house and site come out of this fund. It is recommended that funding options from Cobb County be explored. The Friends of the Mable House expressed the need for a docent at the house more often, and explained that they are in need of volunteers. The Friends expressed the need of having someone not connected with the Arts Center to maintain the house and organize more tours.

Themes for Interpretation

There are themes that interpret important aspects of the Mable’s lives. These themes describe how they earned a living. Focusing on these themes will give an interpretation of what the Mable family did on the land and what they profited from.

The gold rush is an important theme relating to the time the Mable’s occupied the
house. The first gold was found in a creek on the Mable property.\textsuperscript{77} Gold was mined on the Mable plantation, and this continued until the 20th century. This attracted people who passed through Mableton, and they paid a small stipend to dig and pan for gold. This could be marked on a map showing where the gold was being mined, and this topic can be used for an interactive children's activity teaching how pan for gold. There is a gold table that is used for festivals demonstrating how to pan for gold.

Themes that relate to Mableton as a whole include the schoolhouse that was on the property. The schoolhouse was originally a log cabin where the family lived before the house was built. There is hearthstone still standing where the cabin would of been (See Appendix C: Geometric Magnetometer Survey). The schoolhouse on the Mable property was named “The Mable School” after Robert and his daughters who taught at the school. The school was later converted into a post office. Since the schoolhouse/post office is no longer on the property its approximate location can also be marked on a map for visitors, and more information can be read in the brochure that contains the map.

Robert Mable was a prominent leader in the community and he contributed to early industrialization and commercialization of Cobb County by giving a right of way for the laying of the rail line through his property. Mable listed himself as millwright, and not a farmer. Mable's saw mill was located across Floyd Road for the house. Mable's granddaughter Edith Mable Cole, called her grandfather “thrifty, and he accumulated a good sum of wealth”.\textsuperscript{78} He was known to make money off of everything, and his other enterprises on the plantation were the sorghum production, the sawmill and grist mill.

There was not enough gold found to make a living off of it. The Mable family's primary source of income was running the farm. The farm contributed greatly to Mableton as a whole providing livestock, cotton and crops. Crops that were grown on the farm include cotton, potatoes, corn, sorghum, beans, and pears. Butter was made in churns, and fruit and vegetables were canned and dried. Edith Cole Mable recalls cows in the pasture during her interview. Meat was smoked or cured with salt in the smokehouse. Potatoes and onions would be stored in either the sweet potato house or root cellar.

The sweet potato house on the property is not original to the house, but the Mables most likely had one to store their sweet potatoes. According to the 1850-1860 agricultural census, Robert Mable grew 60-100 bushels of sweet potatoes a year, and sweet potatoes were the largest crop. In 1925, the land was rented out to tenant farmers. Tenant farming began in the early 20th century and farmers grew cotton, corn and potatoes. The well provided water for the farm as well as for washing, drinking and cooking. The Friends of the Mable House have expressed interest in restoring the well back to its original form, a bucket well, and plexiglass can cover the well to protect it.
There is a garden on the property and fruit and vegetables that were grown on the farm can be grown seasonally to show what would be growing on the farm and when. This will attract garden and nature enthusiasts, can be related to the Farmers Market that operates during June to September and can be incorporated into activities for children during field trips. Eventually, more land can be used to establish a small-scale working farm simulating the crops grown by the Mable family.

Establishing these themes to become a part of the tour will allow the interpretation of the landscape, buildings and house to clearly lead visitors around the property with a brochure and map as well as a docent to follow along with these themes and add supplementing stories. The map will show each building and site with a number corresponding to a number inside the brochure giving more information through text and pictures supplementing the interpretive panels along the tour.

Outdoor tours have the option of being self-guided with a brochure that should clearly guide visitors around the property with supplementing information. Tours inside the house will continue to be docent-led. These tours will follow the same guide the brochure should illustrate.

School field trips will follow the same tour along with interactive activities to further the learning and understand the Mable’s and their lives on the property. Questions, activities, and interactive learning experiences can be offered.

- Supplementing questions can be asked along the tour such as “The Mables did not have electricity, how do you think they could see when it was dark at night?” and examples of candles and kerosene lamps could be offered to see.

- With the garden operational, children would be able to see what would be typical to be grown on the farm, and if sweet potatoes or root vegetables were being grown they could help bring them to the sweet potato house to store them. Other activities that could include the farm include churning butter.

- On field trips children can be asked how they eat at home, and how food is stored. These experiences can be compared to how the Mable family had a kitchen outside the home, along with the farm, and smoke house. The children can be led on experience around the property as if they were going to prepare dinner, and partake in all the steps that had to be done. Children will understand that the Mable family could not go down the street to the store, and that everything was made on the property.

- Teaching with Historic Places on the National Park Services website: http://www.nps.gov/nr/twhp/descrip.htm, offers activities and lesson plans that could be implemented during this experience.

75 Wade, Eleanor, Ed. *Historic Mable House Docent Handbook*, Unpublished

76 Dreger, Rick; Lorenc, Julia; Shares, Ashley, Interview with Mary Hill and Barbara Hollis from the Friends of the Mable House, November 8, 2014.


78 Wade, Christopher A, “Interview with Edith Emelene Mable Cole.” *Cobb County Oral History Series*, 1984
Proper maintenance is the key to preserving historic buildings. The Secretary's Standards for the Treatment of Historic Properties (see Appendix D) should always be followed when maintaining and treating historic building materials to ensure authenticity and the best possible results. Some maintenance may need prioritization while routine maintenance should be carried out on a cyclical basis, such as termite inspection, landscaping and removing debris from gutters.

Cyclical

Roofing and Gutters

As one of the most important components in preventing decay, roofing must be inspected at least biannually, in the spring and early fall, for signs of leaking, wear, and missing or corroded elements. Missing, worn or corroded elements should be replaced in-kind. Because the Mable House is not used as a residence, it is important to be mindful to inspect the roofing and gutters during and after a heavy rain as well as after any severe storms with winds over 40 miles per hour.

Gutters and downspouts, once installed, must be inspected in the spring, fall and winter and kept clear of debris. All downspouts should include a “foot” and splash block to properly direct rainwater away from the foundation of the house. Remember to check the attic for leaks as well. A new roof should last 15-20 years. New roofing is recommended for the east porch roof.

Masonry

Masonry must be regularly checked for deterioration including damaged mortar joints, cracks, and moisture damage such as spalling. Care must be taken to clean masonry using the gentlest means possible, usually low pressure (garden hose) or medium pressure water. Using a non-ionic detergent such as Igepal by GAF, Tergitol by Union Carbide, or Triton by Rohm & Haas can help remove oily materials without leaving a residue as a household soap would. A non-metal bristle brush may also be used for stubborn dirt and debris.

For more information, please refer to NPR Preservation Briefs 1 (http://www.nps.gov/tps/how-to-preserve/briefs/1-cleaning-water-repellent.htm) and 2 (http://www.nps.gov/tps/125)
Structural elements including the foundation, which is historic brick masonry, should be inspected annually for signs of decay, damage or stress. Replacements, if required, should be made with in-kind materials.

**Exterior Cladding**

Inspect exterior cladding for signs of wear, missing parts, and damage caused by moisture, abrasion, weather conditions, animals, or UV rays. Changes in exterior paint may be an indication of neglect or excess moisture. If damage cannot be repaired, boards must be replaced in-kind.

**Paint and other Coatings**

Painted surfaces must be inspected for chipping, alligatoring or peeling. Damage to paint and other coatings may lessen their protective qualities, but may also be a symptom of other problems such as moisture or ultraviolet damage. Repaint with an appropriate color when needed. Paint should last 10-15 years.

**Windows and Doors**

Windows should be inspected twice a year, in the spring and fall, and kept watertight through re-caulking or weather stripping to ensure energy efficiency, as well as to prevent moisture damage, which is the primary cause of deterioration in windows. All windows should be inspected for changes in paint such as peeling and flaking on the interior and exterior. Also check the wood window surrounds for raised grain and make ensure the glazing putty is successfully preventing moisture from condensing on wood. All sills should allow rainwater to run off with no pooling and water should not collect in the muntins or corner joints. All windows should be able to close and lock. Loose or damaged frames or window hardware must be repaired if at all possible or replaced in-kind as a last resort.

For more information, please read NPS Brief 9 (http://www.nps.gov/tps/how-to-preserve/briefs/9-wooden-windows.htm)

Likewise, exterior doors should be made weather tight to prevent excess moisture from entering the house and to promote energy efficiency.

**Landscaping**

Landscaping must be kept two to three feet away from structures and trimmed seasonally. Inspect seasonally for climbing vines as well as overgrown trees and shrubbery. Remove and prune as necessary, as vegetation creates a moist microclimate and may also directly damage materials through abrasion or growth into weak mortar joints.
Pests

The site must remain free of pests, such as mice and squirrels, which may cause damage to historic materials and accelerate deterioration. Annually inspect the Mable House and surrounding property for signs of vermin.

Termite inspection must be carried out annually and if possible, followed by treatment to prevent the deterioration of historic materials as well as structural elements.

HVAC

A new HVAC system is recommended for the Mable House and should be set to run in a manner that allows for proper air exchange. Close grilles seasonally, when appropriate in winter if not needed, or in summer if hot humid air is diffusing into air-conditioned spaces.

Security Systems

Security is important to the preservation of historic structures by preventing theft and vandalism. The security system should be made functional and checked regularly, and the batteries replaced annually.

Fire Prevention

The smoke detector batteries must be changed annually. Sprinklers should also be tested annually.

Moisture Control

Gutters are recommended to ease moisture problems as well as a new HVAC system. Conduct routine maintenance checks on the sump pump, including a battery checkup twice a year if moisture problem in basement remains unresolved. Check basement and crawl space every 4 months, or after a major storm.

Before temperatures fall below freezing, all exterior water valves should be turned off and drained to prevent broken pipes.

Maintenance Checklist

As needed

- Cut grass frequently, especially in the spring and summer.

Seasonally

- Check the basement and crawl space for damage and excess moisture. Also check during and after a heavy rainstorm.
- Trim shrubbery and tree limbs away from the house and smokehouse and remove
other vegetation such as vines three feet away from the structure.
- Replace the HVAC air filter every 90 days.

Biannually

- Inspect the roof for loose or missing shingles, nails, flashing, and other components. Replace in-kind and repair as needed.
- Check sump-pump and check battery.
- Inspect exterior cladding, windows, and doors.

Annually

- Replace smoke detector batteries and test the sprinkler system.
- Replace batteries and test the security system.
- Hire a professional for termite inspection and possible treatment.
- Observe the gutters (recommended as part of treatment) during a rainstorm. Water should flow without obstruction and water should be directed away from the foundation.
- Inspect the interior of the house during and immediately after a rainstorm for signs of leaks.

Long term

- Repaint as needed or every 10-15 years.
- A new roof will be needed every 15-20 years.

Clean and repoint masonry as needed.
APPENDIX A:
Plans with Photograph Locations

Site Map
Basement Floorplan
First Floor Floorplan
Second Floor Floorplan
APPENDIX B:
The Mable Cemetery Description and Recommendations

The Mable Family Cemetery is located east of the main house. It measures roughly 81’ by 45’. It is bordered by a wood picket fence with two locked gates that was installed in 1981. All burials face the east. A large magnolia tree, estimated to be between 100 and 130 years old stands in the southwest corner just inside the gate. One section, which contains twenty-three graves, is paved and covered with pea gravel (photo 1). Twenty-two of the graves are marked. The unpaved section contains nine slave burials. Only three of the burials are known: Celia, Thack, and Suck. Fifteen other names are listed on a plaque (photo 2) as possibly being buried there. There are eighteen dark-colored fieldstones of various sizes marking the gravesites. (photo 3)

The family section contains forty features of marble, granite, and limestone including headstones, footstones, and fragmented markers. (photo 4) Two of these fragmented markers in the westernmost row belong to Robert Mable Jr. and Clifford Lowe. Their entire headstones are missing. The markers are limestone, granite, or marble. The family section is in excellent condition, especially given the age of some of the markers. The earliest burial occurred in 1851 (photo 5) and the last in 1958 (photo 6). Only two markers are significantly out of plumb (photos 7-8). Only one existing marker has significant damage (photos 9-10). Two features are metal Confederate States of America (CSA) crosses dedicated to Alexander and Joel Mable. (photo 11) Originally, they were painted. The paint has deteriorated and exposed the metal to the elements and resulted in some rusting. It is advised that the rust is removed with a small wire-bristle brush and the features repainted with a compatible paint. One of the CSA markers is located on the footstone of Robert Mable Jr., who died in 1857. Joel Mable, who served in the Civil War on the side of the Confederacy, is not buried in the family cemetery.

There are two issues that require attention in the family section: the cement paving and the magnolia tree. Paving cemeteries is a very rare occurrence and is a modern practice. The Mable family cemetery was paved between 1986 and 1991. The cement is beginning to spall due to moisture accumulation in the shade of the magnolia (photo 12) and is being pushed up from below by the root system (photos 13-14). Despite the fact that it is a modern addition and has moisture damage, the cement has been valuable to the integrity of the cemetery. It has prevented leaning and sinking into the ground that is common with most stones over time. Additionally, the cement also acts as a moisture barrier preventing rising damp. These pros and cons can be discussed with the Mable family, and the trustees who will have ultimate jurisdiction over what changes are made to the cemetery.
Magnolia trees have root systems that can extend as far as their branches do. In this case, the roots extend beneath many of the southwestern graves. Whether the cement is removed or not, it is recommended that an arborist assess the possibility of severing one-third of the tree's root system in order to prevent further damage. Although the graves have not yet been affected on the surface, it is certain that they are present throughout the soil of the nutrient-rich grave shafts. It is only a matter of time before the roots will compromise the markers themselves. If the roots are cleanly cut with a very sharp power saw, no long-term harm will come to the tree which, due to its age, is an important part of the interpretation of the site. Trees are a traditional feature in most rural Southern family cemeteries.

The field stones in the African-American section of the cemetery are all quite weathered and sunken into the ground (photo 15). It is recommended that the ones that have sunk to the point of near-disappearance be extracted and replanted so they are visible to visitors.

**Ongoing maintenance**

- It is important to keep the ground clear of magnolia debris. This debris leads to harmful moisture accumulation around the bases of monuments.

- To clean the headstones, a soft-bristle brush and one ounce of non-ionic detergent diluted in a gallon of water may be used. Do not clean the stones during the winter however because the freeze thaw cycle can trap moisture in minute cracks and slowly break apart the stone.

- Cutting the grass in a cemetery should be done very carefully to ensure the stones aren’t damaged. At times it may be advantageous to trim grass by hand with a pair of garden shears very near the stones.

- If any of the stones have minor chipping, a consolidant can be applied that will prevent moisture damage to the exposed cut in the stone.

- Joints between the base and die (bottom and top pieces) can be sealed and pointed with a historic mortar to prevent moisture penetration.
Photo 1: View of the paved family cemetery
The oldest head stone: Pheriby Lane, d. 1851

Photo 2- Monument to the Mable Family's slaves

Photo 3- Fieldstone in the slave section of the cemetery

Photo 4- Example of a broken stone feature

Photo 5- The oldest head stone: Pheriby Lane, d. 1851
Photo 6- The more recent stone: Margaret Mable, d. 1958

Photo 7- Headstone of Pheriby Mable Lowe, which is significantly out of plumb.

Photo 8- Headstone of Harry LeRoy Blair, which is significantly out of plumb.
Photos 9, 10- Deterioration and damage to the headstone of Mary Mitchell

Photo 11- C.S.A. marker on Robert Mable Jr.'s footstone (incorrectly placed)

Photo 12- Spalling cement under the shade of the magnolia tree.
Photo 13, 14- Tree roots causing the cement to be raised up

Photo 15- Fieldstone in the slave section that has significantly sunk into the earth
Magnetometer Survey

In an effort to locate a more precise location of the Mable log cabin, a geophysical survey was performed on November 11, 2014. Geophysical methods are used to discover subsurface anomalies without performing ground disturbing archaeological methods. Using a Geometrics G-858 MagMapper, a magnetometer survey was performed in the area surrounding the hearthstone located near the southwest corner of the main house. Magnetometry is used to identify magnetic variability in the soil. According to the information that the log cabin burned prior to 1900, there should have been a stronger magnetic signal in the region of the burned floor of the cabin.

A grid was laid out encompassing areas on both sides of the hearthstone. Measuring twenty meters north to south and eight meters east to west, the grid included the hearthstone and two similarly sized areas of land on either side of the hearthstone. Transects were measured in half meter intervals in order to acquire accurate data regarding subsurface soil variability within the grid. In the following figure, the bottom left corner of the map correlates with the southeast corner of the 20 x 8 meter grid. There is a large area of interference in the middle of the grid, possibly associated with a utility line, which covers the exact area where the hearthstone is located. To the left of this region, which corresponds with the southern portion of the grid, there is a darkened region that likely represents the burned footprint of the former cabin. The footprint covers about a 5 square meter surface area, which is consistent with the historic estimate that the cabin was likely 16' x 16'. The results of the survey indicate that the cabin was most likely to the south of the existing hearthstone.
# APPENDIX D:

## Architectural Schedules

### Door Schedule

<table>
<thead>
<tr>
<th>Door No.</th>
<th>Location</th>
<th>Style</th>
<th>Type of Panels</th>
<th>Type of Knobs</th>
<th>Finish</th>
<th>Lock</th>
<th>Historic</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-1</td>
<td>Front Door</td>
<td>4-panel</td>
<td>4</td>
<td>Exterior (recessed)</td>
<td>Pine</td>
<td>Rim</td>
<td>None</td>
<td>Non-Modern</td>
</tr>
<tr>
<td>D-2</td>
<td>Back Door</td>
<td>4-panel</td>
<td>4</td>
<td>Exterior (raised)</td>
<td>Pine</td>
<td>Rim</td>
<td>None</td>
<td>Modern Metal</td>
</tr>
<tr>
<td>D-3</td>
<td>Side Door to outside in Bedroom (102)</td>
<td>4-panel</td>
<td>4</td>
<td>Exterior (recessed)</td>
<td>Pine</td>
<td>Rim</td>
<td>None</td>
<td>Modern Metal</td>
</tr>
<tr>
<td>D-4</td>
<td>Bedroom (102) to Office (104)</td>
<td>4-panel</td>
<td>4</td>
<td>Exterior (recessed)</td>
<td>Pine</td>
<td>Rim</td>
<td>None</td>
<td>Modern Metal</td>
</tr>
<tr>
<td>D-5</td>
<td>Hall (101) to Bedroom (102)</td>
<td>4-panel</td>
<td>4</td>
<td>Exterior (recessed)</td>
<td>Pine</td>
<td>Rim</td>
<td>None</td>
<td>Modern Metal</td>
</tr>
<tr>
<td>D-6</td>
<td>Hall (101) to Parlor (103)</td>
<td>4-panel</td>
<td>4</td>
<td>Exterior (recessed)</td>
<td>Pine</td>
<td>Rim</td>
<td>None</td>
<td>Modern Metal</td>
</tr>
<tr>
<td>D-7</td>
<td>Hall (101) to Bedroom (105)</td>
<td>4-panel</td>
<td>4</td>
<td>Exterior (recessed)</td>
<td>Pine</td>
<td>Rim</td>
<td>None</td>
<td>Modern Metal</td>
</tr>
<tr>
<td>D-8</td>
<td>Closet under stairs</td>
<td>4-panel</td>
<td>4</td>
<td>Exterior (recessed)</td>
<td>Pine</td>
<td>Rim</td>
<td>None</td>
<td>Modern Metal</td>
</tr>
</tbody>
</table>

### Second Floor

<table>
<thead>
<tr>
<th>Door No.</th>
<th>Location</th>
<th>Style</th>
<th>Type of Panels</th>
<th>Type of Knobs</th>
<th>Finish</th>
<th>Lock</th>
<th>Historic</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-10</td>
<td>Hall (201) to Storage (203)</td>
<td>4-panel</td>
<td>4</td>
<td>Exterior (recessed)</td>
<td>Pine</td>
<td>Rim</td>
<td>None</td>
<td>Modern Metal</td>
</tr>
<tr>
<td>D-11</td>
<td>Hall (201) to Storage (202)</td>
<td>4-panel</td>
<td>4</td>
<td>Exterior (recessed)</td>
<td>Pine</td>
<td>Rim</td>
<td>None</td>
<td>Modern Metal</td>
</tr>
<tr>
<td>D-12</td>
<td>Hall (201) to Attic (204)</td>
<td>4-panel</td>
<td>4</td>
<td>Exterior (recessed)</td>
<td>Pine</td>
<td>Rim</td>
<td>None</td>
<td>Modern Metal</td>
</tr>
</tbody>
</table>
Front door (D-1) interior agateware knob, 1840s

Office (104) (D-4) 4 panel: Exterior (recessed)

Office (104) (D-4) interior brass knob

Office (104) (D-4) 4-panel: Interior (raised)

Storage (203) (D-10) glass knob

Storage (202) (D-11) black "porcelain" knob
Molding Profiles

Room 102

M.1. Profile of fireplace decorative column and pilaster
M.2. Wainscot molding along all four walls. (Wainscotting is also present in rooms 103, 104 and 105).
M.3. Decorative molding along doors. (This is an example for all rooms).
M.4. Decorative molding along windows (This is an example for all rooms).
M.5. Profile of fireplace molding

M.6. Profile of fireplace molding
Room 105

M.7. Fireplace Molding

Rooms 202 and 203

M.8. Fireplace Molding (Fireplaces are the same in both upstairs rooms)
Molding Key

Depth in Inches

Room 102 Fireplace Molding
Depth: top 2 1/2
Bottom: 2 3/4

Room 103 Fireplace Molding
Depth: top: 2 1/4
Bottom: 2 3/4

Room 104 Fireplace Molding
Depth: top: 1
Bottom: 1 1/4

Room 105 Fireplace Molding
Depth: top: 1
Bottom: 1 1/4
Rooms 202, 203 Fireplace Molding
(both fireplaces are the same)
Depth: top: 1 1/2

Wainscot
Depth: 1 1/2
Door Molding
Depth: ½ in.

Window Molding
Depth: ½ in.
APPENDIX E:
Historic Photographs

Mable Family ca. late nineteenth-early twentieth century
(The South Cobb Development Authority, Mable Property Rural Preservation Plan: Utilization and Implementation: Jaeger/Rayburn Inc. 1989.)

Photo of Curry, a slave born on the Mable Plantation in 1845—date unknown
(Mable House Collection)
Ruth Mable's Estate, 1942. She was the last of Robert Mable's children to reside in the home. (Keaton, Rebecca. "Ruth Mable's Estate." Cobb County's Land Records System. Web. 6 Nov. 2014. http://www.cobbsuperiorcourtclerk.com:8888/LRSSearch/#/MainMenu)
Mable House, 1969
(Cobb County Times or Marietta Daily Journal. September 13, 1969. (author unknown)).

Central Hall looking East, showing bathroom
(National Register of Historic Places, Robert Mable House and Cemetery, Mableton, Georgia, National Register # 87001345. Photographer: James R. Lockhart)

Historic hearthstone in single piece ca. 1986
(Photo taken by the Covered Bridge Garden Club)
Main House-West Façade, August 1986
(National Register of Historic Places, Robert Mable House and Cemetery, Mableton, Georgia, National Register # 87001345. Photographer: James R. Lockhart)

Main House East Façade, August 1986
(National Register of Historic Places, Robert Mable House and Cemetery, Mableton, Georgia, National Register # 87001345. Photographer: James R. Lockhart)
Main House and Well, 1989
(The South Cobb Development Authority, Mable Property Rural Preservation Plan: Utilization and Implementation: Jaeger/Rayburn Inc. 1989.)

Sweet Potato House to be moved to Mable Property, 1989
(The South Cobb Development Authority, Mable Property Rural Preservation Plan: Utilization and Implementation: Jaeger/Rayburn Inc. 1989.)
The proposed domestic yard location of the Mable Living History Farm (1989)

The proposed agricultural yard location of the Mable Living History Farm (1989)

Photos of the Mable Property, 1989 (The South Cobb Development Authority, Mable (Property Rural Preservation Plan: Utilization and Implementation: Jaeger/Rayburn Inc. 1989.)
APPENDIX F:
Preliminary Paint Analyses

Preliminary Finishes Analysis

November 19, 2014
By
Maryellen Higginbotham
Preservation/Design Consultant

Introduction

This preliminary paint analysis of the 1843 Robert Mable House in Mableton, Georgia, was conducted in conjunction with the 2014 Conservation of Historic Building Material Class from Georgia State University.

Of special interest concerning paint history of the Mable House is a black and white photograph of Mable Family members sitting on the front porch and a letter mentioning painting of the interior.

Fig. 1 Mable House Archives

Scope of Work

Exterior and interior spaces of the house were examined during two Saturday field experiences. Cratering, a paint analysis technique, was conducted on the north side of an original porch column. Exterior paint samples were taken for microscopic analysis from exterior architectural elements visible in the Mable Family photograph and from interior walls, doors, and mantles.

Fig. 2 Mable House Archives
Findings

Exterior

Exterior architectural elements shown in the Mable Family photograph appear to be polychromed in the manner fashionable in the 1890s to early 1900s. Clothing worn by the family in the photograph also suggests the fashion of the 1890s to early 1900s.

Condition of exterior wood substrate and microscopic view of dirt before paint suggest a period of time between construction and painting. Paint analysis indicated that the exterior has at least fourteen layers some of which are primer coatings. The first color scheme is light tan on siding and medium tan on trim.

<table>
<thead>
<tr>
<th>SIDING</th>
<th>PORCH CEILING</th>
<th>PORCH COLUMN MIDDLE</th>
<th>PORCH COLUMN TRIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dirt</td>
<td>Dirt</td>
<td>Dirt</td>
<td>Dirt</td>
</tr>
<tr>
<td>Light tan</td>
<td>Light tan</td>
<td>Light tan dirt</td>
<td>Tan</td>
</tr>
<tr>
<td>Light grey</td>
<td>Light grey</td>
<td>Medium grey</td>
<td>Creamy white</td>
</tr>
<tr>
<td></td>
<td>Light blue</td>
<td>Medium grey</td>
<td>Light grey</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dark grey</td>
</tr>
</tbody>
</table>
Robert Mable’s last surviving daughter, Ruth Mable, lived in the Mable house all her life and taught school in Mableton during the early 20th century. In the 1940’s Lucy Mable Ruff, granddaughter of Robert and niece of Ruth, moved into the house and made several changes. She was the first in 100 years to have the house painted." [Mable House Archives, 6/22/99 letter from Rosemary Woodward, direct descendant of Robert Mable). 

Interior paint analysis focused on room 101 [Hall], room 102 [Bedroom], and room 103 [Parlor]. Microscopic analysis revealed that doors in these rooms were grained and/or varnished before the first paint colors were placed on the walls. Mantles in room 102 and room 103 were painted black and grained or varnished doors before the walls were painted. In the 19th century, mantles were sometimes painted black to cover smoke discoloration when walls were left unpainted. The mantel in room 102 has some replacement of architectural elements. 

The first color paint in all three rooms was a thick tan color on walls and trim. The tan color appeared to be darker on the walls than on the trim. No distinct dirt layer was seen before the second paint color suggesting that the tan paint was a primer or that the second paint color was applied a short time later.

### ROOM 101a [HALL]

<table>
<thead>
<tr>
<th>WALL</th>
<th>FRONT DOOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Med tan</td>
<td>Grained &amp; varnished</td>
</tr>
<tr>
<td>Gold</td>
<td>Grained &amp; varnished</td>
</tr>
<tr>
<td>Off white/Yellow</td>
<td>Cream</td>
</tr>
</tbody>
</table>

### ROOM 102 [BEDROOM]

<table>
<thead>
<tr>
<th>WALL</th>
<th>WAINSCOT</th>
<th>MANTLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light tan</td>
<td>Tan</td>
<td>Black/grained</td>
</tr>
<tr>
<td>Yellow</td>
<td></td>
<td>Tan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cream</td>
</tr>
</tbody>
</table>

### ROOM 102 [BEDROOM]

<table>
<thead>
<tr>
<th>WALL</th>
<th>WAINSCOT</th>
<th>MANTLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tan</td>
<td>Tan</td>
<td>Black/grained/Varnished</td>
</tr>
<tr>
<td>Cream</td>
<td>Light blue-gray</td>
<td>Cream/light blue gray</td>
</tr>
<tr>
<td>Cream</td>
<td>Light green</td>
<td>Light Green</td>
</tr>
</tbody>
</table>
Several samples were taken in first floor rooms 104 [Museum Room] and room 105 [Bedroom]. Doors were initially grained and mantles were painted black then grained or varnished. The first paint color in both rooms was tan.
Several samples were also taken in second floor rooms. Doors and mantels were not painted black or varnished. These rooms did not appear to have been painted at the same time the first floor room were painted. The first paint color in all rooms was a light cream.

Comments

1. 1890 to early 1900 exterior paint schemes

“Selecting appropriate colors for the age and style of the house was as vexing a problem in the nineteenth century as it is today. Harrison Bros. & Co. attempted to assist its customers with the services of cards published in Philadelphia and Chicago, c.1890...House E uses three shades of Slate on the body, rim, and gables, and one on the shutters...The Athenaeum of Philadelphia Collection.”


Fig. 4 Harrison Bros. & Co. paint company paint card above illustrates the use of multiple color paint schemes in the 1890s. Illustration E shows a gray color scheme similar to the gray colors found on the exterior of the Mable House.
2. 1930s into the 1940s paint schemes

Colonial Williamsburg Foundation restoration paint studies showing the use of both light and dark paint colors inside and outside colonial houses in Williamsburg influenced American exterior and interior paint schemes from the late 1920s into the 1940s and beyond. John Masury Paint Company of New York produced the first Colonial Williamsburg approved paint chart.

![Fig.5 John Masury Paint Company Chart 1937 in Paint in America.](image)

3. A paint conservator could be engaged for a more detailed analysis and paint color matching.
Due to the extensive peeling of paint inside the Mable House, a cursory inspection was made to determine the cause. The interior of Mable House was unpainted until the 1930s. Since then there have been numerous coats applied, the latest just a few weeks prior to the visit.

There are many reasons why paint does not adhere to its intended surface and peels off. The most common are:

1. Incompatible paint layers
2. Moisture on surface before or after paint applied
3. Temperature when applied
4. Dirt/mildew/soot on surface

1. Incompatible paint layers

This usually means latex paint applied over oil paint. In historic houses, this is nearly a universal problem, since old houses tend to start out with oil (often lead) paint.

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.

Interior painting is also more likely to be done by nonprofessional painters who are unaware of this problem and proper preparation. The Mable House history of rentals, volunteers, and county maintenance has no doubt contributed to poor preparation of surfaces for painting. Evidence of insufficient scraping, roller marks, and lack of backbrushing testifies to unprofessional painting practices.
2. Moisture

Moisture in the wood will not allow the paint to penetrate the wood and adhere. Also, applying paint in very humid conditions (above 70% humidity) is not recommended. After the paint dries, the introduction of excessive moisture will cause the wood to swell and separate from the paint. This is clearly happening in the south parlor where moisture has caused extensive damage to a window and surrounding wall.

3. Temperature when applied

Painting done when it is too cold (usually below 55 degrees Fahrenheit, but it depends on the manufacturer’s specifications) can retard paint adhesion, which makes it more likely to peel from other causes in the future.

4. Dirt/mildew/soot

Anything on the surface of the wood that gets between the wood and the paint will keep the paint from adhering to the wood. Since this house was unpainted for close to a hundred years, it is possible that a considerable film of dirt, mildew, fireplace soot, tobacco smoke, cooking fumes, etc., may have coated the surfaces before it was painted for the first time. If the surface was not first cleaned and primed, any paint would have a hard time adhering to it.

Summary

It is likely that a combination of the above factors is involved. The widespread nature of the peeling leads me to suspect that number 4 (and perhaps 3) may be major causes. It would be interesting to find out what time of year it was painted and by whom. Successive layers of incompatible paints and changes in temperature and humidity have also contributed to peeling. Until the surfaces are properly prepared by scraping, sanding, and priming, this condition will continue. Paint analysis would provide a more accurate diagnosis of the issues involved with the interior paint conditions of Mable House. The presence of lead paint must be evaluated as well and mitigated, especially if chips are falling in areas open to the public.

At the very least, the following Preservation Briefs should be consulted before any further actions are taken on the interior finishes of Mable House.

http://www.nps.gov/tps/how-to-preserve/briefs/10-paint-problems.htm

APPENDIX G:
How to Apply Latex Over Oil-Based Paint

Step 1: Test the Paint
Before painting an old door, it's important to determine if the original paint is oil-based or latex; latex paint will not adhere to oil-based paint unless certain preparatory work is done. Soak a clean rag in denatured alcohol and rub the surface of the door. If the paint starts to soften, it is latex. If it doesn't, the paint is oil-based. This door is oil-based.

Step 2: Sand the Door
To apply latex over oil-based paint, clean the door thoroughly. Use 150-grit sandpaper to sand all the rough spots (Image 1). Follow with 220-grit sandpaper to sand the door nice and smooth (Image 2). Clean all the dust off door.
Step 3: Prime and Paint
Prime the door with a good acrylic-based bonding primer. Paint with latex paint.

Taken from "How to Apply Latex over Oil-Based Paint."

http://www.diynetwork.com/how-to/how-to-apply-latex-over-oil-based-paint/index.html
APPENDIX H:

Secretary of the Interior’s Standards for Rehabilitation

The Standards apply to historic buildings of all periods, styles, types, materials, and sizes. They apply to both the exterior and the interior of historic buildings. The Standards also encompass related landscape features and the building’s site and environment as well as attached, adjacent, or related new construction.

1. A property shall be used for its historic purpose or be placed in a new use that requires minimal change to the defining characteristics of the building and its site and environment.

2. The historic character of a property shall be retained and preserved. The removal of historic materials or alteration of features and spaces that characterize a property shall be avoided.

3. Each property shall be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or architectural elements from other buildings, shall not be undertaken.

4. Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved.

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

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

7. Chemical or physical treatments, such as sandblasting, that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the gentlest means possible.

8. Significant archeological resources affected by a project shall be protected and preserved. If such resources must be disturbed, mitigation measures shall be undertaken.
9. New additions, exterior alterations, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.

10. New additions and adjacent or related new construction shall 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.
APPENDIX I:

Glossary

**Agateware:** Pottery decorated with a combination of contrasting colored clays

![Agateware Image](image1.png)

**Alligatoring:** A pattern of cracking of paint on a surface leaving roughly hexagonal areas of un-cracked paint

![Alligatoring Image](image2.png)

**Baluster:** One of a series of short, vertical, often vase-shaped members used to support a stair or porch handrail, forming a balustrade (see photo for balustrade)

![Baluster Image](image3.png)

**Balustrade:** An entire rail system with top rail and balusters.

![Balustrade Image](image4.png)
**Cricket:** A ridge structure designed to divert water on a roof around the high side of a chimney or the transition from one roof area to another

![Diagram of Cricket](image)

**Elevation:** Any one of the external faces or facades of a building

**Facade:** One exterior side of a building

**Fascia:** A frieze or band running horizontally and situated vertically under a roof edge, or which forms the outer surface of a cornice, visible to an observer. Typically consisting of a wooden board or sheet metal

![Diagram with labels Bargeboard, Downpipe, Gutter, Fascia, Soffit](image)

**Flashing:** Thin metal sheets used to prevent moisture infiltration at joints of roof planes and between the roof and vertical surfaces.

![Flashing images](image)
**Hand-hewn:** Cut or shaped with hard blows of a heavy cutting instrument like an ax or chisel

![Image of hand-hewn beam with an ax being used to cut it](image)

**I-House:** A one-room-deep house with a distinctive tall, narrow profile; floor plans include central hallway, hall-parlor, double-pen, and saddlebag; often with rear shed or porch

![Image of I-House](image)

**Lintel:** A piece of wood or stone that lies across the top of a door or window and holds the weight of the structure above it

**Microclimate:** Climatic condition in a relatively small area, within a few feet above and below the Earth's surface and within canopies of vegetation. Microclimates are affected by such factors as temperature, humidity, wind and turbulence, dew, frost, heat balance, evaporation, the nature of the soil and vegetation, the local topography, latitude, elevation, and season. Weather and climate are sometimes influenced by microclimatic conditions, especially by variations in surface characteristics
**Mortise:** A cavity cut into a timber to receive a tenon

![Mortise Diagram](image)

**Parged Brick:** Brick covered in a thin layer of plaster to give it a smooth finish

![Parged Brick Image](image)

**Pier:** An upright support for a structure or superstructure

![Pier Image](image)
Plantation Plain: A version of the I-House but with an integral one-story rear shed, containing two or three rooms, and usually a full-width front porch; built exclusively in rural areas (See photo for I-House)

Portland cement: A strong, inflexible hydraulic cement used to bind mortar. Mortar or patching materials with a high Portland cement content should not be used on pre-1920 buildings. The Portland cement is harder than the masonry, thereby causing serious damage over annual freeze-thaw cycles.)

Rim lock: A face mounted door lock that modified an Egyptian pin-tumbler lock and utilizes a revolving cylinder

Sash: The framework in which panes of glass are set in a window

Sill: The shelf at the bottom of a window frame. 2. A strong horizontal member at the base of any structure
**Soffit:** The underside of a part or member of a building (see picture for fascia)

**Spalling:** The flaking off of a brick or stone surface. This is evident when the face of the masonry is missing

**Subfloor:** A rough floor laid as a base for a finished floor

**Tenon:** A projection on the end of a timber for insertion into a mortise (see picture for ‘mortise’)

**Transom:** A horizontal opening (or bar) over a door or window
**Vernacular**: A regional form or adaptation of an architectural style

**Wainscoting**: Vertically mounted tongue and groove boards or raised paneling mounted on the lower portion of a wall to protect plaster

**Witness**: Evidence of the presence of earlier construction, i.e. paint outline, nail holes, etc.

**Wythe**: A single thickness of brick or other masonry unit
APPENDIX J:
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Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings

Robert C. Mack, AIA
Anne Grimmer

Inappropriate cleaning and coating treatments are a major cause of damage to historic masonry buildings. While either or both treatments may be appropriate in some cases, they can be very destructive to historic masonry if they are not selected carefully. Historic masonry, as considered here, includes stone, brick, architectural terra cotta, cast stone, concrete and concrete block. It is frequently cleaned because cleaning is equated with improvement. Cleaning may sometimes be followed by the application of a water-repellent coating. However, unless these procedures are carried out under the guidance and supervision of an architectural conservator, they may result in irrevocable damage to the historic resource.

The purpose of this Brief is to provide information on the variety of cleaning methods and materials that are available for use on the exterior of historic masonry buildings, and to provide guidance in selecting the most appropriate method or combination of methods. The difference between water-repellent coatings and waterproof coatings is explained, and the purpose of each, the suitability of their application to historic masonry buildings, and the possible consequences of their inappropriate use are discussed.

The Brief is intended to help develop sensitivity to the qualities of historic masonry that makes it so special, and to assist historic building owners and property managers in working cooperatively with architects, architectural conservators and contractors (Fig. 1). Although specifically intended for historic buildings, the information is applicable to all masonry buildings. This publication updates and expands Preservation Brief 1: The Cleaning and Waterproof Coating of Masonry Buildings. The Brief is not meant to be a cleaning manual or a guide for preparing specifications. Rather, it provides general information to raise awareness of the many factors involved in selecting cleaning and water-repellent treatments for historic masonry buildings.

Figure 1. Low-to medium-pressure steam (hot-pressurized water washing), is being used to clean the exterior of the U.S. Tariff Commission Building, the first marble building constructed in Washington, D.C., in 1839. This method was selected by an architectural conservator as the “gentlest means possible” to clean the marble. Steam can soften heavy soiling deposits such as those on the cornice and column capitals, and facilitate easy removal. Note how these deposits have been removed from the right side of the cornice which has already been cleaned.
Preparing for a Cleaning Project

Reasons for cleaning. First, it is important to determine whether it is appropriate to clean the masonry. The objective of cleaning a historic masonry building must be considered carefully before arriving at a decision to clean. There are several major reasons for cleaning a historic masonry building: improve the appearance of the building by removing unattractive dirt or soiling materials, or non-historic paint from the masonry; retard deterioration by removing soiling materials that may be damaging the masonry; or provide a clean surface to accurately match repointing mortars or patching compounds, or to conduct a condition survey of the masonry.

Identify what is to be removed. The general nature and source of dirt or soiling material on a building must be identified to remove it in the gentlest means possible — that is, in the most effective, yet least harmful, manner. Soot and smoke, for example, require a different cleaning agent to remove than oil stains or metallic stains. Other common cleaning problems include biological growth such as mold or mildew, and organic matter such as the tendrils left on masonry after removal of ivy (Fig. 2).

Consider the historic appearance of the building. If the proposed cleaning is to remove paint, it is important in each case to learn whether or not unpainted masonry is historically appropriate. And, it is necessary to consider why the building was painted (Fig. 3). Was it to cover bad repointing or unmatched repairs? Was the building painted to protect soft brick or to conceal deteriorating stone? Or, was painted masonry simply a fashionable treatment in a particular historic period? Many buildings were painted at the time of construction or shortly thereafter; retention of the paint, therefore, may be more appropriate historically than removing it. And, if the building appears to have been painted for a long time, it is also important to think about whether the paint is part of the character of the historic building and if it has acquired significance over time.

Consider the practicalities of cleaning or paint removal. Some gypsum or sulfate crusts may have become integral with the stone and, if cleaning could result in removing some of the stone surface, it may be preferable not to clean. Even where unpainted masonry is appropriate, the retention of the paint may be more practical than removal in terms of long-range preservation of the masonry. In some cases, however, removal of the paint may be desirable. For example, the old paint layers may have built up to such an extent that removal is necessary to ensure a sound surface to which the new paint will adhere.

Study the masonry. Although not always necessary, in some instances it can be beneficial to have the coating or paint type, color, and layering on the masonry researched before attempting its removal. Analysis of the nature of the soiling or of the paint to be removed from the masonry, as well as guidance on the appropriate cleaning method, may be provided by professional consultants, including architectural conservators, conservation scientists and preservation architects. The State Historic Preservation Office (SHPO), local historic district commissions, architectural review boards and preservation-oriented websites may also be able to supply useful information on masonry cleaning techniques.
Understanding the Building Materials

The construction of the building must be considered when developing a cleaning program because inappropriate cleaning can have a deleterious effect on the masonry as well as on other building materials. The masonry material or materials must be correctly identified. It is sometimes difficult to distinguish one type of stone from another; for example, certain sandstones can be easily confused with limestones. Or, what appears to be natural stone may not be stone at all, but cast stone or concrete. Historically, cast stone and architectural terra cotta were frequently used in combination with natural stone, especially for trim elements or on upper stories of a building where, from a distance, these substitute materials looked like real stone (Fig. 4). Other features on historic buildings that appear to be stone, such as decorative cornices, entablatures and window hoods, may not even be masonry, but metal.

Identify prior treatments. Previous treatments of the building and its surroundings should be researched and building maintenance records should be obtained, if available. Sometimes if streaked or spotty areas do not seem to get cleaner following an initial cleaning, closer inspection and analysis may be warranted. The discoloration may turn out not to be dirt but the remnant of a water-repellent coating applied long ago which has darkened the surface of the masonry over time (Fig. 5). Successful removal may require testing several cleaning agents to find something that will dissolve and remove the coating. Complete removal may not always be possible. Repairs may have been stained to match a dirty building, and cleaning may make these differences apparent. De-icing salts used near the building that have dissolved can

migrate into the masonry. Cleaning may draw the salts to the surface, where they will appear as efflorescence (a powdery, white substance), which may require a second treatment to be removed. Allowances for dealing with such unknown factors, any of which can be a potential problem, should be included when investigating cleaning methods and materials. Just as more than one kind of masonry on a historic building may necessitate multiple cleaning approaches, unknown conditions that are encountered may also require additional cleaning treatments.

Choose the appropriate cleaner. The importance of testing cleaning methods and materials cannot be over emphasized. Applying the wrong cleaning agents to historic masonry can have disastrous results. Acidic cleaners can be extremely damaging to acid-sensitive stones, such as marble and limestone, resulting in etching and dissolution of these stones. Other kinds of masonry can also be damaged by incompatible cleaning agents, or even by cleaning agents that are usually compatible. There are also numerous kinds of sandstone, each with a considerably different geological composition. While an acid-based cleaner may be safely used on some sandstones, others are acid-sensitive and can be severely etched or dissolved by an acid cleaner. Some sandstones contain water-soluble minerals and can be eroded by water cleaning. And, even if the stone type is correctly identified, stones, as well as some bricks, may contain unexpected impurities, such as iron particles, that may react negatively with a particular cleaning agent and result in staining. Thorough understanding of the physical and chemical properties of the masonry will help avoid the inadvertent selection of damaging cleaning agents.
Figure 6. Timed water soaking can be very effective for cleaning limestone and marble as shown here at the Marble Collegiate Church in New York City. In this case, a twelve-hour soak using a multi-nozzle manifold was followed by a final water rinse. Photo: Diane S. Kaese, Wiss, Janney, Elstner Associates, Inc., N.Y., N.Y.

Other building materials also may be affected by the cleaning process. Some chemicals, for example, may have a corrosive effect on paint or glass. The portions of building elements most vulnerable to deterioration may not be visible, such as embedded ends of iron window bars. Other totally unseen items, such as iron cramps or ties which hold the masonry to the structural frame, also may be subject to corrosion from the use of chemicals or even from plain water. The only way to prevent problems in these cases is to study the building construction in detail and evaluate proposed cleaning methods with this information in mind. However, due to the very likely possibility of encountering unknown factors, any cleaning project involving historic masonry should be viewed as unique to that particular building.

Cleaning Methods and Materials

Masonry cleaning methods generally are divided into three major groups: water, chemical, and abrasive. Water methods soften the dirt or soiling material and rinse the deposits from the masonry surface. Chemical cleaners react with dirt, soiling material or paint to effect their removal, after which the cleaning effluent is rinsed off the masonry surface with water. Abrasive methods include blasting with grit, and the use of grinders and sanding discs, all of which mechanically remove the dirt, soiling material or paint (and, usually, some of the masonry surface). Abrasive cleaning is also often followed with a water rinse. Laser cleaning, although not discussed here in detail, is another technique that is used sometimes by conservators to clean small areas of historic masonry. It can be quite effective for cleaning limited areas, but it is expensive and generally not practical for most historic masonry cleaning projects.

Although it may seem contrary to common sense, masonry cleaning projects should be carried out starting at the bottom and proceeding to the top of the building always keeping all surfaces wet below the area being cleaned. The rationale for this approach is based on the principle that dirty water or cleaning effluent dripping from cleaning in progress above will leave streaks on a dirty surface but will not streak a clean surface as long as it is kept wet and rinsed frequently.

Water Cleaning

Water cleaning methods are generally the gentlest means possible, and they can be used safely to remove dirt from all types of historic masonry.* There are essentially four kinds of water-based methods: soaking; pressure water washing; water washing supplemented with non-ionic detergent; and steam, or hot-pressurized water cleaning. Once water cleaning has been completed, it is often necessary to follow up with a water rinse to wash off the loosened soiling material from the masonry.

Soaking. Prolonged spraying or misting with water is particularly effective for cleaning limestone and marble. It is also a good method for removing heavy accumulations of soot, sulfate crusts or gypsum crusts that tend to form in protected areas of a building not regularly washed by rain. Water is distributed to lengths of punctured hose or pipe with non-ferrous fittings hung from moveable scaffolding or a swing stage that continuously mists the surface of the masonry with a very fine spray (Fig. 6). A timed on-off spray is another approach to using this cleaning technique. After one area has been cleaned, the apparatus is moved on to another. Soaking is often used in combination with water washing and is also followed by a final water rinse. Soaking is a very slow method—it may take several days or a week—but it is a very gentle method to use on historic masonry.

Water Washing. Washing with low-pressure or medium-pressure water is probably one of the most commonly used methods for removing dirt or other pollutant soiling from historic masonry buildings (Fig. 7). Starting with a very low pressure (100 psi or below), even using a garden hose, and progressing as needed to slightly higher pressure—generally no higher than 300-400 psi—is always the recommended way to begin. Scrubbing with natural bristle or synthetic bristle brushes—never metal which can abrade the surface and leave metal particles that can stain the masonry—can help in cleaning areas of the masonry that are especially dirty.

Water Washing with Detergents. Non-ionic detergents—which are not the same as soaps—are synthetic organic compounds that are especially effective in removing oily soil. (Examples of some of the numerous proprietary non-ionic detergents include Igepal by GAF, Tergitol by Union Carbide and Triton by Rohm & Haas.) Thus, the addition of a non-ionic detergent, or surfactant, to a low- or medium-pressure water wash can be a useful aid in the cleaning

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*Water cleaning methods may not be appropriate to use on some badly deteriorated masonry because water may exacerbate the deterioration, or on gypsum or alabaster which are very soluble in water.
process. (A non-ionic detergent, unlike most household detergents, does not leave a solid, visible residue on the masonry.) Adding a non-ionic detergent and scrubbing with a natural bristle or synthetic bristle brush can facilitate cleaning textured or intricately carved masonry. This should be followed with a final water rinse.

**Steam/Hot-Pressurized Water Cleaning.** Steam cleaning is actually low-pressure hot water washing because the steam condenses almost immediately upon leaving the hose. This is a gentle and effective method for cleaning stone and particularly for acid-sensitive stones. Steam can be especially useful in removing built-up soiling deposits and dried-up plant materials, such as ivy disks and tendrils. It can also be an efficient means of cleaning carved stone details and, because it does not generate a lot of liquid water, it can sometimes be appropriate to use for cleaning interior masonry (Figs. 8-9).

**Potential hazards of water cleaning.** Despite the fact that water-based methods are generally the most gentle, even they can be damaging to historic masonry. Before beginning a water cleaning project, it is important to make sure that all mortar joints are sound and that the building is watertight. Otherwise water can seep through the walls to the interior, resulting in rusting metal anchors and stained and ruined plaster.

Some water supplies may contain traces of iron and copper which may cause masonry to discolor. Adding a chelating or complexing agent to the water, such as EDTA (ethylene diamine tetra-acetic acid), which inactivates other metallic ions, as well as softens minerals and water hardness, will help prevent staining on light-colored masonry.

Any cleaning method involving water should never be done in cold weather or if there is any likelihood of frost or freezing because water within the masonry can freeze, causing spalling and cracking. Since a masonry wall may take over a week to dry after cleaning, no water cleaning should be permitted for several days prior to the first average frost date, or even earlier if local forecasts predict cold weather.

Most essential of all, it is important to be aware that using water at too high a pressure, a practice common to "power washing" and "water blasting", is very abrasive and can easily etch marble and other soft stones, as well as some types of brick (Figs. 10-11). In addition, the distance of the nozzle from the masonry surface and the type of nozzle, as well as gallons per minute (gpm), are also important variables in a water cleaning process that can have a significant impact on the outcome of the project. This is why it is imperative that the cleaning be closely monitored to ensure that the cleaning operators do not raise the pressure or bring the nozzle too close to the masonry in an effort to "speed up" the process. The appearance of grains of stone or sand in the cleaning effluent on the ground is an indication that the water pressure may be too high.

**Figure 7.** Glazed architectural terra cotta often may be cleaned successfully with a low-pressure water wash and hand scrubbing supplemented, if necessary, with a non-ionic detergent. Photo: National Park Service Files.

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**Chemical Cleaning**

Chemical cleaners, generally in the form of proprietary products, are another material frequently used to clean historic masonry. They can remove dirt, as well as paint and other coatings, metallic and plant stains, and graffiti. Chemical cleaners used to remove dirt and soil include acids, alkalies and organic compounds. Acidic cleaners, of course, should not be used on masonry that is acid sensitive. Paint removers are alkaline, based on organic solvents or other chemicals.

**Chemical Cleaners to Remove Dirt**

Both alkaline and acidic cleaning treatments include the use of water. Both cleaners are also likely to contain surfactants (wetting agents), that facilitate the chemical reaction that removes the dirt. Generally, the masonry is wet first for both types of cleaners, then the chemical cleaner is sprayed on at very low pressure or brushed onto the surface. The cleaner is left to dwell on the masonry for an amount of time recommended by the product manufacturer or, preferably, determined by testing, and rinsed off with a low- or moderate-pressure cold, or sometimes hot, water wash. More than one application of the cleaner may be necessary, and it is always a good practice to test the product manufacturer's recommendations concerning dilution rates and dwell times. Because each cleaning situation is unique, dilution rates and dwell times can vary considerably. The masonry surface may be scrubbed lightly with natural or synthetic bristle brushes prior to rinsing. After rinsing, pH strips should be applied to the surface to ensure that the masonry has been neutralized completely.
Acidic Cleaners. Acid-based cleaning products may be used on non-acid sensitive masonry, which generally includes: granite, most sandstones, slate, unglazed brick and unglazed architectural terra cotta, cast stone and concrete (Fig. 12). Most commercial acidic cleaners are composed primarily of hydrofluoric acid, and often include some phosphoric acid to prevent rust-like stains from developing on the masonry after the cleaning. Acid cleaners are applied to the pre-wet masonry which should be kept wet while the acid is allowed to "work", and then removed with a water wash.

Alkaline Cleaners. Alkaline cleaners should be used on acid-sensitive masonry, including: limestone, polished and unpolished marble, calcareous sandstone, glazed brick and glazed architectural terra cotta, and polished granite. (Alkaline cleaners may also be used sometimes on masonry materials that are not acid sensitive—after testing, of course—but they may not be as effective as they are on acid-sensitive masonry.) Alkaline cleaning products consist primarily of two ingredients: a non-ionic detergent or surfactant; and an alkali, such as potassium hydroxide or ammonium hydroxide. Like acidic cleaners, alkaline products are usually applied to pre-wet masonry, allowed to dwell, and then rinsed off with water. (Longer dwell times may be necessary with alkaline cleaners than with acidic cleaners.) Two additional steps are required to remove alkaline cleaners after the initial rinse. First the masonry is given a slightly acidic wash—often with acetic acid—to neutralize it, and then it is rinsed again with water.

**Chemical Cleaners to Remove Paint and Other Coatings, Stains and Graffiti**

Removing paint and some other coatings, stains and graffiti can best be accomplished with alkaline paint removers, organic solvent paint removers, or other cleaning compounds. The removal of layers of paint from a masonry surface usually involves applying the remover either by brush, roller or spraying, followed by a thorough water wash. As with any chemical cleaning, the manufacturer's recommendations regarding application procedures should always be tested before beginning work.

**Alkaline Paint Removers.** These are usually of much the same composition as other alkaline cleaners, containing potassium or ammonium hydroxide, or trisodium phosphate. They are used to remove oil, latex and acrylic paints, and are effective for removing multiple layers of paint. Alkaline cleaners may also remove some acrylic, water-repellent coatings. As with other alkaline cleaners, both an acidic neutralizing wash and a final water rinse are generally required following the use of alkaline paint removers.

**Organic Solvent Paint Removers.** The formulation of organic solvent paint removers varies and may include a combination of solvents, including methylene chloride, methanol, acetone, xylene and toluene.
Figure 10. High-pressure water washing too close to the surface has abraded and, consequently, marred the limestone on this early-20th century building.

Other Paint Removers and Cleaners. Other cleaning compounds that can be used to remove paint and some painted graffiti from historic masonry include paint removers based on N-methyl-2-pyrrolidone (NMP), or on petroleum-based compounds. Removing stains, whether they are industrial (smoke, soot, grease or tar), metallic (iron or copper), or biological (plant and fungal) in origin, depends on carefully matching the type of remover to the type of stain (Fig. 13). Successful removal of stains from historic masonry often requires the application of a number of different removers before the right one is found. The removal of layers of paint from a masonry surface is usually accomplished by applying the remover either by brush, roller or spraying, followed by a thorough water wash (Fig. 14).

Potential hazards of chemical cleaning. Since most chemical cleaning methods involve water, they have many of the potential problems of plain water cleaning. Like water methods, they should not be used in cold weather because of the possibility of freezing. Chemical cleaning should never be undertaken in temperatures below 40 degrees F (4 degrees C), and generally not below 50 degrees F. In addition, many chemical cleaners simply do not work in cold temperatures. Both acidic and alkaline cleaners can be dangerous to cleaning operators and, clearly, there are environmental concerns associated with the use of chemical cleaners.

If not carefully chosen, chemical cleaners can react adversely with many types of masonry. Obviously, acidic cleaners should not be used on acid-sensitive materials; however, it is not always clear exactly what the composition is of any stone or other masonry material. For this reason, testing the cleaner on an inconspicuous spot on the building is always necessary. While certain acid-based cleaners may be appropriate if used as directed on a particular type of masonry, if left too long or if not adequately rinsed from the masonry they can have a negative effect. For example, hydrofluoric acid can etch masonry leaving a hazy residue (whitish deposits of silica or calcium fluoride salts) on the surface. While this efflorescence may usually be removed by a second cleaning—although it is likely to be expensive and time-consuming—hydrofluoric acid can also leave calcium fluoride salts or a colloidal silica deposit on masonry which may be impossible to remove (Fig. 15). Other acids, particularly hydrochloric (muriatic) acid, which is very powerful, should not be used on historic masonry, because it can dissolve lime-based mortar, damage brick and some stones, and leave chloride deposits on the masonry.
Alkaline cleaners can stain sandstones that contain a ferrous compound. Before using an alkaline cleaner on sandstone it is always important to test it, since it may be difficult to know whether a particular sandstone may contain a ferrous compound. Some alkaline cleaners, such as sodium hydroxide (caustic soda or lye) and ammonium bifluoride, can also damage or leave disfiguring brownish-yellow stains and, in most cases, should not be used on historic masonry. Although alkaline cleaners will not etch a masonry surface as acids can, they are caustic and can burn the surface. In addition, alkaline cleaners can deposit potentially damaging salts in the masonry which can be difficult to rinse thoroughly.

**Abrasive and Mechanical Cleaning**

Generally, abrasive cleaning methods are not appropriate for use on historic masonry buildings. Abrasive cleaning methods are just that—abrasive. Grit blasters, grinders, and sanding discs all operate by abrading the dirt or paint off the surface of the masonry, rather than reacting with the dirt and the masonry which is how water and chemical methods work. Since the abrasives do not differentiate between the dirt and the masonry, they can also remove the outer surface of the masonry at the same time, and result in permanently damaging the masonry. Brick, architectural terra cotta, soft stone, detailed carvings, and polished surfaces are especially susceptible to physical and aesthetic damage by abrasive methods. Brick and architectural terra cotta are fired products which have a smooth, glazed surface which can be removed by abrasive blasting or grinding (Figs. 18-19). Abrasively-cleaned masonry is damaged aesthetically as well as physically, and it has a rough surface which tends to hold dirt and the roughness will make future cleaning more difficult. Abrasive cleaning processes can also increase the likelihood of subsurface cracking of the masonry. Abrasion of carved details causes a rounding of sharp corners and other loss of delicate features, while abrasion of polished surfaces removes the polished finish of stone.
Graffiti and stains, which have penetrated into the masonry, often are best removed by using a poultice. A poultice consists of an absorbent material or clay powder (such as kaolin or fuller’s earth, or even shredded paper or paper towels), mixed with a liquid (solvent or other remover) to form a paste which is applied to the stain (Figs. 16-17). As it dries, the paste absorbs the staining material so that it is not redeposited on the masonry surface. Some commercial cleaning products and paint removers are specially formulated as a paste or gel that will cling to a vertical surface and remain moist for a longer period of time in order to prolong the action of the chemical on the stain. Pre-mixed poultices are also available as a paste or in powder form needing only the addition of the appropriate liquid. The masonry must be pre-wet before applying an alkaline cleaning agent, but not when using a solvent. Once the stain has been removed, the masonry must be rinsed thoroughly.
Figure 18. The glazed bricks in the center of the pier were covered by a signboard that protected them being damaged by the sandblasting which removed the glaze from the surrounding bricks.

Figure 19. A comparison of undamaged bricks surrounding the electrical conduit with the rest of the brick facade emphasizes the severity of the erosion caused by sandblasting.

**Abrasive Blasting.** Blasting with abrasive grit or another abrasive material is the most frequently used abrasive method. *Sandblasting* is most commonly associated with abrasive cleaning. Finely ground silica or glass powder, glass beads, ground garnet, powdered walnut and other ground nut shells, grain hulls, aluminum oxide, plastic particles and even tiny pieces of sponge, are just a few of the other materials that have also been used for abrasive cleaning. Although abrasive blasting is not an appropriate method of cleaning historic masonry, it can be safely used to clean some materials. Finely-powdered walnut shells are commonly used for cleaning monumental bronze sculpture, and skilled conservators clean delicate museum objects and finely detailed, carved stone features with very small, micro-abrasive units using aluminum oxide.

A number of current approaches to abrasive blasting rely on materials that are not usually thought of as abrasive, and not as commonly associated with traditional abrasive grit cleaning. Some patented abrasive cleaning processes – one dry, one wet – use finely-ground glass powder intended to “erase” or remove dirt and surface soiling only, but not paint or stains (Fig. 20). Cleaning with baking soda (sodium bicarbonate) is another patented process. Baking soda blasting is being used in some communities as a means of quick graffiti removal. However, it should not be used on historic masonry which it can easily abrade and can permanently “etch” the graffiti into the stone; it can also leave potentially damaging salts in the stone which cannot be removed. Most of these abrasive grits may be used either dry or wet, although dry grit tends to be used more frequently.

Figure 20. (Left) A comparison of the limestone surface of a 1920s office building before and after “cleaning” with a proprietary abrasive process using fine glass powder clearly shows the effectiveness of this method. But this is an abrasive technique and it has “cleaned” by removing part of the masonry surface with the dirt. Because it is abrasive, it is generally not recommended for large-scale cleaning of historic masonry, although it may be suitable to use in certain, very limited cases under controlled circumstances. (Right) A vacuum chamber where the used glass powder is collected for environmentally safe disposal is a unique feature of this particular process. The specially-trained operators in the chamber wear protective clothing, masks and breathing equipment. Photos: Tom Keohan.
Ice particles, or pelletized dry ice (carbon dioxide or CO2), are another medium used as an abrasive cleaner (Fig. 21). This is also too abrasive to be used on most historic masonry, but it may have practical application for removing mastics or asphaltic coatings from some substrates.

Some of these processes are promoted as being more environmentally safe and not damaging to historic masonry buildings. However, it must be remembered that they are abrasive and that they "clean" by removing a small portion of the masonry surface, even though it may be only a minuscule portion. The fact that they are essentially abrasive treatments must always be taken into consideration when planning a masonry cleaning project. In general, abrasive methods should not be used to clean historic masonry buildings. In some, very limited instances, highly-controlled, gentle abrasive cleaning may be appropriate on selected, hard-to-clean areas of a historic masonry building if carried out under the watchful supervision of a professional conservator. But, abrasive cleaning should never be used on an entire building.

**Grinders and Sanding Disks.** Grinding the masonry surface with mechanical grinders and sanding disks is another means of abrasive cleaning that should not be used on historic masonry. Like abrasive blasting, grinders and disks do not really clean masonry but instead grind away and abridentally remove and, thus, damage the masonry surface itself rather than remove just the soiling material.

**Planning A Cleaning Project**

Once the masonry and soiling material or paint have been identified, and the condition of the masonry has been evaluated, planning for the cleaning project can begin.

## Testing Cleaning Methods

In order to determine the gentlest means possible, several cleaning methods or materials may have to be tested prior to selecting the best one to use on the building. Testing should always begin with the gentlest and least invasive method proceeding gradually, if necessary, to more complicated methods, or a combination of methods. All too often simple methods, such as low-pressure water wash, are not even considered, yet they frequently are effective, safe, and not expensive. Water of slightly higher pressure or with a non-ionic detergent additive also may be effective. It is worth repeating that these methods should always be tested prior to considering harsher methods; they are safer for the building and the environment, often safer for the applicator, and relatively inexpensive.

The level of cleanliness desired also should be determined prior to selection of a cleaning method. Obviously, the intent of cleaning is to remove most of the dirt, soiling material, stains, paint or other coating. A "brand new" appearance, however, may be inappropriate for an older building, and may require an overly harsh cleaning method to be achieved. When undertaking a cleaning project, it is important to be aware that some stains simply may not be removable. It may be wise, therefore, to agree upon a slightly lower level of cleanliness that will serve as the standard for the cleaning project. The precise amount of residual dirt considered acceptable may depend on the type of masonry, the type of soiling and difficulty of total removal, and local environmental conditions.

Cleaning tests should be carried out in an area of sufficient size to give a true indication of their effectiveness. It is preferable to conduct the test in an inconspicuous location on the building so that it will not be obvious if the test is not successful. A test area may be quite small to begin, sometimes as small as six square inches, and gradually may be increased in size as the most appropriate methods and cleaning agents are determined. Eventually the test area may be expanded to a square yard or more, and it should include several masonry units and mortar joints (Fig. 22). It should be remembered that a single building may have several types of masonry and that even similar materials may have different surface finishes. Each material and different finish should be tested separately. Cleaning tests should be evaluated only after the masonry has dried completely. The results of the tests may indicate that several methods of cleaning should be used on a single building.

When feasible, test areas should be allowed to weather for an extended period of time prior to final evaluation. A waiting period of a full year would be ideal in order to expose the test patch to a full range of seasons. If this is not possible, the test patch should weather for at least a month or two. For any building which is considered historically important, the delay is insignificant compared to the potential damage and disfigurement which may result from using an incompletely tested method. The successfully cleaned test patch should be protected as it will serve as a standard against which the entire cleaning project will be measured.
Environmental considerations. The potential effect of any method proposed for cleaning historic masonry should be evaluated carefully. Chemical cleaners and paint removers may damage trees, shrubs, grass, and plants. A plan must be provided for environmentally safe removal and disposal of the cleaning materials and the rinsing effluent before beginning the cleaning project. Authorities from the local regulatory agency—usually under the jurisdiction of the federal or state Environmental Protection Agency (EPA) should be consulted prior to beginning a cleaning project, especially if it involves anything more than plain water washing. This advance planning will ensure that the cleaning effluent or run-off, which is the combination of the cleaning agent and the substance removed from the masonry, is handled and disposed of in an environmentally sound and legal manner. Some alkaline and acidic cleaners can be neutralized so that they can be safely discharged into storm sewers. However, most solvent-based cleaners cannot be neutralized and are categorized as pollutants, and must be disposed of by a licensed transport, storage and disposal facility. Thus, it is always advisable to consult with the appropriate agencies before starting to clean to ensure that the project progresses smoothly and is not interrupted by a stop-work order because a required permit was not obtained in advance.

Vinyl guttering or polyethylene-lined troughs placed around the perimeter of the base of the building can serve to catch chemical cleaning waste as it is rinsed off the building. This will reduce the amount of chemicals entering and polluting the soil, and also will keep the cleaning waste contained until it can be removed safely. Some patented cleaning systems have developed special equipment to facilitate the containment and later disposal of cleaning waste.

Concern over the release of volatile organic compounds (VOCs) into the air has resulted in the manufacture of new, more environmentally responsible cleaners and paint removers, while some materials traditionally used in cleaning may no longer be available for these same reasons. Other health and safety concerns have created additional cleaning challenges, such as lead paint removal, which is likely to require special removal and disposal techniques.

Cleaning can also cause damage to non-masonry materials on a building, including glass, metal and wood. Thus, it is usually necessary to cover windows and doors, and other features that may be vulnerable to chemical cleaners. They should be covered with plastic or polyethylene, or a masking agent that is applied as a liquid which dries to form a thin protective film on glass, and is easily peeled off after the cleaning is finished. Wind drift, for example, can also damage other property by carrying cleaning chemicals onto nearby automobiles, resulting in etching of the glass or spotting of the paint finish. Similarly, airborne dust can enter surrounding buildings, and excess water can collect in nearby yards and basements.

Safety considerations. Possible health dangers of each method selected for the cleaning project must be considered before selecting a cleaning method to avoid harm to the cleaning applicators, and the necessary precautions must be taken. The precautions listed in Material Safety Data Sheets (MSDS) that are provided with chemical products should always be followed. Protective clothing, respirators, hearing and face shields, and gloves must be provided to workers to be worn at all times. Acidic and alkaline chemical cleaners in both liquid and vapor forms can also cause serious injury to passers-by (Fig. 23). It may be necessary to schedule cleaning at night or weekends if the building is located in a busy urban area to reduce the potential danger of chemical overspray to pedestrians. Cleaning during non-business hours will allow HVAC systems to be turned off and vents to be covered to prevent dangerous chemical fumes from entering the building which will also ensure the safety of the building's occupants. Abrasive and mechanical methods produce dust which can pose a serious health hazard, particularly if the abrasive or the masonry contains silica.

Water-Repellent Coatings and Waterproof Coatings

To begin with, it is important to understand that waterproof coatings and water-repellent coatings are not the same. Although these terms are frequently interchanged and commonly confused with one another, they are completely different materials. Water-repellent coatings—often referred to incorrectly as "sealers", but which do not or should not seal—are intended to keep liquid water from penetrating the surface but to allow water vapor to enter and leave, or pass through, the surface of the masonry (Fig. 24). Water-repellent coatings are generally transparent, or clear, although once applied some may darken or discolor certain types of masonry while others may give it a glossy or shiny appearance. Waterproof coatings seal the surface from liquid water and from water vapor. They are usually opaque, or pigmented, and include bituminous coatings and some elastomeric paints and coatings.
Water-Repellent Coatings

Water-repellent coatings are formulated to be vapor permeable, or "breathable". They do not seal the surface completely to water vapor so it can enter the masonry wall as well as leave the wall. While the first water-repellent coatings to be developed were primarily acrylic or silicone resins in organic solvents, now most water-repellent coatings are water-based and formulated from modified siloxanes, silanes and other alkoxysilanes, or metallic stearates. While some of these products are shipped from the factory ready to use, other waterborne water repellents must be diluted at the job site. Unlike earlier water-repellent coatings which tended to form a "film" on the masonry surface, modern water-repellent coatings actually penetrate into the masonry substrate slightly and, generally, are almost invisible if properly applied to the masonry. They are also more vapor permeable than the old coatings, yet they still reduce the vapor permeability of the masonry. Once inside the wall, water vapor can condense at cold spots producing liquid water which, unlike water vapor, cannot escape through a water-repellent coating. The liquid water within the wall, whether from condensation, leaking gutters, or other sources, can cause considerable damage.

Water-repellent coatings are not consolidants. Although modern water repellents may penetrate slightly beneath the masonry surface, instead of just "sitting" on top of it, they do not perform the same function as a consolidant which is to "consolidate" and replace lost binder to strengthen deteriorating masonry. Even after many years of laboratory study and testing few consolidants have proven very effective. The composition of fired products such as brick and architectural terra cotta, as well as many types of building stone, does not lend itself to consolidation.

Some modern water-repellent coatings which contain a binder intended to replace the natural binders in stone that have been lost through weathering and natural erosion are described in product literature as both a water repellent and a consolidant. The fact that newer water-repellent coatings penetrate beneath the masonry surface instead of just forming a layer on top of the surface may indeed convey at least some consolidating properties to certain stones. However, a water-repellent coating cannot be considered a consolidant. In some instances, a water-repellent or "preservative" coating, if applied to already damaged or spalling stone, may form a surface crust which, if it fails, may exacerbate the deterioration by pulling off even more of the stone (Fig. 25).

Is a Water-Repellent Treatment Necessary?

Water-repellent coatings are frequently applied to historic masonry buildings for the wrong reason. They also are often applied without an understanding of what they are and what they are intended to do. And these coatings can be very difficult, if not impossible, to remove from the masonry if they fail or become discolored. Most importantly, the application of water-repellent coatings to historic masonry is usually unnecessary.

Most historic masonry buildings, unless they are painted, have survived for decades without a water-repellent coating and, thus, probably do not need one now. Water penetration to the interior of a masonry building is seldom due to porous masonry, but results from poor or deferred maintenance. Leaking roofs, clogged or deteriorated gutters and downspouts, missing mortar, or cracks and open joints around door and window openings are almost always the cause of moisture-related problems in a historic masonry building. If historic masonry buildings are kept watertight and in good repair, water-repellent coatings should not be necessary.

Rising damp (capillary moisture pulled up from the ground), or condensation can also be a source of excess moisture in masonry buildings. A water-repellent coating will not solve this problem either and, in fact, may be likely to exacerbate it. Furthermore, a water-repellent coating should never be applied to a damp wall. Moisture in the wall would reduce the ability of a coating to adhere to the masonry and to penetrate below the surface. But, if it did adhere, it would hold the moisture inside the masonry because, although a water-repellent coating is permeable to water vapor, liquid water cannot pass through it. In the case of rising damp, a coating may force the moisture to go even higher in the wall because it can slow down evaporation, and thereby retain the moisture in the wall.

Excessive moisture in masonry walls may carry waterborne soluble salts from the masonry units themselves or from the mortar through the walls. If the water is permitted to come to the surface, the salts may appear on the masonry surface as efflorescence (a whitish powder) upon evaporation. However, the salts can be potentially dangerous if they remain in the masonry and crystallize.
Figure 24. Although the application of a water-repellent coating was probably not needed on either of these buildings, the coating on the brick building (above), is not visible and has not changed the character of the brick. But the coating on the brick column (below), has a high gloss that is incompatible with the historic character of the masonry.

beneath the surface as subflorescence. Subflorescence eventually may cause the surface of the masonry to spall, particularly if a water-repellent coating has been applied which tends to reduce the flow of moisture out from the subsurface of the masonry. Although many of the newer water-repellent products are more breathable than their predecessors, they can be especially damaging if applied to masonry that contains salts, because they limit the flow of moisture through masonry.

When a Water-Repellent Coating May be Appropriate

There are some instances when a water-repellent coating may be considered appropriate to use on a historic masonry building. Soft, incompletely fired brick from the 18th- and early-19th centuries may have become so porous that paint or some type of coating is needed to protect it from further deterioration or dissolution. When a masonry building has been neglected for a long period of time, necessary repairs may be required in order to make it watertight. If, following a reasonable period of time after the building has been made watertight and has dried out completely, moisture appears actually to be penetrating through the repointed and repaired masonry walls, then the application of a water-repellent coating may be considered in selected areas only. This decision should be made in consultation with an architectural conservator. And, if such a treatment is undertaken, it should not be applied to the entire exterior of the building.

Anti-graffiti or barrier coatings are another type of clear coating—although barrier coatings can also be pigmented—that may be applied to exterior masonry, but they are not formulated primarily as water repellents. The purpose of these coatings is to make it harder for graffiti to stick to a masonry surface and, thus, easier to clean. But, like water-repellent coatings, in most cases the application of anti-graffiti coatings is generally not recommended for historic masonry buildings. These coatings are often quite shiny which can greatly alter the appearance of a historic masonry surface, and they are not always effective (Fig. 26). Generally, other ways of discouraging graffiti, such as improved lighting, can be more effective than a coating. However, the application of anti-graffiti coatings may be appropriate in some instances on vulnerable areas of historic masonry buildings which are frequent targets of graffiti that are located in out-of-the-way places where constant surveillance is not possible.

Some water-repellent coatings are recommended by product manufacturers as a means of keeping dirt and pollutants or biological growth from collecting on the surface of masonry buildings and, thus, reducing the need for frequent cleaning. While this at times may be true, in some cases a coating may actually retain dirt more than uncoated masonry. Generally, the application of a water-repellent coating is not recommended on a historic masonry building as a means of preventing biological growth. Some water-repellent coatings may actually encourage biological growth on a masonry wall. Biological growth on masonry buildings has traditionally been kept at bay through regularly-scheduled cleaning as part of a maintenance plan. Simple cleaning of the masonry with low-pressure water using a natural- or synthetic-bristled scrub brush can be very effective if done on a regular basis. Commercial products are also available which can be sprayed on masonry to remove biological growth.

In most instances, a water-repellent coating is not necessary if a building is watertight. The application of a water-repellent coating is not a recommended treatment for historic masonry buildings unless there is a specific

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problem which it may help solve. If the problem occurs on only part of the building, it is best to treat only that area rather than an entire building. Extreme exposures such as parapets, for example, or portions of the building subject to driving rain can be treated more effectively and less expensively than the entire building. Water-repellent coatings are not permanent and must be reapplied periodically although, if they are truly invisible, it can be difficult to know when they are no longer providing the intended protection.

Testing a water-repellent coating by applying it in one small area may not be helpful in determining its suitability for the building because a limited test area does not allow an adequate evaluation of such a treatment. Since water may enter and leave through the surrounding untreated areas, there is no way to tell if the coated test area is "breathable." But trying a coating in a small area may help to determine whether the coating is visible on the surface or if it will otherwise change the appearance of the masonry.

**Waterproof Coatings**

In theory, waterproof coatings usually do not cause problems as long as they exclude all water from the masonry. If water does enter the wall from the ground or from the inside of a building, the coating can intensify the damage because the water will not be able to escape. During cold weather this water in the wall can freeze causing serious mechanical disruption, such as spalling.

In addition, the water eventually will get out by the path of least resistance. If this path is toward the interior, damage to interior finishes can result; if it is toward the exterior, it can lead to damage to the masonry caused by built-up water pressure (Fig. 27).

In most instances, **waterproof coatings should not be applied to historic masonry.** The possible exception to this might be the application of a waterproof coating to below-grade exterior foundation walls as a last resort to stop water infiltration on interior basement walls. Generally, however, **waterproof coatings, which include elastomeric paints, should almost never be applied above grade to historic masonry buildings.**

![Figure 25](image1.png) *Figure 25. The clear coating applied to this limestone molding has failed and is taking off some of the stone surface as it peels. Photo: Frances Gale.*

![Figure 26](image2.png) *Figure 26. The anti-graffiti or barrier coating on this column is very shiny and would not be appropriate to use on a historic masonry building. The coating has discolored as it has aged and whitish streaks reveal areas of bare concrete where the coating was incompletely applied.*

![Figure 27](image3.png) *Figure 27. Instead of correcting the roof drainage problems, an elastomeric coating was applied to the already saturated limestone cornice. An elastomeric coating holds moisture in the masonry because it does not “breathe” and does not allow liquid moisture to escape. If the water pressure builds up sufficiently it can cause the coating to break and pop off as shown in this example, often pulling pieces of the masonry with it. Photo: National Park Service Files.*
Summary

A well-planned cleaning project is an essential step in preserving, rehabilitating or restoring a historic masonry building. Proper cleaning methods and coating treatments, when determined necessary for the preservation of the masonry, can enhance the aesthetic character as well as the structural stability of a historic building. Removing years of accumulated dirt, pollutants, stains, graffiti or paint, if done with appropriate caution, can extend the life and longevity of the historic resource. Cleaning that is carelessly or insensitively prescribed or carried out by inexperienced workers can have the opposite of the intended effect. It may scar the masonry permanently, and may actually result in hastening deterioration by introducing harmful residual chemicals and salts into the masonry or causing surface loss. Using the wrong cleaning method or using the right method incorrectly, applying the wrong kind of coating or applying a coating that is not needed can result in serious damage, both physically and aesthetically, to a historic masonry building. Cleaning a historic masonry building should always be done using the gentlest means possible that will clean, but not damage the building. It should always be taken into consideration before applying a water-repellent coating or a waterproof coating to a historic masonry building whether it is really necessary and whether it is in the best interest of preserving the building.

Selected Reading


Acknowledgments

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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. Comments on the usefulness of this publication may be directed to: Sharon C. Park, FAIA, Chief, Technical Preservation Services Branch, Heritage Preservation Services Program, National Park Service, 1849 C Street, N.W., Suite NC200, Washington, D.C. 20240 (www2.cr.nps.gov/tps). This publication is not copyrighted and can be reproduced without penalty. Normal procedures for credit to the authors and the National Park Service are appreciated.

Photographs used to illustrate this Brief were taken by Anne Grimmer unless otherwise credited.

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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 (Fig. 1). Properly done, repointing restores the visual and physical integrity of the masonry. Improperly done, repointing not only detracts from the appearance of the building, but may also cause physical damage to the masonry units themselves.

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

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

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

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

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

Identifying the Problem Before Repointing

The decision to repoint is most often related to some obvious sign of deterioration, such as disintegrating mortar, cracks in mortar joints, loose bricks or stones, damp walls, or damaged plasterwork. It is, however, erroneous to assume that repointing alone will solve deficiencies that result from other problems (Fig. 2). The root cause of the deterioration—leaking roofs or gutters, differential settlement of the building, capillary action causing rising damp, or extreme weather exposure—should always be dealt with prior to beginning work. Without appropriate repairs to eliminate the source of the problem, mortar deterioration will continue and any repointing will have been a waste of time and money.

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

Finding an Appropriate Mortar Match

Preliminary research is necessary to ensure that the proposed repointing work is both physically and visually appropriate to the building. Analysis of unweathered portions of the historic mortar to which the new mortar will be matched can suggest appropriate mixes for the repointing mortar so that it will not damage the building because it is excessively strong or vapor impermeable. Examination and analysis of the masonry units—brick, stone or terra cotta—and the techniques used in the original construction will assist in maintaining the building's historic appearance (Figs. 3-4). A simple, non-technical, evaluation of the masonry units and mortar can provide information concerning the relative strength and permeability of each—critical factors in selecting the repointing mortar—while a visual analysis of the historic mortar can provide the information necessary for developing the new mortar mix and application techniques.

Although not crucial to a successful repointing project, for projects involving properties of special historic significance, a mortar analysis by a qualified laboratory can be useful by providing information on the original ingredients. However, there are limitations with such an analysis, and replacement mortar specifications should not be based solely on laboratory analysis. Analysis requires interpretation, and there are important factors which affect the condition and performance of the mortar that cannot be established through laboratory analysis. These may include: the original water content, rate of curing, weather conditions during original construction, the method of mixing and placing the mortar, and the cleanliness and condition of the sand. The most useful information that can come out of laboratory analysis is the identification of sand by...
Figure 3. Good-quality repointing closely replicates the original in composition, texture, joint type and profile on this 19th century brick building (left), and on this late-19th century granite on H.H. Richardson's Glessner House in Chicago (right). Photos: Charles E. Fisher. Sharon C. Park, FAIA.

gradation and color. This allows the color and the texture of the mortar to be matched with some accuracy because sand is the largest ingredient by volume.

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

• The new mortar must match the historic mortar in color, texture and tooling. (If a laboratory analysis is undertaken, it may be possible to match the binder components and their proportions with the historic mortar, if those materials are available.)

• The sand must match the sand in the historic mortar. (The color and texture of the new mortar will usually fall into place if the sand is matched successfully.)

• The new mortar must have greater vapor permeability and be softer (measured in compressive strength) than the masonry units.

• The new mortar must be as vapor permeable and as soft or softer (measured in compressive strength) than the historic mortar. (Softness or hardness is not necessarily an indication of permeability; old, hard lime mortars can still retain high permeability.)

Properties of Mortar

Mortars for repointing should be softer or more permeable than the masonry units and no harder or more impermeable than the historic mortar to prevent damage to the masonry units. It is a common error to assume that hardness or high strength is a measure of appropriateness, particularly for lime-based historic mortars. Stresses within a wall caused by expansion, contraction, moisture migration, or settlement must be accommodated in some manner; in a masonry wall these

Figure 4. (left) The poor quality of this repointing—it appears to have been "tooled" with the mason's finger—does not match the delicacy of the original beaded joint on this 19th-century brick wall. (right) It is obvious that the repointing on this "test patch" is not an appropriate replacement mortar joint for this early-19th century stone foundation. Photos: Lee H. Nelson, FAIA.
stresses should be relieved by the mortar rather than by the masonry units. A mortar that is stronger in compressive strength than the masonry units, will not “give,” thus causing the stresses to be relieved through the masonry units—resulting in permanent damage to the masonry, such as cracking and spalling, that cannot be repaired easily (Fig. 5). While stresses can also break the bond between the mortar and the masonry units, permitting water to penetrate the resulting hairline cracks, this is easier to correct in the joint through repointing than if the break occurs in the masonry units.

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

Components of Mortar

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

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

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

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

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

Lime. Mortar formulations prior to the late-19th century used lime as the primary binding material. Lime is derived from heating limestone at high temperatures which burns off the carbon dioxide, and turns the limestone into quicklime. There are three types of limestone—calcium, magnesium, and dolomitic—differentiated by the different levels of magnesium carbonate they contain which impart specific qualities to mortar. Historically, calcium lime was used for mortar rather than the dolomitic lime (calcium magnesium carbonate) most often used today. But it is also important to keep in mind the fact that the historic limes, and other components of mortar, varied a great deal because they were natural, as opposed to modern lime which is manufactured and, therefore, standardized. Because some of the kinds of lime, as well as other components of mortar, that were used historically are no longer readily available, even when a conscious effort is made to replicate a “historic” mix, this may not be achievable due to the differences between modern and historic materials.

Figure 5. The use of hard, portland-cement mortar that is less permeable than the soft bricks has resulted in severe damage to this brick wall. Moisture trapped in the wall was unable to evaporate through the mortar which is intended to be sacrificial, and thus protect the bricks. As a result the moisture remained in the walls until water pressure eventually popped the surface off the bricks. Photo: National Park Service Files.
Lime, itself, when mixed with water into a paste is very plastic and creamy. It will remain workable and soft indefinitely, if stored in a sealed container. Lime (calcium hydroxide) hardens by carbonation absorbing carbon dioxide primarily from the air, converting itself to calcium carbonate. Once a lime and sand mortar is mixed and placed in a wall, it begins the process of carbonation. If lime mortar is left to dry too rapidly, carbonation of the mortar will be reduced, resulting in poor adhesion and poor durability. In addition, lime mortar is slightly water soluble and thus is able to re-seal any hairline cracks that may develop during the life of the mortar. Lime mortar is soft, porous, and changes little in volume during temperature fluctuations, thus making it a good choice for historic buildings. Because of these qualities, high calcium lime mortar may be considered for many repointing projects, not just those involving historic buildings.

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

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

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

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

**Masonry cement.** Masonry cement is a preblended mortar mix commonly found at hardware and home repair stores. It is designed to produce mortars with a compressive strength of 750 psi or higher when mixed

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**MORTAR ANALYSIS**

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

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

The drawback of most mortar analysis methods is that mortar samples of known composition have not been analyzed in order to evaluate the method. Historic mortars were not prepared to narrowly defined specifications from materials of uniform quality; they contain a wide array of locally derived materials combined at the discretion of the mason. While a particular method might be able to accurately determine the original proportions of a lime-cement-sand mortar prepared from modern materials, the usefulness of that method for evaluating historic mortars is questionable unless it has been tested against mortars prepared from materials more commonly used in the past.

Lorraine Schnabel.
with sand and water at the job site. It may contain hydrated lime, but it always contains a large amount of portland cement, as well as ground limestone and other workability agents, including air-entraining agents. Because masonry cements are not required to contain hydrated lime, and generally do not contain lime, they produce high strength mortars that can damage historic masonry. For this reason, they generally are not recommended for use on historic masonry buildings.

Lime mortar (pre-blended). Hydrated lime mortars, and pre-blended lime putty mortars with or without a matched sand are commercially available. Custom mortars are also available with color. In most instances, pre-blended lime mortars containing sand may not provide an exact match; however, if the project calls for total repointing, a pre-blended lime mortar may be worth considering as long as the mortar is compatible in strength with the masonry. If the project involves only selected, “spot” repointing, then it may be better to carry out a mortar analysis which can provide a custom pre-blended lime mortar with a matching sand. In either case, if a preblended lime mortar is to be used, it should contain Type S or SA hydrated lime conforming to ASTM C 207.

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

Other Components

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

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

Pigments. Some historic mortars, particularly in the late 19th century, were tinted to match or contrast with the brick or stone (Fig. 6). Red pigments, sometimes in the form of brick dust, as well as brown, and black pigments were commonly used. Modern pigments are available which can be added to the mortar at the job site, but they should not exceed 10 per cent by weight of the portland cement in the mix, and carbon black should be limited to 2 per cent. Only synthetic mineral oxides, which are alkali-proof and sun-fast, should be used to prevent bleaching and fading.

Modern components. Admixtures are used to create specific characteristics in mortar, and whether they should be used will depend upon the individual project. Air-entraining agents, for example, help the mortar to resist freeze-thaw damage in northern climates. Accelerators are used to reduce mortar freezing prior to setting while retarders help to extend the mortar life in hot climates. Selection of admixtures should be made by the architect or architectural conservator as part of the specifications, not something routinely added by the masons. Generally, modern chemical additives are unnecessary and may, in fact, have detrimental effects in historic masonry projects. The use of antifreeze compounds is not recommended. They are not very effective with high lime mortars and may introduce salts, which may cause efflorescence later. A better practice is to warm the sand and water, and to protect the completed work from freezing. No definitive study has determined whether air-entraining additives should be used to resist frost action and enhance plasticity, but in areas of extreme exposure requiring high-strength mortars with lower permeability, air-entrainment of 10-16 percent may be desirable (see formula for “severe weather exposure” in Mortar Type and Mix). Bonding agents are not a substitute for proper joint preparation, and they should generally be avoided. If the joint is properly prepared, there will be a good bond between the new mortar and the adjacent surfaces. In addition, a bonding agent is difficult to remove if smeared on a masonry surface (Fig. 7).
Mortar Type and Mix

Mortars for repointing projects, especially those involving historic buildings, typically are custom mixed in order to ensure the proper physical and visual qualities. These materials can be combined in varying proportions to create a mortar with the desired performance and durability. The actual specification of a particular mortar type should take into consideration all of the factors affecting the life of the building including: current site conditions, present condition of the masonry, function of the new mortar, degree of weather exposure, and skill of the mason. Thus, no two repointing projects are exactly the same. Modern materials specified for use in repointing mortar should conform to specifications of the American Society for Testing and Materials (ASTM) or comparable federal specifications, and the resulting mortar should conform to ASTM C 270, Mortar for Unit Masonry.

Specifying the proportions for the repointing mortar for a specific job is not as difficult as it might seem. Five mortar types, each with a corresponding recommended mix, have been established by ASTM to distinguish high strength mortar from soft flexible mortars. The ASTM designated them in decreasing order of approximate general strength as Type M (2,500 psi), Type S (1,800 psi), Type N (750 psi), Type O (350 psi) and Type K (75 psi). (The letters identifying the types are from the words MASON WORK using every other letter.) Type K has the highest lime content of the mixes that contain portland cement, although it is seldom used today, except for some historic preservation projects. The designation “L” in the accompanying chart identifies a straight lime and sand mix. Specifying the appropriate ASTM mortar by proportion of ingredients, will ensure the desired physical properties. Unless specified otherwise, measurements or proportions for mortar mixes are always given in the following order: cement-lime-sand. Thus, a Type K mix, for example, would be referred to as 1-3-10, or 1 part cement to 3 parts lime to 10 parts sand. Other requirements to create the desired visual qualities should be included in the specifications.

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

Budgeting and Scheduling

Repointing is both expensive and time consuming due to the extent of handwork and special materials required. It is preferable to repoint only those areas that require work rather than an entire wall, as is often specified. But, if 25 to 50 per cent or more of a wall needs to be repointed, repointing the entire wall may be more cost effective than spot repointing. Total repointing may also be more sensible when access is difficult, requiring the erection of expensive scaffolding (unless the majority of the mortar is sound and unlikely to require replacement in the foreseeable future). Each project requires judgement based on a variety of factors. Recognizing this at the outset will help to prevent many jobs from becoming prohibitively expensive.

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

The relationship of repointing to other work proposed on the building must also be recognized. For example, if paint removal or cleaning is anticipated, and if the mortar joints are basically sound and need only selective repointing, it is generally better to postpone repointing.
Figure 9. Comparison of incorrect and correct preparation of mortar joints for repointing. Drawing: Robert C. Mack, FAIA, and David W. Look, AIA.

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

Execution of the Work

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

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

**Joint Preparation.** Old mortar should be removed to a
minimum depth of 2 to 2-1/2 times the width of the joint
to ensure an adequate bond and to prevent mortar
"popouts" (Fig. 8). For most brick joints, this will
require removal of the mortar to a depth of approximately
1/4 to 1 inch; for stone masonry with wide joints,
mortar may need to be removed to a depth of several
inches. Any loose or disintegrated mortar beyond this
minimum depth also should be removed (Fig. 9).

Although some damage may be inevitable, careful joint
preparation can help limit damage to masonry units.
The traditional manner of removing old mortar is
through the use of hand chisels and mash hammers
(Fig. 10). Though labor-intensive, in most instances this
method poses the least threat for damage to historic
masonry units and produces the best final product.

The most common method of removing mortar,
however, is through the use of power saws or grinders.
The use of power tools by unskilled masons can be
disastrous for historic masonry, particularly soft brick.
Using power saws on walls with thin joints, such as
most brick walls, almost always will result in damage to
the masonry units by breaking the edges and by
overcutting on the head, or vertical joints (Fig. 11).

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

Under certain circumstances, thin diamond-bladed
grinders may be used to cut out horizontal joints only on
hard portland cement mortar common to most early-20th
century masonry buildings (Fig. 12). Usually, automatic
tools most successfully remove old mortar without
damaging the masonry units when they are used in
combination with hand tools in preparation for
repointing. Where horizontal joints are uniform and
fairly wide, it may be possible to use a power masonry
saw to assist the removal of mortar, such as by cutting
along the middle of the joint; final mortar removal from
the sides of the joints still should be done with a hand
chisel and hammer. Caulking cutters with diamond
blades can sometimes be used successfully to cut out
joints without damaging the masonry. Caulking cutters
are slow; they do not rotate, but vibrate at very high
speeds, thus minimizing the possibility of damage to
masonry units (Fig. 13). Although mechanical tools may
be used safely in limited circumstances to cut out
horizontal joints in preparation for repointing, they
should never be used on vertical joints because of the
danger of slipping and cutting into the brick above or
below the vertical joint. Using power tools to remove
mortar without damaging the surrounding masonry
units also necessitates highly skilled masons experienced
in working on historic masonry buildings. Contractors
Granite steps are first cut out mechanically (note the vacuum attached to the cutting tool in foreground to cut down on dust). Mechanical preparation of horizontal joints by an experienced mason may sometimes be acceptable, especially where the joints are quite wide and the old mortar is done by hand to avoid damage to the edges of the joints. Cutting tool in foreground to cut down on dust), (right) Final removal of the mortar of the desired consistency is reached. The total volume of water necessary may vary from batch to batch, depending on weather conditions. It is important to keep the water to a minimum for two reasons: first, a drier mortar is cleaner to work with, and it can be compacted tightly into the joints; second, with no excess water to evaporate, the mortar cures without shrinkage cracks. Mortar should be used within approximately 30 minutes of final mixing, and “retempering,” or adding more water, should not be permitted.

Using Lime Putty to Make Mortar. Mortar made with lime putty and sand, sometimes referred to as roughage or course stuff, should be measured by volume, and may require slightly different proportions from those used with hydrated lime (Fig. 14). No additional water is usually needed to achieve a workable consistency because enough water is already contained in the putty. Sand is proportioned first, followed by the lime putty, then mixed for five minutes or until all the sand is thoroughly coated with the lime putty. But mixing, in the familiar sense of turning over with a hoe, sometimes may not be sufficient if the best possible performance is to be obtained from a lime putty mortar. Although the old practice of chopping, beating and ramming the mortar has largely been forgotten, recent field work has confirmed that lime putty and sand rammed and beaten with a wooden mallet or ax handle, interspersed by chopping with a hoe, can significantly improve workability and performance. The intensity of this action increases the overall lime/sand contact and removes any surplus water by compacting the other ingredients. It may also be advantageous for larger projects to use a mortar pan mill for mixing. Mortar pan mills which have a long tradition in Europe produce a superior lime putty mortar not attainable with today’s modern paddle and drum type mixers.

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

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

Filling the Joint. Where existing mortar has been removed to a depth of greater than 1 inch, these deeper areas should be filled first, compacting the new mortar in several layers. The back of the entire joint should be filled successively by applying approximately 1/4 inch of mortar, packing it well into the back corners. This should demonstrate proficiency with power tools before their use is approved.

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

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

Mortar Preparation. Mortar components should be measured and mixed carefully to assure the uniformity of visual and physical characteristics. Dry ingredients are measured by volume and thoroughly mixed before the addition of any water. Sand must be added in a damp, loose condition to avoid over sanding. Repointing mortar is typically pre-hydrated by adding water so it will just hold together, thus allowing it to stand for a period of time before the final water is added. Half the water should be added, followed by mixing for approximately 5 minutes. The remaining water should then be added in small portions until a mortar of the desired consistency is reached. The total volume of water necessary may vary from batch to batch, depending on weather conditions. It is important
application may extend along the wall for several feet. As soon as the mortar has reached thumb-print hardness, another ¼ inch layer of mortar—approximately the same thickness—may be applied. Several layers will be needed to fill the joint flush with the outer surface of the masonry. It is important to allow each layer time to harden before the next layer is applied; most of the mortar shrinkage occurs during the hardening process and layering thus minimizes overall shrinkage.

When the final layer of mortar is thumb-print hard, the joint should be tooled to match the historic joint (Fig. 15). Proper timing of the tooling is important for uniform color and appearance. If tooled when too soft, the color will be lighter than expected, and hairline cracks may occur; if tooled when too hard, there may be dark streaks called “tool burning,” and good closure of the mortar against the masonry units will not be achieved.

If the old bricks or stones have worn, rounded edges, it is best to recess the final mortar slightly from the face of the masonry. This treatment will help avoid a joint which is visually wider than the actual joint; it also will avoid creation of a large, thin featheredge which is easily damaged, thus admitting water (Fig. 16). After toothing, excess mortar can be removed from the edge of the joint by brushing with a natural bristle or nylon brush. Metal bristle brushes should never be used on historic masonry.

**Curing Conditions.** The preliminary hardening of high-lime content mortars—those mortars that contain more lime by volume than portland cement, i.e., Type O (1:2:9), Type K (1:3:11), and straight lime/sand, Type “L”(0:1:3)—takes place fairly rapidly as water in the mix is lost to the porous surface of the masonry and through evaporation. A high lime mortar (especially Type “L”) left to dry out too rapidly can result in chalking, poor adhesion, and poor durability. Periodic wetting of the repointed area after the mortar joints are thumb-print hard and have been finish tooled may significantly accelerate the carbonation process. When feasible, misting using a hand sprayer with a fine nozzle can be simple to do for a day or two after repointing. Local conditions will dictate the frequency of wetting, but initially it may be as often as every hour and gradually reduced to every three or four hours. Walls should be covered with burlap for the first three days after repointing. (Plastic may be used, but it should be tented out and not placed directly against the wall.) This helps keep the walls damp and protects them from direct sunlight. Once carbonation of the lime has begun, it will continue for many years and the lime will gain strength as it reverts back to calcium carbonate within the wall.

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

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

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

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

Several precautions should be taken if a freshly repointed masonry wall is to be cleaned. First, the mortar should be fully hardened before cleaning. Thirty days is usually sufficient, depending on weather and exposure; as mentioned previously, the mortar will continue to cure even after it has hardened. Test panels should be prepared to evaluate the effects of different cleaning methods.
Mortar Types
(Measured by volume)

<table>
<thead>
<tr>
<th>Designation</th>
<th>Cement</th>
<th>Hydrated Lime or Lime Putty</th>
<th>Sand</th>
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<td>1/4</td>
<td>3 - 3 1/4</td>
</tr>
<tr>
<td>S</td>
<td>1</td>
<td>1/4</td>
<td>4 - 4 1/2</td>
</tr>
<tr>
<td>N</td>
<td>1</td>
<td>1</td>
<td>5 - 6</td>
</tr>
<tr>
<td>O</td>
<td>1</td>
<td>2</td>
<td>8 - 9</td>
</tr>
<tr>
<td>K</td>
<td>1</td>
<td>3</td>
<td>10 - 12</td>
</tr>
<tr>
<td>&quot;L&quot;</td>
<td>0</td>
<td>1</td>
<td>2 1/4 - 3</td>
</tr>
</tbody>
</table>

Suggested Mortar Types for Different Exposures

<table>
<thead>
<tr>
<th>Masonry Material</th>
<th>Sheltered</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Durable:</td>
<td>O</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>granite, hard-cored brick, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderately Durable:</td>
<td>K</td>
<td>O</td>
<td>N</td>
</tr>
<tr>
<td>limestone, durable stone, molded brick</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimally Durable:</td>
<td>&quot;L&quot;</td>
<td>K</td>
<td>O</td>
</tr>
<tr>
<td>soft hand-made brick</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Methods. Generally, on newly repointed masonry walls, only very low pressure (100 psi) water washing supplemented by stiff natural bristle or nylon brushes should be used, except on glazed or polished surfaces, where only soft cloths should be used.**

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

Surface Grouting is sometimes suggested as an alternative to repointing brick buildings, in particular. This process involves the application of a thin coat of cement-based grout to the mortar joints and the mortar/brick interface. To be effective the grout must extend slightly onto the face of the masonry units, thus widening the joint visually. The change in the joint appearance can alter the historic character of the structure to an unacceptable degree. In addition, although masking of the bricks is intended to keep the grout off the remainder of the face of the bricks, some level of residue, called “veiling,” will inevitably remain. Surface grouting cannot substitute for the more extensive work of repointing, and it is not a recommended treatment for historic masonry.

Summary

For the Owner/Administrator. The owner or administrator of a historic building should remember that repointing is likely to be a lengthy and expensive process. First, there must be adequate time for evaluation of the building and investigation into the cause of problems. Then, there will be time needed for preparation of the contract documents. The work itself is precise, time-consuming and noisy, and scaffolding may cover the face of the building for some time. Therefore, the owner must carefully plan the work to avoid problems. Schedules for both repointing and other activities will thus require careful coordination to avoid unanticipated conflicts. The owner must avoid the tendency to rush the work or cut corners if the historic building is to retain its visual integrity and the job is to be durable.

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

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

Visually Examining the Mortar and the Masonry Units

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

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

1) Remove with a chisel and hammer three or four unweathered samples of the mortar to be matched from several locations on the building. (Set the largest sample aside—this will be used later for comparison with the repointing mortar). Removing a full representation of samples will allow selection of a “mean” or average mortar sample.

2) Mash the remaining samples with a wooden mallet, or hammer if necessary, until they are separated into their constituent parts. There should be a good handful of the material.

3) Examine the powdered portion—the lime and/or cement matrix of the mortar. Most particularly, note the color. There is a tendency to think of historic mortars as having white binders, but grey portland cement was available by the last quarter of the 19th century, and traditional limes were also sometimes grey. Thus, in some instances, the natural color of the historic binder may be grey, rather than white. The mortar may also have been tinted to create a colored mortar, and this color should be identified at this point.

4) Carefully blow away the powdery material (the lime and/or cement matrix which bound the mortar together).

5) With a low power (10 power) magnifying glass, examine the remaining sand and other materials such as lumps of lime or shell.

6) Note and record the wide range of color as well as the varying sizes of the individual grains of sand, impurities, or other materials.

Other Factors to Consider

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

Pointing Style. Close examination of the historic masonry wall and the techniques used in the original construction will assist in maintaining the visual qualities of the building (Fig. 18). Pointing styles and the methods of producing them should be examined. It is important to look at both the horizontal and the vertical joints to determine the order in which they were tooled and whether they were the same style. Some late-19th and early-20th century buildings, for example, have horizontal joints that were raked back while the vertical joints were finished flush and stained to match the bricks, thus creating the illusion of horizontal bands. Pointing styles may also differ from one facade to another; front walls often received greater attention to mortar detailing than side and rear walls (Fig. 19).

Tuckpointing is not true repointing but the
Application of a raised joint or lime putty joint on top of flush mortar joints (Fig. 20). Penciling is a purely decorative, painted surface treatment over a mortar joint, often in a contrasting color.

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

Matching Color and Texture of the Repointing Mortar

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

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

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

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

A good repointing job is meant to last, at least 30 years, and preferably 50-100 years. Shortcuts and poor craftsmanship result not only in diminishing the historic character of a building, but also in a job that looks bad, and will require future repointing sooner than if the work had been done correctly (Fig. 17). The mortar joint in a historic masonry building has often been called a wall’s “first line of defense.” Good repointing practices guarantee the long life of the mortar joint, the wall, and the historic structure. Although careful maintenance will help preserve the freshly repointed mortar joints, it is important to remember that mortar joints are intended to be sacrificial and will probably require repointing some time in the future. Nevertheless, if the historic mortar joints proved durable for many years, then careful repointing should have an equally long life, ultimately contributing to the preservation of the entire building.

Selected Reading


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


Useful Addresses

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

Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077

Acknowledgments

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

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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. Comments about this publication should be directed to de Teel Patterson Tiller, Chief, Heritage Preservation Services Program, National Park Service, 1849 C Street, N.W. Suite NC200, Washington, D.C. 20240. This publication is not copyrighted and can be reproduced without penalty. Normal procedures for credit to the authors and the National Park Service are appreciated.

Front Cover: Repointing a historic brick building using a lime-based mortar. Traditional lime mortars have a consistency that enables the mortar to cling to a repointing tool while in a vertical position. Photo: John P. Speweik.

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Preservation Briefs: 9
The Repair of Historic Wooden Windows

John H. Myers

The windows on many historic buildings are an important aspect of the architectural character of those buildings. Their design, craftsmanship, or other qualities may make them worthy of preservation. This is self-evident for ornamental windows, but it can be equally true for warehouses or factories where the windows may be the most dominant visual element of an otherwise plain building (see figure 1). Evaluating the significance of these windows and planning for their repair or replacement can be a complex process involving both objective and subjective considerations. The Secretary of the Interior's Standards for Rehabilitation, and the accompanying guidelines, call for respecting the significance of original materials and features, repairing and retaining them wherever possible, and when necessary, replacing them in kind. This Brief is based on the issues of significance and repair which are implicit in the standards, but the primary emphasis is on the technical issues of planning for the repair of windows including evaluation of their physical condition, techniques of repair, and design considerations when replacement is necessary.

Much of the technical section presents repair techniques as an instructional guide for the do-it-yourselfer. The information will be useful, however, for the architect, contractor, or developer on large-scale projects. It presents a methodology for approaching the evaluation and repair of existing windows, and considerations for replacement, from which the professional can develop alternatives and specify appropriate materials and procedures.

Architectural or Historical Significance

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

Historically, the first windows in early American houses were casement windows; that is, they were hinged at the side and opened outward. In the beginning of the eighteenth century single- and double-hung windows were introduced. Subsequently many styles of these vertical sliding sash windows have come to be associated with specific building periods or architectural styles, and this is an important consideration in determining the significance of windows, especially on a local or regional basis. Site-specific, regionally oriented architectural comparisons should be made to determine the significance of windows in question. Although such comparisons may focus on specific window types and their details, the ultimate determination of significance should be made within the context of the whole building, wherein the windows are one architectural element (see figure 2).

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

Physical Evaluation

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

Many factors such as poor design, moisture, vandalism, insect attack, and lack of maintenance can contribute to window deterioration, but moisture is the primary contributing factor in wooden window decay. All window units should be inspected to see if water is entering around the edges of the frame and, if so, the joints or seams should be caulked to eliminate this danger. The glazing putty should be checked for cracked, loose, or missing sections which allow water to saturate the wood, especially at the joints. The back putty on the interior side of the pane should also be inspected, because it creates a seal which prevents condensation from running down into the joinery. The sill should be examined to insure that it slopes downward away from the building and allows water to drain off. In addition, it may be advisable to cut a dripline along the underside of the sill. This almost invisible treatment will insure proper water run-off, particularly if the bottom of the sill is flat. Any conditions, including poor original design, which permit water to come in contact with the wood or to puddle on the sill must be corrected as they contribute to deterioration of the window.

One clue to the location of areas of excessive moisture is the condition of the paint; therefore, each window should be examined for areas of paint failure. Since excessive moisture is detrimental to the paint bond, areas of paint blistering, cracking, flaking, and peeling usually identify points of water penetration, moisture saturation, and potential deterioration. Failure of the paint should not, however, be mistakenly interpreted as a sign that the wood is in poor condition and hence, irreparable. Wood is frequently in sound physical condition beneath unsightly paint. After noting areas of paint failure, the next step is to inspect the condition of the wood, particularly at the points identified during the paint examination.

Each window should be examined for operational soundness beginning with the lower portions of the frame and sash. Exterior rainwater and interior condensation can flow downward along the window, entering and collecting at points where the flow is blocked. The sill, joints between the sill and jamb, corners of the bottom rails and muntin joints are typical points where water collects and deterioration begins (see figure 3). The operation of the window (continuous opening and closing over the years and seasonal temperature changes) weakens the joints, causing movement and slight separation. This process makes the joints more vulnerable to water which is readily absorbed into the end-grain of the wood. If severe deterioration exists in these areas, it will usually be apparent on visual inspection, but other less severely deteriorated areas of the wood may be tested by two traditional methods using a small ice pick.

An ice pick or an awl may be used to test wood for soundness. The technique is simply to jab the pick into a wetted wood surface at an angle and pry up a small sec-

Figure 2. These drawings of window details identify major components, terminology, and installation details for a wooden double-hung window.
tion of the wood. Sound wood will separate in long fibrous splinters, but decayed wood will lift up in short irregular pieces due to the breakdown of fiber strength.

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

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

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

**Repair Class I: Routine Maintenance**

Repairs to wooden windows are usually labor intensive and relatively uncomplicated. On small scale projects this allows the do-it-yourselfer to save money by repairing all or part of the windows. On larger projects it presents the opportunity for time and money which might otherwise be spent on the removal and replacement of existing windows, to be spent on repairs, subsequently saving all or part of the material cost of new window units. Regardless of the actual costs, or who performs the work, the evaluation process described earlier will provide the knowledge from which to specify an appropriate work program, establish the work element priorities, and identify the level of skill needed by the labor force.

The routine maintenance required to upgrade a window to "like new" condition normally includes the following steps: 1) some degree of interior and exterior paint removal, 2) removal and repair of sash (including reglazing where necessary), 3) repairs to the frame, 4) weather-stripping and reinstalation of the sash, and 5) repainting. These operations are illustrated for a typical double-hung wooden window (see figures 4a-f), but they may be adapted to other window types and styles as applicable.

Historic windows have usually acquired many layers of paint over time. Removal of excess layers or peeling and flaking paint will facilitate operation of the window and restore the clarity of the original detailing. Some degree of paint removal is also necessary as a first step in the proper surface preparation for subsequent refinishing (if paint color analysis is desired, it should be conducted prior to the onset of the paint removal). There are several safe and effective techniques for removing paint from wood, depending on the amount of paint to be removed. Several techniques such as scraping, chemical stripping, and the use of a hot air gun are discussed in "Preservation Briefs: 10 Paint Removal from Historic Woodwork" (see Additional Reading section at end).

Paint removal should begin on the interior frames, being careful to remove the paint from the interior stop and the parting bead, particularly along the seam where these stops meet the jamb. This can be accomplished by running a utility knife along the length of the seam, breaking the paint bond. It will then be much easier to remove the stop, the parting bead and the sash. The interior stop may be initially loosened from the sash side to avoid visible scarring of the wood and then gradually pried loose using a pair of putty knives, working up and down the stop in small increments (see figure 4b). With the stop removed, the lower or interior sash may be withdrawn. The sash cords should be detached from the sides of the sash and their ends may be pinned with a nail or tied in a knot to prevent them from falling into the weight pocket.

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

The sash can be stripped of paint using appropriate techniques, but if any heat treatment is used (see figure 4c), the glass should be removed or protected from the sudden temperature change which can cause breakage. An
The following series of photographs of the repair of a historic double-hung window use a unit which is structurally sound but has many layers of paint, some cracked and missing putty, slight separation at the joints, broken sash cords, and one cracked pane. Photo: John H. Myers

Reglazing or replacement of the putty requires that the existing putty be removed manually, the glazing points be extracted, the glass removed, and the back putty scraped out. To reglaze, a bed of putty is laid around the perimeter of the rabbet, the pane is pressed into place, glazing points are inserted to hold the pane (shown), and a final seal of putty is beveled around the edge of the glass. Photo: John H. Myers

After removing paint from the seam between the interior stop and the jamb, the stop can be pried out and gradually worked loose using a pair of putty knives as shown. To avoid visible scarring of the wood, the sash can be raised and the stop pried loose initially from the outer side. Photo: John H. Myers

A common repair is the replacement of broken sash cords with new cords (shown) or with chains. The weight pocket is often accessible through a removable plate in the jamb, or by removing the interior trim. Photo: John H. Myers

Following the relatively simple repairs, the window is weathertight, like new in appearance, and serviceable for many years to come. Both the historic material and the detailing and craftsmanship of this original window have been preserved. Photo: John H. Myers
overlay of aluminum foil on gypsum board or asbestos can protect the glass from such rapid temperature change. It is important to protect the glass because it may be historic and often adds character to the window.

Deteriorated putty should be removed manually, taking care not to damage the wood along the rabbet. If the glass is to be removed, the glazing points which hold the glass in place can be extracted and the panes numbered and removed for cleaning and reuse in the same openings. With the glass panes out, the remaining putty can be removed and the sash can be sanded, patched, and primed with a preservative primer. Hardened putty in the rabbets may be softened by heating with a soldering iron at the point of removal. Putty remaining on the glass may be softened by soaking the panes in linseed oil, and then removed with less risk of breaking the glass. Before reinstalling the glass, a bead of glazing compound or linseed oil putty should be laid around the rabbet to cushion and seal the glass. Glazing compound should only be used on wood which has been brushed with linseed oil and primed with an oil based primer or paint. The pane is then pressed into place and the glazing points are pushed into the wood around the perimeter of the pane (see figure 4d). The final glazing compound or putty is applied and beveled to complete the seal. The sash can be refinished as desired on the inside and painted on the outside as soon as a “skin” has formed on the putty, usually in 2 or 3 days. Exterior paint should cover the beveled glazing compound or putty and lap over onto the glass slightly to complete a weathertight seal. After the proper curing times have elapsed for paint and putty, the sash will be ready for reinstallation.

While the sash are out of the frame, the condition of the wood in the jamb and sill can be evaluated. Repair and refinishing of the frame may proceed concurrently with repairs to the sash, taking advantage of the curing times for the paints and putty used on the sash. One of the most common work items is the replacement of the sash cords with new rope cords or with chains (see figure 4e). The weight pocket is frequently accessible through a door on the face of the frame near the sill, but if no door exists, the trim on the interior face may be removed for access. Sash weights may be increased for easier window operation by elderly or handicapped persons. Additional repairs to the frame and sash may include consolidation or replacement of deteriorated wood. Techniques for these repairs are discussed in the following sections.

The operations just discussed summarize the efforts necessary to restore a window with minor deterioration to “like new” condition (see figure 4f). The techniques can be applied by an unskilled person with minimal training and experience. To demonstrate the practicality of this approach, and photograph it, a Technical Preservation Services staff member repaired a wooden double-hung, two over two window which had been in service over ninety years. The wood was structurally sound but the window had one broken pane, many layers of paint, broken sash cords and inadequate, worn-out weatherstripping. The staff member found that the frame could be stripped of paint and the sash removed quite easily. Paint, putty and glass removal required about one hour for each sash, and the reglazing of both sash was accomplished in about one hour. Weatherstripping of the sash and frame, replacement of the sash cords and reinstallation of the sash, parting bead, and stop required an hour and a half. These times refer only to individual operations; the entire process took several days due to the drying and curing times for putty, primer, and paint, however, work on other window units could have been in progress during these lag times.

**Repair Class II: Stabilization**

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

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

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

Wood may also be strengthened and stabilized by consolidation, using semi-rigid epoxies which saturate the porous decayed wood and then harden. The surface of the consolidated wood can then be filled with a semi-rigid epoxy patching compound, sanded and painted (see figure 5). Epoxy patching compounds can be used to build up

![Figure 5. This illustrates a two-part epoxy patching compound used to fill the surface of a weathered sill and rebuild the missing edge. When the epoxy cures, it can be sanded smooth and painted to achieve a durable and waterproof repair. Photo: John H. Myers](image-url)
missing sections or decayed ends of members. Profiles can be duplicated using hand molds, which are created by pressing a ball of patching compound over a sound section of the profile which has been rubbed with butcher’s wax. This can be a very efficient technique where there are many typical repairs to be done. Technical Preservation Services has published *Epoxies for Wood Repairs in Historic Buildings* (see Additional Reading section at end), which discusses the theory and techniques of epoxy repairs. The process has been widely used and proven in marine applications; and proprietary products are available at hardware and marine supply stores. Although epoxy materials may be comparatively expensive, they hold the promise of being among the most durable and long lasting materials available for wood repair.

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

**Repair Class III: Splices and Parts Replacement**

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

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

Another alternative may be considered if parts replacement is required, and that is sash replacement. If extensive replacement of parts is necessary and the job becomes prohibitively expensive it may be more practical to purchase new sash which can be installed into the existing frames. Such sash are available as exact custom reproductions, reasonable facsimiles (custom windows with similar profiles), and contemporary wooden sash which are similar in appearance. There are companies which still manufacture high quality wooden sash which would duplicate most historic sash. A few calls to local building suppliers may provide a source of appropriate replacement sash, but if not, check with local historical associations, the state historic preservation office, or preservation related magazines and supply catalogs for information.

If a rehabilitation project has a large number of windows such as a commercial building or an industrial complex, there may be less of a problem arriving at a solution. Once the evaluation of the windows is completed and the scope of the work is known, there may be a potential economy of scale. Woodworking mills may be interested in the work from a large project; new sash in volume may be considerably less expensive per unit; crews can be assembled and trained on site to perform all of the window repairs; and a few extensive repairs can be absorbed (without undue burden) into the total budget for a large number of sound windows. While it may be expensive for the average historic home owner to pay seventy dollars or more for a mill to grind a custom knife to duplicate four or five bad muntins, that cost becomes negligible on large commercial projects which may have several hundred windows.

Most windows should not require the extensive repairs discussed in this section. The ones which do are usually in buildings which have been abandoned for long periods or have totally lacked maintenance for years. It is necessary to thoroughly investigate the alternatives for windows which do require extensive repairs to arrive at a solution which retains historic significance and is also economically feasible. Even for projects requiring repairs identified in this section, if the percentage of parts replacement per window is low, or the number of windows requiring repair is small, repair can still be a cost effective solution.

**Weatherization**

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

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

Window Replacement

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

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

Consider energy efficiency as one of the factors for replacements, but do not let it dominate the issue. Energy conservation is no excuse for the wholesale destruction of historic windows which can be made thermally efficient by historically and aesthetically acceptable means. In fact, a historic wooden window with a high quality storm window added should thermally outperform a new double-glazed metal window which does not have thermal breaks (insulation between the inner and outer frames intended to break the path of heat flow). This occurs because the wood has far better insulating value than the metal, and in addition many historic windows have high ratios of wood to glass, thus reducing the area of highest heat transfer. One measure of heat transfer is the U-value, the number of Btu's per hour transferred through a square foot of material. When comparing thermal performance, the lower the U-value the better the performance. According to ASHRAE 1977 Fundamentals, the U-values for single glazed wooden windows range from 0.88 to 0.99. The addition of a storm window should reduce these figures to a range of 0.44 to 0.49. A non-thermal break, double-glazed metal window has a U-value of about 0.6.

Conclusion

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

Additional Reading

Ferro, Maximillian. Preservation: Present Pathway to Fall River's Future. Fall River, Massachusetts: City of Fall River, 1979 (chapter 7).
Rehab Right. Oakland, California: City of Oakland Planning Department, 1978 (pp. 78-83).

1981
Exterior Paint Problems on Historic Woodwork
Kay D. Weeks and David W. Look, AIA

A cautionary approach to paint removal is included in the guidelines to “The Secretary of the Interior Standards for Historic Preservation Projects.” Removing paints down to bare wood surfaces using harsh methods can permanently damage those surfaces; therefore such methods are not recommended. Also, total removal obliterates evidence of the historical paints and their sequence and architectural context.

This Brief expands on that advice for the architect, building manager, contractor, or homeowner by identifying and describing common types of paint surface conditions and failures, then recommending appropriate treatments for preparing exterior wood surfaces for repainting to assure the best adhesion and greatest durability of the new paint. Although the Brief focuses on responsible methods of “paint removal,” several paint surface conditions will be described which do not require any paint removal, and still others which can be successfully handled by limited paint removal. In all cases, the information is intended to address the concerns related to exterior wood. It will also be generally assumed that, because houses built before 1950 involve one or more layers of lead-base paint, the majority of conditions warranting paint removal will mean dealing with this toxic substance along with the dangers of the paint removal tools and chemical strippers themselves.

Purposes of Exterior Paint
Paint applied to exterior wood must withstand yearly extremes of both temperature and humidity. While never expected to be more than a temporary physical shield—requiring re-application every 5-8 years—its importance should not be minimized. Because one of the main causes of wood deterioration is moisture penetration, a primary purpose for painting wood is to exclude such moisture, thereby slowing deterioration not only of a building’s exterior siding and decorative features but, ultimately, its underlying structural members. Another important purpose for painting wood is, of course, to define and accent architectural features and to improve appearance.

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

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

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

Justification for Paint Removal
At the outset of this Brief, it must be emphasized that removing paint from historic buildings—with the exception of cleaning, light scraping, and hand sanding as part of routine maintenance—should be avoided unless absolutely essential. Once conditions warranting removal have

1 General paint type recommendations will be made, but paint color recommendations are beyond the scope of this Brief.
3 Any pigmented liquid, liquefiable, or mastic composition designed for application to a substrate in a thin layer which is converted to an opaque solid film after application. Paint and Coatings Dictionary. 1978. Federation of Societies for Coatings and Technology.
4 For purposes of the Brief, this includes any area of painted exterior woodwork displaying signs of peeling, cracking, or alligatoring to bare wood. See descriptions of these and other paint surface conditions as well as recommended treatments on pp. 5-10.
Excessive paint build-up on architectural details such as this ornamental bracket does not in itself justify total paint removal. If paint is cracked and peeling down to bare wood, however, it should be removed using the gentlest means possible. Photo: David W. Look, AIA.

If paint is cracked and peeling down to bare wood, however, it should be removed using the gentlest means possible. Ph: David IV. Look, AIA.

been identified, the general approach should be to remove paint to the next sound layer using the gentlest means possible, then to repaint (see figure 2). Practically speaking as well, paint can adhere just as effectively to existing paint as to bare wood, providing the previous coats of paint are also adhering uniformly and tightly to the wood and the surface is properly prepared for repainting—cleaned of dirt and chalk and dulled by sanding. But, if painted exterior wood surfaces display continuous patterns of deep cracks or if they are extensively blistering and peeling so that bare wood is visible, then the old paint should be completely removed before repainting. The only other justification for removing all previous layers of paint is if doors, shutters, or windows have literally been “painted shut,” or if new wood is being pieced-in adjacent to old painted wood and a smooth transition is desired (see figure 3).

Paint Removal Precautions

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

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

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

Repainting Historic Buildings for Cosmetic Reasons

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

The decision to repaint may not be based altogether on paint failure. Where there is a new owner, or even where ownership has remained constant through the years, taste in colors often changes. Therefore, if repainting is primarily to alter a building's primary and accent colors, a technical factor of paint accumulation should be taken into consideration. When paint builds up to a thickness of approximately 1/16" (approximately 16-30 layers), one or more extra coats of paint may be enough to trigger cracking and peeling in limited or even widespread areas of the building's surface. This results because excessively thick paint is less able to withstand the shrinkage or pull of an additional coat as it dries and is also less able to tolerate thermal stresses. Thick paint invariably fails at the weakest point of adhesion—the oldest layers next to the wood. Cracking and peeling follow. Therefore, if there are no signs of paint failure, it may be somewhat risky to add still another layer of unneeded paint simply for color's sake (extreme changes in color may also require more than one coat to provide proper hiding power and full color). When paint appears to be nearing the critical thickness, a change of accent colors (that is, just to limited portions of the trim) might be an acceptable compromise without chancing cracking and peeling of paint on wooden siding.

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

Identification of Exterior Paint Surface Conditions/Recommended Treatments

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

The historic building will undoubtedly exhibit a variety of exterior paint surface conditions. For example, paint on the wooden siding and doors may be adhering firmly; paint on the eaves peeling; and paint on the porch balusters and window sills cracking and alligating. The accurate identification of each paint problem is therefore the first step in planning an appropriate overall solution.

Paint surface conditions can be grouped according to their relative severity: CLASS I conditions include minor blemishes or dirt collection and generally require no paint removal; CLASS II conditions include failure of the top layer or layers of paint and generally require limited paint removal; and CLASS III conditions include substantial or multiple-layer failure and generally require total paint removal. It is precisely because conditions will vary at different points on the building that a careful inspection is critical. Each item of painted exterior woodwork (i.e., siding, doors, windows, eaves, shutters, and decorative elements) should be examined early in the planning phase and surface conditions noted.

CLASS I Exterior Surface Conditions Generally Requiring No Paint Removal

- Dirt, Soot, Pollution, Cobwebs, Insect Cocoons, etc.

Cause of Condition

Environmental "grime" or organic matter that tends to cling to painted exterior surfaces and, in particular, protected surfaces such as eaves, do not constitute a paint problem unless painted over rather than removed prior to repainting. If not removed, the surface deposits can be a barrier to proper adhesion and cause peeling.

Recommended Treatment

Most surface matter can be loosened by a strong, direct stream of water from the nozzle of a garden hose. Stubborn dirt and soot will need to be scrubbed off using 1/2 cup of household detergent in a gallon of water with a medium soft bristle brush. The cleaned surface should then be rinsed thoroughly, and permitted to dry before further inspection to determine if repainting is necessary. Quite often, cleaning provides a satisfactory enough result to postpone repainting.

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See the Reading List for paint research and documentation information. See also The Secretary of the Interior's Standards for Historic Preservation Projects with Guidelines for Applying the Standards for recommended approaches on paints and finishes within various types of project work treatments.
• Mildew

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

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

• Excessive Chalking

Cause of Condition
Chalking—or powdering of the paint surface—is caused by the gradual disintegration of the resin in the paint film. (The amount of chalking is determined both by the formulation of the paint and the amount of ultraviolet light to which the paint is exposed.) In moderation, chalking is the ideal way for a paint to "age," because the chalk, when rinsed by rainwater, carries discoloration and dirt away with it and thus provides an ideal surface for repainting. In excess, however, it is not desirable because the chalk can wash down onto a surface of a different color beneath the painted area and cause streaking as well as rapid disintegration of the paint film itself. Also, if a paint contains too much pigment for the amount of binder (as the old white lead carbonate/oil paints often did), excessive chalking can result.

Recommended Treatment
The chalk should be cleaned off with a solution of \( \frac{1}{2} \) cup household detergent to one gallon water, using a medium soft bristle brush. After scrubbing to remove the chalk, the surface should be rinsed with a direct stream of water from the nozzle of a garden hose, allowed to dry thoroughly, (but not long enough for the chalking process to recur) and repainted, using a non-chalking paint.

• Staining

Cause of Condition
Staining of paint coatings usually results from excess moisture reacting with materials within the wood substrate. There are two common types of staining, neither of which requires paint removal. The most prevalent type of stain is due to the oxidation or rusting of iron nails or metal (iron, steel, or copper) anchorage devices. A second type of stain is caused by a chemical reaction between moisture and natural extractives in certain woods (red cedar or redwood) which results in a surface deposit of colored matter. This is most apt to occur in new replacement wood within the first 10-15 years.

Recommended Treatment
In both cases, the source of the stain should first be located and the moisture problem corrected.

When stains are caused by rusting of the heads of nails used to attach shingles or siding to an exterior wall or by rusting or oxidizing iron, steel, or copper anchorage devices adjacent to a painted surface, the metal objects themselves should be hand sanded and coated with a rust-inhibitive primer followed by two finish coats. (Exposed nail heads should ideally be countersunk, spot primed, and the holes filled with a high quality wood filler except where exposure of the nail head was part of the original construction system or the wood is too fragile to withstand the countersinking procedure.)

Discoloration due to color extractives in replacement wood can usually be cleaned with a solution of equal parts denatured alcohol and water. After the affected area
has been rinsed and permitted to dry, a "stain-blocking primer" especially developed for preventing this type of stain should be applied (two primer coats are recommended for severe cases of bleeding prior to the finish coat). Each primer coat should be allowed to dry at least 48 hours.

CLASS II Exterior Surface Conditions Generally Requiring Limited Paint Removal

• Crazing

Cause of Condition

Crazing—fine, jagged interconnected breaks in the top layer of paint—results when paint that is several layers thick becomes excessively hard and brittle with age and is consequently no longer able to expand and contract with the wood in response to changes in temperature and humidity (see figure 5). As the wood swells, the bond between paint layers is broken and hairline cracks appear. Although somewhat more difficult to detect as opposed to other more obvious paint problems, it is well worth the time to scrutinize all surfaces for crazing. If not corrected, exterior moisture will enter the crazed surface, resulting in further swelling of the wood and, eventually, deep cracking and alligatoring, a Class III condition which requires total paint removal.

Recommended Treatment

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

Fig. 5 Crazing—or surface cracking—is an exterior surface condition which can be successfully treated by sanding and painting. Photo: Courtesy, National Decorating Products Association.

• Intercoat Peeling

Cause of Condition

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

Another common cause of intercoat peeling is incompatibility between paint types (see figure 6). For example, if oil paint is applied over latex paint, peeling of the top coat can sometimes result since, upon aging, the oil paint becomes harder and less elastic than the latex paint. If latex paint is applied over old, chalking oil paint, peeling can also occur because the latex paint is unable to penetrate the chalky surface and adhere.

Recommended Treatment

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

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

Fig. 6 This is an example of intercoat peeling. A latex top coat was applied directly over old oil paint and, as a result, the latex paint was unable to adhere. If latex is being used over oil, an oil-base primer should be applied first. Although much of the peeling latex paint can be scraped off, in this case, the best solution may be to chemically dip strip the entire shutter to remove all of the paint down to bare wood, rinse thoroughly, then repaint. Photo: Mary L. Oehlein, AIA.

• Solvent Blistering

Cause of Condition

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

- **Wrinkling**

  **Cause of Condition**

  Another error in application that can easily be avoided is wrinkling (see figure 7). This occurs when the top layer of paint dries before the layer underneath. The top layer of paint actually moves as the paint underneath (a primer, for example) is drying. Specific causes of wrinkling include: (1) applying paint too thick; (2) applying a second coat before the first one dries; (3) inadequate brushing out; and (4) painting in temperatures higher than recommended by the manufacturer.

  **Recommended Treatment**

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

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**CLASS III Exterior Surface Conditions Generally Requiring Total Paint Removal**

If surface conditions are such that the majority of paint will have to be removed prior to repainting, it is suggested that a small sample of intact paint be left in an inconspicuous area either by covering the area with a metal plate, or by marking the area and identifying it in some way. (When repainting does take place, the sample should not be painted over). This will enable future investigators to have a record of the building’s paint history.

- **Peeling**

  **Cause of Condition**

  Peeling to bare wood is most often caused by excess interior or exterior moisture that collects behind the paint film, thus impairing adhesion (see figure 8). Generally beginning as blisters, cracking and peeling occur as moisture causes the wood to swell, breaking the adhesion of the bottom layer.

  **Recommended Treatment**

  There is no sense in repainting before dealing with the moisture problems because new paint will simply fail. Therefore, the first step in treating peeling is to locate and remove the source or sources of the moisture, not only because moisture will jeopardize the protective coating of paint but because, if left unattended, it can ultimately cause permanent damage to the wood. Excess interior moisture should be removed from the building through installation of exhaust fans and vents. Exterior moisture should be eliminated by correcting the following conditions prior to repainting: faulty flashing; leaking gutters; defective roof shingles; cracks and holes in siding and trim; deteriorated caulking in joints and seams; and shrubbery growing too close to painted wood. After the moisture problems have been solved, the wood must be permitted to dry out thoroughly. The damaged paint can then be scraped off with a putty knife, hand or mechanically sanded, primed, and repainted.

![Fig. 8 Peeling to bare wood—one of the most common types of paint failure—is usually caused by an interior or exterior moisture problem. Photo: Anne E. Grimmer.](image)

- **Cracking/Alligatoring**

  **Cause of Condition**

  Cracking and alligatoring are advanced stages of crazing (see figure 9). Once the bond between layers has been broken due to intercoat paint failure, exterior moisture is able to penetrate the surface cracks, causing the wood to swell and deeper cracking to take place. This process continues until cracking, which forms parallel to grain, extends to bare wood. Ultimately, the cracking becomes an overall pattern of horizontal and vertical breaks in the paint layers that looks like reptile skin; hence, “alligatoring.” In advanced stages of cracking and alligatoring, the surfaces will also flake badly.

  **Recommended Treatment**

  If cracking and alligatoring are present only in the top layers they can probably be scraped, hand or mechanically sanded to the next sound layer, then repainted. However, if cracking and/or alligatoring have progressed to
bare wood and the paint has begun to flake, it will need to be totally removed. Methods include scraping or paint removal with the electric heat plate, electric heat gun, or chemical strippers, depending on the particular area involved. Bare wood should be primed within 48 hours, then repainted.

Fig. 9 Cracking, alligatoring, and flaking are evidence of long-term neglect of painted surfaces. The remaining paint on the clapboard shown here can be removed with an electric heat plate and wide-bladed scraper. In addition, unsound wood should be replaced and moisture problems corrected before primer and top coats of paint are applied. Photo: David W. Look, AIA.

Selecting the Appropriate/Safest Method to Remove Paint

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

The treatments recommended—based upon field testing as well as onsite monitoring of Department of Interior grant-in-aid and certification of rehabilitation projects—are therefore those which take three over-riding issues into consideration (1) the continued protection and preservation of the historic exterior woodwork; (2) the retention of the sequence of historic paint layers; and (3) the health and safety of those individuals performing the paint removal. By applying these criteria, it will be seen that no paint removal method is without its drawbacks and all recommendations are qualified in varying degrees.

Methods for Removing Paint

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

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

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

- **Abrasiv**e—“Abrading” the painted surface by manual and/or mechanical means such as scraping and sanding. Generally used for surface preparation and limited paint removal.

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

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

- **Abrasive Methods (Manual)**

  If conditions have been identified that require limited paint removal such as crazing, intercoat peeling, solvent blistering, and wrinkling, scraping and hand sanding should be the first methods employed before using mechanical means. Even in the case of more serious conditions such as peeling—where the damaged paint is weak and already sufficiently loosened from the wood surface—scraping and hand sanding may be all that is needed prior to repainting.

  **Recommended Abrasive Methods (Manual)**

  - **Putty Knife/Paint Scraper:** Scraping is usually accomplished with either a putty knife or a paint scraper, or both. Putty knives range in width from one to six inches and have a beveled edge. A putty knife is used in a pushing motion going under the paint and working from an area of loose paint toward the edge where the paint is still firmly adhered and, in effect, “beveling” the remaining layers so that a smooth transition as possible is made between damaged and undamaged areas (see figure 10).

    Paint scrapers are commonly available in 1 1/2, 2 1/2, and 3 1/2 inch widths and have replaceable blades. In addition, profiled scrapers can be made specifically for use on moldings. As opposed to the putty knife, the paint scraper is used in a pulling motion and works by raking the damaged areas of paint away.

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

  - **Sanding Sponge:** After manually removing the damaged layer or layers by scraping, the uneven surface (due to the almost inevitable removal of varying numbers of paint layers in a given area) will need to be smoothed or “feathered out” prior to repainting. As stated before, hand sanding, as opposed to harsher mechanical sanding, is recommended if the area is relatively limited. A coarse grit, open-coat flint sandpaper—the least expensive kind—is useful for this purpose because, as the sandpaper clogs with paint it must be discarded and this process repeated until all layers adhere uniformly.

    Blocks made of wood or hard rubber and covered with sandpaper are useful for handsanding flat surfaces. Sanding sponges—rectangular sponges with an abrasive aggregate on their surfaces—are also available for detail work that requires reaching into grooves because the sponge easily conforms to curves and irregular surfaces. All sanding should be done with the grain.
**Summary of Abrasive Methods (Manual)**

**Recommended:** Putty knife, paint scraper, sandpaper, sanding block, sanding sponge.

**Applicable areas of building:** All areas.

**For use on:** Class I, Class II, and Class III conditions.

**Health/Safety factors:** Take precautions against lead dust, eye damage; dispose of lead paint residue properly.

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in this case, the abrasive surface is a continuous belt of sandpaper that travels at high speeds and consequently offers much less control than the orbital sander. Because of the potential for more damage to the paint or the wood, use of the belt sander (also with a medium grit sandpaper) should be limited to flat surfaces and only skilled operators should be permitted to operate it within a historic preservation project.

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**Fig. 10** An excellent example of inadequate scraping before repainting; the problems here are far more than cosmetic. This improperly prepared surface will permit moisture to get behind the paint film which, in turn, will result in chipping and peeling. Photo: Baird M. Smith, AIA.

**Fig. 11** The orbital sander can be used for limited paint removal, i.e., for smoothing flat surfaces after the majority of deteriorated paint has already been scraped off. Photo: Charles E. Fisher, III.

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**Abrasive Methods (Mechanical)**

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

**Recommended Abrasive Methods (Mechanical)**

**Orbital sander:** Designed as a finishing or smoothing tool—not for the removal of multiple layers of paint—the orbital sander is thus recommended when limited paint removal is required prior to repainting. Because it sands in a small diameter circular motion (some models can also be switched to a back-and-forth vibrating action), this tool is particularly effective for "feathering" areas where paint has first been scraped (see figure 11). The abrasive surface varies from about $3 \times 7$ inches to $4 \times 9$ inches and sandpaper is attached either by clamps or sliding clips. A medium grit, open-coat aluminum oxide sandpaper should be used; fine sandpaper clogs up so quickly that it is ineffective for smoothing paint.

**Belt sander:** A second type of power tool—the belt sander—can also be used for removing limited layers of paint but,

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**Not Recommended**

**Rotary Drill Attachments:** Rotary drill attachments such as the rotary sanding disc and the rotary wire stripper should be avoided. The disc sander—usually a disc of sandpaper about 5 inches in diameter secured to a rubber based attachment which is in turn connected to an electric drill or other motorized housing—can easily leave visible circular depressions in the wood which are difficult to hide, even with repainting. The rotary wire stripper—clusters of metals wires similarly attached to an electric drill-type unit—can actually shred a wooden surface and is thus to be used exclusively for removing corrosion and paint from metals.

**Waterblasting:** Waterblasting above 600 p.s.i. to remove paint is not recommended because it can force water into the woodwork rather than cleaning loose paint and grime from the surface; at worst, high pressure waterblasting causes the water to penetrate exterior sheathing and damages interior finishes. A detergent solution, a medium soft bristle brush, and a garden hose for purposes of rinsing, is the gentlest method involving water and is recommended when cleaning exterior surfaces prior to repainting.

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*Fig. 11* The orbital sander can be used for limited paint removal, i.e., for smoothing flat surfaces after the majority of deteriorated paint has already been scraped off. Photo: Charles E. Fisher, III.
Sandblasting: Finally—and undoubtedly most vehemently “not recommended”—sandblasting painted exterior woodwork will indeed remove paint, but at the same time can scar wooden elements beyond recognition. As with rotary wire strippers, sandblasting erodes the soft porous fibers (spring wood) faster than the hard, dense fibers (summer wood), leaving a pitted surface with ridges and valleys. Sandblasting will also erode projecting areas of carvings and moldings before it removes paint from concave areas (see figure 12). Hence, this abrasive method is potentially the most damaging of all possibilities, even if a contractor promises that blast pressure can be controlled so that the paint is removed without harming the historic exterior woodwork. (For Additional Information, See Preservation Briefs 6, “Dangers of Abrasive Cleaning to Historic Buildings”.)

Fig. 12 Sandblasting has permanently damaged this ornamental bracket. Even paint will not be able to hide the deep erosion of the wood. Photo: David W. Look, AIA.

Summary of Abrasive Methods (Mechanical)
Recommended: Orbital sander, belt sander (skilled operator only).
Applicable areas of building: Flat surfaces, i.e., siding, eaves, doors, window sills.
For use on: Class II and Class III conditions.
Health/Safety factors: Take precautions against lead dust and eye damage; dispose of lead paint residue properly.
Not Recommended: Rotary drill attachments, high pressure waterblasting, sandblasting.

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

Recommended Thermal Methods
Electric heat plate: The electric heat plate (see figure 13) operates between 500 and 800 degrees Fahrenheit (not hot enough to vaporize lead paint), using about 15 amps of power. The plate is held close to the painted exterior surface until the layers of paint begin to soften and blister, then moved to an adjacent location on the wood while the softened paint is scraped off with a putty knife (it should be noted that the heat plate is most successful when the paint is very thick!). With practice, the operator can successfully move the heat plate evenly across a flat surface such as wooden siding or a window sill or door in a continuous motion, thus lessening the risk of scorching the wood in an attempt to reheat the edge of the paint sufficiently for effective removal. Since the electric heat plate’s coil is “red hot,” extreme caution should be taken to avoid igniting clothing or burning the skin. If an extension cord is used, it should be a heavy-duty cord (with 3-prong grounded plugs). A heat plate could overload a circuit or, even worse, cause an electrical fire; therefore, it is recommended that this implement be used with a single circuit and that a fire extinguisher always be kept close at hand.

Fig. 13 The electric heat plate (with paint scraper) is particularly useful for removing paint down to bare wood on flat surfaces such as doors, window frames, and siding. After scraping, some light sanding will probably be necessary to smooth the surface prior to application of primer and top coats. Photo: David W. Look, AIA.

Electric heat gun: The electric heat gun (electric hot-air gun) looks like a hand-held hairdryer with a heavy-duty metal case (see figure 14). It has an electrical resistance coil that typically heats between 500 and 750 degrees Fahrenheit and, again, uses about 15 amps of power which requires a heavy-duty extension cord. There are some heat guns that operate at higher temperatures but they should not be purchased for removing old paint.
because of the danger of lead paint vapors. The temperature is controlled by a vent on the side of the heat gun. When the vent is closed, the heat increases. A fan forces a stream of hot air against the painted woodwork, causing a blister to form. At that point, the softened paint can be peeled back with a putty knife. It can be used to best advantage when a paneled door was originally varnished, then painted a number of times. In this case, the paint will come off quite easily, often leaving an almost pristine varnished surface behind. Like the heat plate, the heat gun works best on a heavy paint build-up. (It is, however, not very successful on only one or two layers of paint or on surfaces that have only been varnished. The varnish simply becomes sticky and the wood scorches.)

Although the heat gun is heavier and more tiring to use than the heat plate, it is particularly effective for removing paint from detail work because the nozzle can be directed at curved and intricate surfaces. Its use is thus more limited than the heat plate, and most successfully used in conjunction with the heat plate. For example, it takes about two to three hours to strip a paneled door with a heat gun, but if used in combination with a heat plate for the large, flat area, the time can usually be cut in half. Although a heat gun seldom scorches wood, it can cause fires (like the blow torch) if aimed at the dusty cavity between the exterior sheathing and siding and interior lath and plaster. A fire may smolder for hours before flames break through to the surface. Therefore, this thermal device is best suited for use on solid decorative elements, such as molding, balusters, fretwork, or "gingerbread."

Fig. 14 The nozzle on the electric heat gun permits hot air to be aimed into cavities on solid decorative elements such as this applied column. After the paint has been sufficiently softened, it can be removed with a profiled scraper. Photo: Charles E. Fisher, III.

**Summary of Thermal Methods**

**Recommended:** Electric heat plate, electric heat gun.

**Applicable areas of building:** Electric heat plate—flat surfaces such as siding, eaves, sash, sills, doors. Electric heat gun—solid decorative molding, balusters, fretwork, or "gingerbread."

**For use on:** Class III conditions.

**Health/Safety factors:** Take precautions against eye damage and fire. Dispose of lead paint residue properly.

**Not Recommended:** Blow torch.

**Chemical Methods**

With the availability of effective thermal methods for total paint removal, the need for chemical methods—in the context of preparing historic exterior woodwork for repainting—becomes quite limited. Solvent-base or caustic strippers may, however, play a supplemental role in a number of situations, including:

- Removing paint residue from intricate decorative features, or in cracks or hard to reach areas if a heat gun has not been completely effective;
- Removing paint on window muntins because heat devices can easily break the glass;
- Removing varnish on exterior doors after all layers of paint have been removed by a heat plate/heat gun if the original varnish finish is being restored;
- Removing paint from detachable wooden elements such as exterior shutters, balusters, columns, and doors by dip-stripping when other methods are too laborious.

**Recommended Chemical Methods**

(Use With Extreme Caution)

Because all chemical paint removers can involve potential health and safety hazards, no wholehearted recommendations can be made from that standpoint. Commonly known as "paint removers" or "strippers," both solvent-base or caustic products are commercially available that, when poured, brushed, or sprayed on painted exterior woodwork are capable of softening several layers of paint at a time so that the resulting "sludge"—which should be remembered is nothing less than the sequence of historic
paint layers—can be removed with a putty knife. Detachable wood elements such as exterior shutters can also be "dip-stripped."

**Solvent-base Strippers:** The formulas tend to vary, but generally consist of combinations of organic solvents such as methylene chloride, isopropanol, tolou, xylol, and methanol; thickeners such as methyl cellulose; and various additives such as paraffin wax used to prevent the volatile solvents from evaporating before they have time to soak through multiple layers of paint. Thus, while some solvent-base strippers are quite thin and therefore unsuitable for use on vertical surfaces, others, called "semi-paste" strippers, are formulated for use on vertical surfaces or the underside of horizontal surfaces.

However, whether liquid or semi-paste, there are two important points to stress when using any solvent-base stripper: First, the vapors from the organic chemicals can be highly toxic if inhaled; skin contact is equally dangerous because the solvents can be absorbed; second, many solvent-base strippers are flammable. Even though application out-of-doors may somewhat mitigate health and safety hazards, a respirator with special filters for organic solvents is recommended and, of course, solvent-base strippers should never be used around open flames, lighted cigarettes, or with steel wool around electrical outlets.

Although appearing to be the simplest for exterior use, a particular type of solvent-base stripper needs to be mentioned here because it can actually cause the most problems. Known as "water-rinsable," such products have a high proportion of methylene chloride together with emulsifiers. Although the dissolved paint can be rinsed off with water with a minimum of scraping, this ultimately creates more of a problem in cleaning up and properly disposing of the sludge. In addition, these strippers can leave a gummy residue on the wood that requires removal with solvents. Finally, water-rinsable strippers tend to raise the grain of the wood more than regular strippers.

On balance, then, the regular strippers would seem to work just as well for exterior purposes and are perhaps even better from the standpoint of proper lead sludge disposal because they must be hand scraped as opposed to rinsed off (a coffee-can with a wire stretched across the top is one effective way to collect the sludge: when the putty knife is run across the wire, the sludge simply falls into the can. Then, when the can is filled, the wire is removed, the can capped, and the lead paint sludge disposed of according to local health regulations).

**Caustic Strippers:** Until the advent of solvent-base strippers, caustic strippers were used exclusively when a chemical method was deemed appropriate for total paint removal prior to repainting or refinishing. Now, it is more difficult to find commercially prepared caustic solutions in hardware and paint stores for home-owner use with the exception of lye (caustic soda) because solvent-base strippers packaged in small quantities tend to dominate the market.

Most commercial dip stripping companies, however, continue to use variations of the caustic bath process because it is still the cheapest method available for removing paint. Generally, dip stripping should be left to professional companies because caustic solutions can dissolve skin and permanently damage eyes as well as present serious disposal problems in large quantities.

If exterior shutters or other detachable elements are being sent out* for stripping in a caustic solution, it is wise to see samples of the company’s finished work. While some companies do a first-rate job, others can leave a residue of paint in carvings and grooves. Wooden elements may also be soaked too long so that the wood grain is raised and roughened, requiring extensive hand sanding later. In addition, assurances should be given by these companies that caustic paint removers will be neutralized with a mild acid solution or at least thoroughly rinsed with water after dipping (a caustic residue makes the wood feel slippery). If this is not done, the lye residue will cause new paint to fail.

**Summary of Chemical Methods**

**Recommended, with extreme caution:** Solvent-base strippers, caustic strippers.

**Applicable areas of buildings:** decorative features, window muntins, doors, exterior shutters, columns, balusters, and railings.

**For use on:** Class III Conditions.

**Health/Safety factors:** Take precautions against inhaling toxic vapors; fire; eye damage; and chemical poisoning from skin contact. Dispose of lead residue properly.

**General Paint Type Recommendations**

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

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

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* Marking the original location of the shutter by number (either by stamping numbers into the end grain with metal numeral dies or cutting numbers into the end with a pen knife) will minimize difficulties when rehanging them.

* If the top coat is latex paint (when viewed by the naked eye or, preferably, with a magnifying glass, it looks like a series of tiny craters) it may either be repainted with new latex paint or with oil paint. Normal surface preparation should precede any repainting.
If CLASS III conditions have necessitated total paint removal, there are two options, both of which assure protection of the exterior wood: (1) an oil primer may be applied followed by an oil-type top coat, preferably by the same manufacturer; or (2) an oil primer may be applied followed by a latex top coat, again using the same brand of paint. It should also be noted that primers were never intended to withstand the effects of weathering; therefore, the top coat should be applied as soon as possible after the primer has dried.

Conclusion

The recommendations outlined in this Brief are cautious because at present there is no completely safe and effective method of removing old paint from exterior woodwork. This has necessarily eliminated descriptions of several methods still in a developmental or experimental stage, which can therefore neither be recommended nor precluded from future recommendation. With the ever-increasing number of buildings being rehabilitated, however, paint removal technology should be stimulated and, in consequence, existing methods refined and new methods developed which will respect both the historic wood and the health and safety of the operator.

Reading List


This publication has been prepared pursuant to The Economic Recovery Tax Act of 1981, which directs the Secretary of the Interior to certify rehabilitations of historic buildings that are consistent with their historic character; the advice and guidance in this Brief will assist property owners in complying with the requirements of this law.

Preservation Briefs 10 has been developed under the technical editorship of Lee H. Nelson, AIA, Chief, Preservation Assistance Division, National Park Service, U.S. Department of the Interior, Washington, D.C. 20240. Comments on the usefulness of this information are welcomed and can be sent to Mr. Nelson at the above address.

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Uncontrolled moisture is the most prevalent cause of deterioration in older and historic buildings. It leads to erosion, corrosion, rot, and ultimately the destruction of materials, finishes, and eventually structural components. Ever-present in our environment, moisture can be controlled to provide the differing levels of moisture necessary for human comfort as well as the longevity of historic building materials, furnishings, and museum collections. The challenge to building owners and preservation professionals alike is to understand the patterns of moisture movement in order to better manage it—not to eliminate it. There is never a single answer to a moisture problem. Diagnosis and treatment will always differ depending on where the building is located, climatic and soil conditions, ground water effects, and local traditions in building construction.

Remedial Actions within an Historic Preservation Context

In this Brief, advice about controlling the sources of unwanted moisture is provided within a preservation context based on philosophical principles contained in the Secretary of the Interior’s Standards for the Treatment of Historic Properties. Following the Standards means significant materials and features that contribute to the historic character of the building should be preserved, not damaged during remedial treatment (see fig. 1). It also means that physical treatments should be reversible, whenever possible. The majority of treatments for moisture management in this Brief stress preservation maintenance for materials, effective drainage of troublesome ground moisture, and improved interior ventilation.

The Brief encourages a systematic approach for evaluating moisture problems which, in some cases, can be undertaken by a building owner. Because the source of moisture can be elusive, it may be necessary to consult with historic preservation professionals prior to starting work that would affect historic materials. Architects, engineers, conservators, preservation contractors, and staff of State Historic Preservation Offices (SHPOs) can provide such advice.

Regardless of who does the work, however, these are the principles that should guide treatment decisions:

- Avoid remedial treatments without prior careful diagnosis.
- Undertake treatments that protect the historical significance of the resource.
- Address issues of ground-related moisture and rain runoff thoroughly.
- Manage existing moisture conditions before introducing humidified/dehumidified mechanical systems.
- Implement a program of ongoing monitoring and maintenance once moisture is controlled or managed.
- Be aware of significant landscape and archeological resources in areas to be excavated.

Finally, mitigating the effects of catastrophic moisture, such as floods, requires a different approach and will not be addressed fully in this Brief.

Fig. 1. Moisture problems, if not properly corrected, will increase damage to historic buildings. This waterproof coating trapped moisture from the leaking roof, causing portions of the masonry parapet to fail. Photo: NPS Files.
How and Where to Look for Damaging Moisture

Finding, treating, and managing the sources of damaging moisture requires a systematic approach that takes time, patience, and a thorough examination of all aspects of the problem—including a series of variable conditions (see this page). Moisture problems may be a direct result of one of these factors or may be attributable to a combination of interdependent variables.

Factors Contributing to Moisture Problems

A variety of simultaneously existing conditions contribute to moisture problems in old buildings. For recurring moisture problems, it may be necessary for the owner or preservation professional to address many, if not all, of the following variables:

- Types of building materials and construction systems
- Type and condition of roof and site drainage systems and their rates of discharge
- Type of soil, moisture content, and surface/subsurface water flow adjacent to building
- Building usage and moisture generated by occupancy
- Condition and absorption rates of materials
- Type, operation, and condition of heating, ventilating, cooling, humidification/dehumidification, and plumbing systems
- Daily and seasonal changes in sun, prevailing winds, rain, temperature, and relative humidity (inside and outside), as well as seasonal or tidal variations in groundwater levels
- Unusual site conditions or irregularities of construction
- Conditions in affected wall cavities, temperature and relative humidity, and dewpoints
- Amount of air infiltration present in a building
- Adjacent landscape and planting materials

Diagnosing and treating the cause of moisture problems requires looking at both the localized decay, as well as understanding the performance of the entire building and site. Moisture is notorious for traveling far from the source, and moisture movement within concealed areas of the building construction make accurate diagnosis of the source and path difficult. Obvious deficiencies, such as broken pipes, clogged gutters, or cracked walls that contribute to moisture damage, should always be corrected promptly.

For more complicated problems, it may take several months or up to four seasons of monitoring and evaluation to complete a full diagnosis. Rushing to a solution without adequate documentation can often result in the unnecessary removal of historic materials—and worse—the creation of long-term problems associated with an increase, rather than a decrease, in the unwanted moisture.

Looking for Signs

Identifying the type of moisture damage and discovering its source or sources usually involves the human senses of sight, smell, hearing, touch, and taste combined with intuition. Some of the more common signs of visible as well as hidden moisture damage (see fig. 2, 3) include:

- Presence of standing water, mold, fungus, or mildew
- Wet stains, eroding surfaces, or efflorescence (salt deposits) on interior and exterior surfaces
- Flaking paint and plaster, peeling wallpaper, or moisture blisters on finished surfaces
- Dank, musty smells in areas of high humidity or poorly ventilated spaces
- Rust and corrosion stains on metal elements, such as anchorage systems and protruding roof nails in the attic
- Cupped, warped, cracked, or rotted wood
- Spalled, cracked masonry or eroded mortar joints
- Faulty roofs and gutters including missing roofing slates, tiles, or shingles and poor condition of flashing or gutters
- Condensation on window and wall surfaces
- Ice dams in gutters, on roofs, or moisture in attics

Fig. 2. Historic buildings plagued by dampness problems will benefit from systematic documentation to set a baseline against which moisture changes can be measured. Exterior areas with higher moisture levels may have algae growth or discoloration stains. Drawing: John H. Stubbs.

Fig. 3. The deterioration of this wooden cover was a sign that water was leaking from the fan coil unit behind. Photo: author.
Uncovering and Analyzing Moisture Problems

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

The five most common sources of unwanted moisture include:

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

Above grade exterior moisture generally results from weather related moisture entering through deteriorating materials as a result of deferred maintenance, structural settlement cracks, or damage from high winds or storms (see fig. 4). Such sources as faulty roofs, cracks in walls, and open joints around window and door openings can be corrected through either repair or limited replacement. Due to their age, historic buildings are notoriously “drafty,” allowing rain, wind, and damp air to enter through missing mortar joints; around cracks in windows, doors, and wood siding; and into uninsulated attics. In some cases, excessively absorbent materials, such as soft sandstone, become saturated from rain or gutter overflows, and can allow moisture to dampen interior surfaces. Vines or other vegetative materials allowed to grow directly on building materials without trellis or other framework can cause damage from roots eroding mortar joints and foundations as well as dampness being held against surfaces. In most cases, keeping vegetation off buildings, repairing damaged materials, replacing flashings, rehanging gutters, repairing downspouts, repointing mortar, caulking perimeter joints around windows and doors, and repainting surfaces can alleviate most sources of unwanted exterior moisture from entering a building above grade.

Below grade ground moisture is a major source of unwanted moisture for historic and older buildings. Proper handling of surface rain run-off is one of the most important measures of controlling unwanted ground moisture. Rain water is often referred to as “bulk moisture” in areas that receive significant annual rainfalls or infrequent, but heavy, precipitation. For example, a heavy rain of 2" per hour can produce 200 gallons of water from downspout discharge alone for a house during a one hour period. When soil is saturated at the base of the building, the moisture will wet footings and crawl spaces or find its way through cracks in foundation walls and enter into basements (see fig. 5). Moisture in saturated basement or foundation walls—also exacerbated by high water tables—will generally rise up within a wall and eventually cause deterioration of the masonry and adjacent wooden structural elements.

Builders traditionally left a working area, known as a builder’s trench, around the exterior of a foundation wall. These trenches have been known to increase moisture problems if the infill soil is less than fully compacted or includes rubble backfill, which, in some cases, may act as a reservoir holding damp materials against masonry walls. Broken subsurface pipes or downspout drainage can leak into the builder’s trench and dampen walls some distance from the source. Any subsurface penetration of the foundation wall for sewer, water, or other piping also can act as a direct conduit of ground moisture unless these holes are well sealed. A frequently unsuspected, but serious, modern source of ground moisture is a landscape irrigation system set too close to the building. Incorrect placement of sprinkler heads can add a tremendous amount of moisture at the foundation level and on wall surfaces.

Fig. 4. Deferred maintenance often leads to blocked gutters and downspouts. This cracked gutter system allowed moisture to penetrate the upper exterior wall, erode mortar joints, and rot fascia boards. Photo: NPS files.

Fig. 5. Excavating this foundation revealed that the downspout pipe had corroded at the "u-trap" and was leaking moisture into the soil. Openings around the horizontal water supply line and cracks in the wall allowed moisture to penetrate the basement in multiple locations. Photo: author.
The ground, and subsequently the building, will stay much drier by 1) re-directing rain water away from the foundation through sloping grades, 2) capturing and disposing downspout water well away from the building, 3) developing a controlled ground gutter or effective drainage for buildings historically without gutters and downspouts, and 4) reducing splash-back of moisture onto foundation walls. The excavation of foundations and the use of dampproof coatings and footing drains should only be used after the measures of reducing ground moisture listed above have been implemented.

Leaking plumbing pipes and mechanical equipment can cause immediate or long-term damage to historic building interiors. Routine maintenance, repair, or, if necessary, replacement of older plumbing and mechanical equipment are common solutions. Older water and sewer pipes are subject to corrosion over time. Slow leaks at plumbing joints hidden within walls and ceilings can ultimately rot floor boards, stain ceiling plaster, and lead to decay of structural members. Frozen pipes that crack can damage interior finishes (see fig. 6). In addition to leaking plumbing pipes, old radiators in some historic buildings have been replaced with water-supplied fan coil units which tend to leak. These heating and cooling units, as well as central air equipment, have overflow and condensation pans that require cyclical maintenance to avoid mold and mildew growth and corrosion blockage of drainage channels. Uninsulated forced-air sheet metal ductwork and cold water pipes in walls and ceilings often allow condensation to form on the cold metal, which then drips and causes bubbling plaster and peeling paint. Careful design and vigilant maintenance, as well as repair and insulating pipes or ductwork, will generally rid the building of these common sources of moisture.

Fig. 6. Uninsulated plumbing pipes close to the exterior wall froze and cracked, wetting this ornamental plaster ceiling before the water supply line could be shut off. As a result, limited portions of the ceiling needed reattaching. Photo: author.

Interior moisture from building use and modern humidified heating and cooling systems can create serious problems. In northern U.S. climates, heated buildings will have winter-time relative humidity levels ranging from 10%-35% Relative Humidity (RH). A house with four occupants generates between 10 and 16 pounds of water a day (approximately 1 - 2 gallons) from human residents. Moisture from food preparation, showering, or laundry use will produce condensation on windows in winter climates.

When one area or floor of a building is air-conditioned and another area is not, there is the chance for condensation to occur between the two areas. Most periodic condensation does not create a long-term problem.

Humidified climate control systems are generally a major problem in museums housed within historic buildings. They produce between 35%-55% RH on average which, as a vapor, will seek to dissipate and equalize with adjacent spaces (see fig. 7). Moisture can form on single-glazed windows in winter with exterior temperatures below 30 F and interior temperatures at 70 F with as little as 35% RH. Frequent condensation on interior window surfaces is an indication that moisture is migrating into exterior walls, which can cause long-term damage to historic materials. Materials and wall systems around climate controlled areas may need to be made of moisture resistant finishes in order to handle the additional moisture in the air. Moist interior conditions in hot and humid climates will generate mold and fungal growth. Unvented mechanical equipment, such as gas stoves, dryers, and kerosene heaters, generate large quantities of moisture. It is important to provide adequate ventilation and find a balance between interior temperature, relative humidity, and airflow to avoid interior moisture that can damage historic buildings.

Fig. 7. Condensation dripping from the large overhead courtyard skylight was damaging the masonry in this museum. A new skylight with thermal glazing was installed, replacing the deteriorated single-glazed unit. A new climate control system monitors interior temperature and humidity. Photo: © Isabella Stewart Gardner Museum, Boston.

Moisture from maintenance and construction materials can cause damage to adjacent historic materials. Careless use of liquids to wash floors can lead to water seepage through cracks and dislodge adhesives or cup and curl materials. High-pressure power washing of exterior walls and roofing materials can force water into construction joints where it can dislodge mortar, lift roofing tiles, and saturate frame walls and masonry. Replastered or newly
plastered interior walls or the construction of new additions attached to historic buildings may hold moisture for months; new plaster, mortar, or concrete should be fully cured before they are painted or finished. The use of materials in projects that have been damaged by moisture prior to installation or have too high a moisture content may cause concealed damage (see fig. 8).

**Transport or Movement of Moisture**

Knowing the five most common sources of moisture that cause damage to building materials is the first step in diagnosing moisture problems. But it is also important to understand the basic mechanisms that affect moisture movement in buildings. Moisture transport, or movement, occurs in two states: liquid and vapor. It is directly related to pressure differentials. For example, water in a gaseous or vapor state, as warm moist air, will move from its high pressure area to a lower pressure area where the air is cooler and drier. Liquid water will move as a result of differences in hydrostatic pressure or wind pressure. It is the pressure differentials that drive the rate of moisture migration in either state. Because the building materials themselves resist this moisture movement, the rate of movement will depend on two factors: the permeability of the materials when affected by vapor and the absorption rates of materials in contact with liquid.

The mechanics, or physics, of moisture movement is complex, but if the driving force is difference in pressure, then an approach to reducing moisture movement and its damage is to reduce the difference in pressure, not to increase it. That is why the treatments discussed in this Brief will look at managing moisture by draining bulk moisture and ventilating vapor moisture before setting up new barriers with impermeable coatings or over-pressurized new climate control systems that threaten aging building materials and archaic construction systems.

Three forms of moisture transport are particularly important to understand in regards to historic buildings — infiltration, capillary action, and vapor diffusion — remembering, at the same time, that the subject is infinitely complex and, thus, one of continuing scientific study (see fig. 9). Buildings were traditionally designed to deal with the movement of air. For example, cupolas and roof lanterns allowed hot air to rise and provided a natural draft to pull air through buildings. Cavity walls in both frame and masonry buildings were constructed to allow moisture to dissipate in the air space between external and internal walls. Radiators were placed in front of windows to keep cold surfaces warm, thereby reducing condensation on these surfaces. Many of these features, however, have been altered over time in an effort to modernize appearances, improve energy efficiency, or accommodate changes in use. The change in use will also affect moisture movement, particularly in commercial and industrial buildings with modern mechanical systems. Therefore, the way a building handles air and moisture today may be different from that intended by the original builder or architect, and poorly conceived changes may be partially responsible for chronic moisture conditions.

Moisture moves into and through materials as both a visible liquid (capillary action) and as a gaseous vapor (infiltration and vapor diffusion). Moisture from leaks, saturation, rising damp, and condensation can lead to the deterioration of materials and cause an unhealthy environment. Moisture in its solid form, ice, can also cause damage from frozen, cracked water pipes, or split gutter seams or spalled masonry from freeze-thaw action. Moisture from melting ice dams, leaks, and condensation often can travel great distances down walls and along construction surfaces, pipes, or conduits. The amount of moisture and how it deteriorates materials is dependent upon complex forces and variables that must be considered for each situation.
Determining the way moisture is handled by the building is further complicated because each building and site is unique. Water damage from blocked gutters and downspouts can saturate materials on the outside, and high levels of interior moisture can saturate interior materials. Difficult cases may call for technical evaluation by consultants specializing in moisture monitoring and diagnostic evaluation. In other words, it may take a team to effectively evaluate a situation and determine a proper approach to controlling moisture damage in old buildings.

**Infiltration** is created by wind, temperature gradients (hot air rising), ventilation fan action, and the stack or chimney effect that draws air up into tall vertical spaces. Infiltration as a dynamic force does not actually move liquid water, but is the vehicle by which dampness, as a component of air, finds its way into building materials. Older buildings have a natural air exchange, generally from 1 to 4 changes per hour, which, in turn, may help control moisture by diluting moisture within a building. The tighter the building construction, however, the lower will be the infiltration rate and the natural circulation of air. In the process of infiltration, however, moisture that has entered the building and saturated materials can be drawn in and out of materials, thereby adding to the dampness in the air (see fig. 10). Inadequate air circulation where there is excessive moisture (i.e., in a damp basement), accelerates the deterioration of historic materials. To reduce the unwanted moisture that accompanies infiltration, it is best to incorporate maintenance and repair treatments to close joints and weatherstrip windows, while providing controlled air exchanges elsewhere. The worst approach is to seal the building so completely, while limiting fresh air intake, that the building cannot breathe.

**Capillary action** occurs when moisture in saturated porous building materials, such as masonry, wicks up or travels vertically as it evaporates to the surface. In capillary attraction, liquid in the material is attracted to the solid surface of the pore structure causing it to rise vertically; thus, it is often called "rising damp," particularly when found in conjunction with ground moisture. It should not, however, be confused with moisture that laterally penetrates a foundation wall through cracks and settles in the basement. Not easily controlled, most rising damp comes from high water tables or a constant source under the footing. In cases of damp masonry walls with capillary action, there is usually a whitish stain or horizontal tide mark of efflorescence that seasonally fluctuates about 1-3 feet above grade where the excess moisture evaporates from the wall (see fig. 11). This tide mark is full of salt crystals, that have been drawn from the ground and building materials along with the water, making the masonry even more sensitive to additional moisture absorption from the surrounding air. Capillary migration of moisture may occur in any material with a pore structure where there is a constant or recurring source of moisture.

**Vapor diffusion** is the natural movement of pressurized moisture vapor through porous materials. It is most readily apparent as humidified interior air moves out through walls to a cooler exterior. In a hot and humid climate, the reverse will happen as moist hot air moves into cooler, dryer, air-conditioned, interiors. The movement of the moisture vapor is not a serious problem until the dewpoint temperature is reached and the vapor changes into liquid moisture known as condensation. This can occur within a wall or on interior surfaces. Vapor diffusion will be more of
a problem for a frame structure with several layers of infill materials within the frame cavity than a dense masonry structure. Condensation as a result of vapor migration usually takes place on a surface or film, such as paint, where there is a change in permeability.

The installation of climate control systems in historic buildings (mostly museums) that have not been properly designed or regulated and that force pressurized damp air to diffuse into perimeter walls is an ongoing concern. These newer systems take constant monitoring and back-up warning systems to avoid moisture damage.

Long-term and undetected condensation or high moisture content can cause serious structural damage as well as an unhealthy environment, heavy with mold and mildew spores. Reducing the interior/exterior pressure differential and the difference between interior and exterior temperature and relative humidity helps control unwanted vapor diffusion. This can sometimes be achieved by reducing interior relative humidity. In some instances, using vapor barriers, such as heavy plastic sheeting laid over damp crawl spaces, can have remarkable success in stopping vapor diffusion from damp ground into buildings. Yet, knowledgeable experts in the field differ regarding the appropriateness of vapor barriers and when and where to use them, as well as the best way to handle natural diffusion in insulated walls.

Adding insulation to historic buildings, particularly in walls of wooden frame structures, has been a standard practice since the 18th century. While insulation has the benefit of increasing the efficiency of heating and cooling by containing temperature controlled air, it does not eliminate surfaces on which damaging moisture can condense. For insulated residential frame structures, the most obvious sign of a moisture diffusion problem is peeling paint on wooden siding, even after careful surface preparation and repainting. Vapor impermeable barriers such as plastic sheeting, or more accurately, vapor retarders, in cold and moderate climates generally help slow vapor diffusion where it is not wanted.

In regions where humidified climate control systems are installed into insulated frame buildings, it is important to stop interstitial, or in-wall, dewpoint condensation. This is very difficult because humidified air can penetrate breaches in the vapor barrier, particularly around electrical outlets (see fig. 12). Improperly or incompletely installed retrofit vapor barriers will cause extensive damage to the building, just in the installation process, and will allow trapped condensation to wet the insulation and sheathing boards, corrode metal elements such as wiring cables and metal anchors, and blister paint finishes. Providing a tight wall vapor barrier, as well as a ventilated cavity behind wooden clapboards or siding appears to help insulated frame walls, if the interior relative humidity can be adjusted or monitored to avoid condensation. Correct placement of vapor retarders within building construction will vary by region, building construction, and type of climate control system.

**Surveying and Diagnosing Moisture Damage: Key Questions to Ask**

It is important for the building to be surveyed first and the evidence and location of suspected moisture damage systematically recorded before undertaking any major work to correct the problem. This will give a baseline from which relative changes in condition can be noted.

When materials become wet, there are specific physical changes that can be detected and noted in a record book or on survey sheets. Every time there is a heavy rain, storm, water in the basement, or mechanical systems failure, the owner or consultant should note and record the way moisture is moving, its appearance, and what variables might contribute to the cause. Standing outside to observe a building in the rain may answer many questions and help trace the movement of water into the building. Evidence of deteriorating materials that cover more serious moisture damage should also be noted, even if it is not immediately clear what is causing the damage. (For example, water stains on the ceiling may be from leaking pipes, blocked fan coil drainage pans above, or from moisture which has penetrated around a poorly sloped window sill above.) Don't jump to conclusions, but use a systematic approach to help establish an educated theory — or hypothesis — of what is causing the moisture problem or what areas need further investigation.

Surveying moisture damage must be systematic so that relative changes can be noted. Tools for investigating can be as simple as a notebook, sketch plans, binoculars, camera, aluminum foil, smoke pencil, and flashlight. The systematic approach involves looking at buildings from the top down and from the outside to the inside. Photographs, floor plans, site plan, and exterior elevations — even roughly sketched — should be used to indicate all evidence of damp or damaged materials, with notations for musty or poorly ventilated areas. Information might be needed on the absorption and permeability characteristics of the building materials and soils. Exterior drainage patterns should be noted and these base plans referred to on a regular basis in different seasons and in differing types of weather (see fig. 13).

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Fig. 12. Vapor diffusion can result in damp air migrating into absorbent materials and condensing on colder surfaces, thereby wetting insulation, damaging electrical conduits, and causing deterioration of the wooden framing. Drawing: NPS Files.
Glossary:

Air flow infiltration: The movement that carries moist air into and through materials. Air flow depends on the difference between indoor and outdoor pressures, wind speed and direction as well as the permeability of materials.

Bulk water: The large quantity of moisture from roof and ground run-off that can enter into a building either above grade or below grade.

Capillary action: The force that moves moisture through the pore structure of materials. Generally referred to as rising damp, moisture at or below the foundation level will rise vertically in a wall to a height at which the rate of evaporation balances the rate at which it can be drawn up by capillary forces.

Condensation: The physical process by which water vapor is transformed into a liquid when the relative humidity of the air reaches 100% and the excess water vapor forms, generally as droplets, on the colder adjacent surface.

Convection: Heat transfer through the atmosphere by a difference in force or air pressure is one type of air transport. Sometimes referred to as the “stack effect,” hotter less dense air will rise, colder dense air will fall creating movement of air within a building.

Dewpoint: The temperature at which water vapor condenses when the air is cooled at a constant pressure and constant moisture content.

Diffusion: The movement of water vapor through a material. Diffusion depends on vapor pressure, temperature, relative humidity, and the permeability of a material.

Evaporation: The transformation of liquid into a vapor, generally as a result of rise of temperature, is the opposite of condensation. Moisture in damp soil, such as in a crawl space, can evaporate into the air, raise the relative humidity in that space, and enter the building as a vapor.

Ground moisture: The saturated moisture in the ground as a result of surface run-off and naturally occurring water tables. Ground moisture can penetrate through cracks and holes in foundation walls or can migrate up from moisture under the foundation base.

Monitoring instrumentation: These devices are generally used for long term diagnostic analysis of a problem, or to measure the performance of a treatment, or to measure changes of conditions or environment. In-wall probes or sensors are often attached to data-loggers which can be down-loaded into computers.

Permeability: A characteristic of porosity of a material generally listed as the rate of diffusion of a pressurized gas through a material. The pore structure of some materials allows them to absorb or adsorb more moisture than other materials. Limestones are generally more permeable than granites.

Relative humidity (RH): Dampness in the air is measured as the percent of water vapor in the air at a specific temperature relative to the amount of water vapor that can be held in a vapor form at that specific temperature.

Survey instrumentation: technical instrumentation that is used on-site to provide quick readings of specific physical conditions. Generally these are hand-held survey instruments, such as moisture, temperature and relative humidity readers, dewpoint sensors, and fiber optic boroscopes.

It is best to start with one method of periodic documentation and to use this same method each time. Because moisture is affected by gravity, many surveys start with the roof and guttering systems and work down through the exterior walls. Any obvious areas of water penetration, damaged surfaces, or staining should be noted. Any recurring damp or stain patterns, both exterior and interior, should also be noted with a commentary on the temperature, weather, and any other facts that may be relevant (driving rains, saturated soil, high interior humidity, recent washing of the building, presence of a lawn watering system, etc.).

The interior should be recorded as well, beginning with the attic and working down to the basement and crawl space. It may be necessary to remove damaged materials selectively in order to trace the path of moisture or to pinpoint a source, such as a leaking pipe in the ceiling. The use of a basic resistance moisture meter, available in many hardware stores, can identify moisture contents of materials and show, over time, if wall surfaces are drying or becoming damper (see fig. 14). A smoke pencil can chart air infiltration around windows or draft patterns in interior spaces. For a quick test to determine if a damp basement is caused by saturated walls or is a result of condensation, tape a piece of foil onto a masonry surface and check it after a day or two; if moisture has developed behind the foil, then it is coming from the masonry. If condensation is on the surface of the foil, then moisture is from the air.

Comparing current conditions with previous conditions, historic drawings, photographs, or known alterations may also assist in the final diagnosis. A chronological record, showing improvement or deterioration, should be backed up with photographs or notations as to the changing size, condition, or features of the deterioration and how these changes have been affected by variables of temperature and rainfall. If a condition can be related in time to a particular event, such as efflorescence developing on a chimney after the building is no longer heated, it may be possible to isolate a cause, develop a hypothesis, and then test the hypothesis (by adding some temporary heat), before applying a remedial treatment.
If the owner or consultant has access to moisture survey and monitoring equipment such as resistance moisture meters, dewpoint indicators, salt detectors, infrared thermography systems, psychrometer, fiber-optic boroscopes, and miniaturized video cameras, additional quantified data can be incorporated into the survey (see fig. 15). If it is necessary to track the wetting and drying of walls over a period of time, deep probes set into walls and in the soil with connector cables to computerized data loggers or the use of long-term recording of hygrothermographs may require a trained specialist. Miniaturized fiber-optic video cameras can record the condition of subsurface drain lines without excavation (see fig. 16). It should be noted, however, that instrumentation, while extremely useful, cannot take the place of careful personal observation and analysis. Relying on instrumentation alone rarely will give the owner the information needed to fully diagnose a moisture problem.

To avoid jumping to a quick—potentially erroneous—conclusion, a series of questions should be asked first. This will help establish a theory or hypothesis that can be tested to increase the chances that a remedial treatment will control or manage existing moisture.

**How is water draining around building and site?** What is the effectiveness of gutters and downspouts? Are the slopes or grading around foundations adequate? What are the locations of subsurface features such as wells, cisterns, or drainage fields? Are there subsurface drainage pipes (or drainage boots) attached to the downspouts and are they in good working condition? Does the soil retain moisture or allow it to drain freely? Where is the water table? Are there window wells holding rain water? What is the flow rate of area drains around the site (can be tested with a hose for several minutes)? Is the storm piping out to the street sufficient for heavy rains, or does water chronically back up on the site? Has adjacent new construction affected site drainage or water table levels?

**How does water/moisture appear to be entering the building?** Have all five primary sources of moisture been evaluated? What is the condition of construction materials and are there any obvious areas of deterioration? Did this building have a builder’s trench around the foundation that could be holding water against the exterior walls? Are the interior bearing walls as well as the exterior walls showing evidence of rising damp? Is there evidence of hydrostatic pressure under the basement floor such as water percolating up through cracks? Has there been moisture damage from an ice dam in the last several months? Is damage localized, on one side of the building only, or over a large area?

**What are the principal moisture dynamics?** Is the moisture condition from liquid or vapor sources? Is the attic moisture a result of vapor diffusion as damp air comes up through the cavity walls from the crawl space or is it from a leaking roof? Is the exterior wall moisture from rising damp with a tide mark or are there uneven spots of dampness from foundation splash back, or other ground
moisture conditions? Is there adequate air exchange in the building, particularly in damp areas, such as the basement? Has the height of the water table been established by inserting a long pipe into the ground in order to record the water levels?

**How is the interior climate handling moisture?** Are there areas in the building that do not appear to be ventilating well and where mold is growing? Are there historic features that once helped the building control air and moisture that can be reactivated, such as operable skylights or windows? Could dewpoint condensation be occurring behind surfaces, since there is often condensation on the windows? Does the building feel unusually damp or smell in an unusual way that suggest the need for further study? Is there evidence of termites, carpenter ants, or other pests attracted to moist conditions? Is a dehumidifier keeping the air dry or is it, in fact, creating a cycle where it is actually drawing moisture through the foundation wall?

**Does the moisture problem appear to be intermittent, chronic, or tied to specific events?** Are damp conditions occurring within two hours of a heavy rain or is there a delayed reaction? Does rust on most nail heads in the attic indicate a condensation problem? What are the wet patterns that appear on a building wall during and after a rain storm? Is it localized or in large areas? Can these rain patterns be tied to gutter over-flows, faulty flashing, or saturation of absorbent materials? Is a repaired area holding up well over time or is there evidence that moisture is returning? Do moisture meter readings of wall cavities indicate they are wet, suggesting leaks or condensation in the wall?

Once a hypothesis of the source or sources of the moisture has been developed from observation and recording of data, it is often useful to prove or disprove this hypothesis with interim treatments, and, if necessary, the additional use of instrumentation to verify conditions. For damp basements, test solutions can help determine the cause. For example, surface moisture in low spots should be redirected away from the foundation wall with regrading to determine if basement dampness improves. If there is still a problem, determine if subsurface downspout collection pipes or cast iron boots are not functioning properly. The above grade downspouts can be disconnected and attached to long, flexible extender pipes and redirected away from the foundation (see fig. 17). If, after a heavy rain or a simulation using a hose, there is no improvement, look for additional ground moisture sources such as high water tables, hidden cisterns, or leaking water service lines as a cause of moisture in the basement. New data will lead to a new hypothesis that should be tested and verified. The process of elimination can be frustrating, but is required if a systematic method of diagnosis is to be successful.

**Selecting an Appropriate Level of Treatment**

The treatments in chart format at the back of this publication are divided into levels based on the degree of moisture problems. Level I covers preservation maintenance; Level II focuses on repair using historically compatible materials and essentially mitigating damaging moisture conditions; and Level III discusses replacement and alteration of materials that permit continued use in a chronically moist environment. It is important to begin with Level I and work through to a manageable treatment as part of the control of moisture problems. Buildings in serious decay will require treatments in Level II, and difficult or unusual site conditions may require more aggressive treatments in Level III. Caution should always be exercised when selecting a treatment. The treatments listed are a guide and not intended to be recommendations for specific projects as the key is always proper diagnosis.

Start with the repair of any obvious deficiencies using sound preservation maintenance. If moisture cannot be managed by maintenance alone, it is important to reduce it by mitigating problems before deteriorated historic materials are replaced (see fig. 18). Treatments should not remove materials that can be preserved; should not involve extensive excavation unless there is a documented need; and should not include coating buildings with waterproof sealers that can exacerbate an existing problem. Some alteration to historic materials, structural systems, mechanical systems, windows, or finishes may be needed when excessive site moisture cannot be controlled by drainage systems, or in areas prone to floods. These changes, however, should, be sensitive to preserving those materials, features, and finishes that convey the historic character of the building and site.

**Ongoing Care**

Once the building has been repaired and the larger moisture issues addressed, it is important to keep a record of additional evidence of moisture problems and to protect the historic or old building through proper cyclical maintenance (see fig. 19). In some cases, particularly in museum environments, it is critical to monitor areas vulnerable to moisture damage. In a number of historic buildings, in-wall moisture monitors are used to ensure that the moisture purposely generated to keep relative humidity at ranges appropriate to a museum collection does not migrate into walls and cause deterioration. The potential problem with all systems is the failure of controls, valves, and panels over time. Back-up systems, warning devices, properly trained staff and an emergency plan will help control damage if there is a system failure.
Ongoing maintenance and vigilance to situations that could potentially cause moisture damage must become a routine part of the everyday life of a building. The owner or staff responsible for the upkeep of the building should inspect the property weekly and note any leaks, mustiness, or blocked drains. Again, observing the building during a rain will test whether ground and gutter drainage are working well.

For some buildings a back-up power system may be necessary to keep sump pumps working during storms when electrical power may be lost. For mechanical equipment rooms, condensation pans, basement floors, and laundry areas where early detection of water is important, there are alarms that sound when their sensors come into contact with moisture.

**Conclusion**

Moisture in old and historic buildings, though difficult to evaluate, can be systematically studied and the appropriate protective measures taken. Much of the documentation and evaluation is based on common sense combined with an understanding of historic building materials, construction technology, and the basics of moisture and air movement. Variables can be evaluated step by step and situations creating direct or secondary moisture damage can generally be corrected. The majority of moisture problems can be mitigated with maintenance, repair, control of ground and roof moisture, and improved ventilation. For more complex situations, however, a thorough diagnosis and an understanding of how the building handles moisture at present, can lead to a treatment that solves the problem without damaging the historic resource.

It is usually advantageous to eliminate one potential source of moisture at a time. Simultaneous treatments may set up a new dynamic in the building with its own set of moisture problems. Implementing changes sequentially will allow the owner or preservation professional to track the success of each treatment.

Moisture problems can be intimidating to a building owner who has diligently tried to control them. Keeping a record of evidence of moisture damage, results of diagnostic tests, and remedial treatments, is beneficial to a building's long-term care. The more complete a survey and evaluation, the greater the success in controlling unwanted moisture now and in the future.

Holding the line on unwanted moisture in buildings will be successful if 1) there is constant concern for signs of problems and 2) there is ongoing physical care provided by those who understand the building, site, mechanical systems, and the previous efforts to deal with moisture. For properties with major or difficult-to-diagnose problems, a team approach is often most effective. The owner working with properly trained staff, contractors and consultants can monitor, select, and implement treatments within a preservation context in order to manage moisture and to protect the historic resource.
**MOISTURE: LEVEL I PRESERVATION MAINTENANCE**

Exterior: Apply cyclical maintenance procedures to eliminate rain and moisture infiltration.

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

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

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

Ground: Apply regular maintenance procedures to eliminate standing water and vegetative threats to building/site.

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

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

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

Basements and foundations: Increase ventilation and maintain surfaces to avoid moisture.

**Equipment:** Check dehumidifiers, sump pump, vent fans, and water detection or alarm systems for proper maintenance as required; check battery back-up twice a year.

**Piping/ductwork:** Check for condensation on pipes and insulate/seal joints, if necessary.

Interior: Maintain equipment to reduce leaks and interior moisture.

**Plumbing pipes:** Add insulation to plumbing or radiator pipes located in areas subject to freezing, such as along outside walls, in attics, or in unheated basements.

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

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

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

Exterior: Repair features that have been damaged. Replace an extensively deteriorated feature with a new feature that matches in design, color, texture, and where possible, materials.

Roofing: Repair roofing, parapets and overhangs that have allowed moisture to enter; add ice and water shield membrane to lower 3-4 feet or roofing in cold climates to limit damage from ice dams; increase attic ventilation, if heat and humidity build-up is a problem. Make gutters slope @ 1/8" to the foot. Use professional handbooks to size gutters and reposition, if necessary and appropriate to historic architecture. Add ventilated chimney caps to unused chimneys that collect rain water.

Walls: Repair spalled masonry, terra cotta, etc. by selectively installing new masonry units to match; replace rotted clapboards too close to grade and adjust grade or clapboards to achieve adequate clearance; protect or cover open window wells.

Ground: Correct serious ground water problems; capture and dispose of downspout water away from foundation; and control vapor diffusion of crawlspace moisture.

Grade: Re-establish positive sloping of grade; try to obtain 6" of fall in the first 10' surrounding building foundation; for buildings without gutter systems, regrade and install a positive subsurface collection system with gravel, or waterproof sheeting and perimeter drains; adjust pitch or slope of eave line grade drains or French drains to reduce splash back onto foundation walls; add subsurface drainage boots or extension pipes to take existing downspout water away from building foundation to the greatest extent feasible.

Crawl space: Add polyethylene vapor barrier (heavy construction grade or Mylar) to exposed dirt in crawlspace if monitoring indicates it is needed and there is no rising damp; add ventilation grilles for additional cross ventilation, if determined advisable.

Foundations and Basements: Correct existing high moisture levels, if other means of controlling ground moisture are inadequate.

Mechanical devices: Add interior perimeter drains and sump pump; add dehumidifiers for seasonal control of humidity in confined, unventilated space (but don't create a problem with pulling dampness out of walls); add ventilator fans to improve air flow, but don't use both the dehumidifier and ventilator fan at the same time.

Walls: Remove commentates coatings, if holding rising damp in walls; coat walls with vapor permeable lime based rendering plaster, if damp walls need a sacrificial coating to protect mortar from erosion; add termite shields, if evidence of termites and dampness cannot be controlled.

Framing: Reinforce existing floor framing weakened by moisture by adding lolly column support and reinforcing joist ends with sistered or parallel supports. Add a vapor impermeable shield, preferably non-ferrous metal, under wood joists coming into contact with moist masonry.

Interior: Eliminate areas where moisture is leaking or causing a problem.

Plumbing: Replace older pipes and fixtures subject to leaking or overflowing; insulate water pipes subject to condensation.

Ventilation: Add exhaust fans and whole house fans to increase air flow through buildings, if areas are damp or need more ventilation to control mold and mildew.

Climate: Adjust temperature and relative humidity to manage interior humidity; Correct areas of improperly balanced pressure for HVAC systems that may be causing a moisture problem.
MOISTURE: LEVEL III REPLACEMENT / ALTERATIONS

Exterior: Undertake exterior rehabilitation work that follows professional repair practices—i.e., replace a deteriorated feature with a new feature to match the existing in design, color, texture, and when possible, materials. In some limited situations, non-historic materials may be necessary in unusually wet areas.

Roofs: Add ventilator fans to exhaust roofs but avoid large projecting features whose designs might negatively affect the appearance of the historic roof. When replacing roofs, correct conditions that have caused moisture problems, but keep the overall appearance of the roof; for example, ventilate under wooden shingles, or detail standing seams to avoid buckling and cracking. Be attentive to provide extra protection for internal or built-in gutters by using the best quality materials, flashing, and vapor impermeable connection details.

Walls: If insulation and vapor barriers are added to frame walls, consider maintaining a ventilation channel behind the exterior cladding to avoid peeling and blistering paint occurrences.

Windows: Consider removable exterior storm windows, but allow operation of windows for periodic ventilation of cavity between exterior storm and historic sash. For stained glass windows using protective glazing, use only ventilated storms to avoid condensation as well as heat build-up.

Ground: Control excessive ground moisture. This may require extensive excavations, new drainage systems, and the use of substitute materials. These may include concrete or new sustainable recycled materials for wood in damp areas when they do not impact the historic appearance of the building.

Grade: Excavate and install water collection systems to assist with positive run-off of low lying or difficult areas of moisture drainage; use drainage mats under finished grade to improve run-off control; consider the use of column plinth blocks or bases that are ventilated or constructed of non-absorbent substitute materials in chronically damp areas. Replace improperly sloped walks; repair non-functioning catch basins and site drains; repair settled areas around steps and other features at grade.
FOR CHRONICALLY DAMP CONDITIONS

Foundations: Improve performance of foundation walls with damp-proof treatments to stop infiltration or damp course layers to stop rising damp. Some substitute materials may need to be selectively integrated into new features.

Walls: excavate, repoint masonry walls, add footing drains, and waterproof exterior subsurface walls; replace wood sill plates and deteriorated structural foundations with new materials, such as pressure treated wood, to withstand chronic moisture conditions; materials may change, but overall appearance should remain similar. Add damp course layer to stop rising damp; avoid chemical injections as these are rarely totally effective, are not reversible, and are often visually intrusive.

Interior: Control the amount of moisture and condensation on the interiors of historic buildings. Most designs for new HVAC systems will be undertaken by mechanical engineers, but systems should be selected that are appropriate to the resource and intended use.

Windows, skylights: Add double and triple glazing, where necessary to control condensation. Avoid new metal sashes or use thermal breaks where prone to heavy condensation.

Mechanical systems: Design new systems to reduce stress on building exterior. This might require insulating and tightening up the building exterior, but provisions must be made for adequate air flow. A new zoned system, with appropriate transition insulation, may be effective in areas with differing climatic needs.

Control devices/Interior spaces: If new climate control systems are added design back-up controls and monitoring systems to protect from interior moisture damage.

Walls: If partition walls sit on floors that periodically flood, consider spacers or isolation membranes behind baseboards to stop moisture from wicking up through absorbent materials.

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I. Critically damp foundation walls were protected with a layer of bentonite clay to reduce moisture penetration. This work was in combination with new downspouts that were connected to drainage boots that deposited captures roof run-off away from the foundation. Photo: Courtesy, Larry D. Dermody and the National Trust for Historic Preservation.

F. Triple glazed windows replaced the originals to control condensation. Photo: © Isabella Stewart Gardner Museum, Boston.

G. New sensors which monitor temperature and relative humidity are located throughout this museum and tied to a computer that controls the climate control system. Photo: © Isabella Stewart Gardner Museum, Boston.

H. New computers tie a variety of monitoring and security features into a comprehensive system which provides warning and backup alerts when any of the system components are not functioning properly. Photo: © Isabella Stewart Gardner Museum, Boston.
Back Cover: The Diagnosing Moisture in Historic Building Symposium held in Washington, DC, May, 1996, brought together practitioners in the field of historic preservation to discuss the issues contained in this Preservation Brief. Attendees are standing in front of the cascading fountains at Meridian Hill Park, a National Historic Landmark. Photo: Eric Avner.

Reading List


Acknowledgments

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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 directed to de Teel Patterson Tiller, Acting Manager, Heritage Preservation Services Program, National Park Service, P.O. Box 37127, Washington, DC 20013-7127. This publication is not copyrighted and can be reproduced without penalty. Copyright photographs included in this publication may not be used to illustrate publications other than as a reference to this Preservation Brief, without permission of the owners. Normal procedures for credit to the authors and the National Park Service are appreciated.

Cover Photo: Masonry repointing in a wet environment. Photo: Williamsport Preservation Training Center, NPS.

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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." 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
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 crawlspace.

• 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.

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 (Fig 1).
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 (Fig 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. 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. It is important 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.

### Cyclic Building Inspection Checklist: Horse Stable

<table>
<thead>
<tr>
<th>Building Feature</th>
<th>Material(s)</th>
<th>Condition Description</th>
<th>Maintenance Action Required</th>
<th>Work Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROOF:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Covering</td>
<td>Clay tile</td>
<td>Two slipped tiles</td>
<td>Reattach tiles</td>
<td>5/4/05</td>
</tr>
<tr>
<td></td>
<td>Painted metal standing seam</td>
<td>Slight corrosion; blistering paint on roof section</td>
<td>Sand and repaint area</td>
<td>6/8/05</td>
</tr>
<tr>
<td>Flashing</td>
<td>Painted metal</td>
<td>Flashing in good condition</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Gutters/Downspouts</td>
<td>6&quot; half round galvanized metal</td>
<td>Gutter sagging; downspouts OK</td>
<td>Realign gutter and put on new hanger strap</td>
<td>5/4/05</td>
</tr>
<tr>
<td></td>
<td>No masonry chimney</td>
<td>N/A</td>
<td>Flush out downspouts</td>
<td>5/5/05</td>
</tr>
<tr>
<td>Chimneys</td>
<td>Metal vent stack and weathervane</td>
<td>Vent stack hood has some peeling paint, vane OK</td>
<td>Sand and repaint vent stack</td>
<td>6/8/05</td>
</tr>
<tr>
<td>Attachments/</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetrations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Inspection date: 04/24/05**

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.
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.

<table>
<thead>
<tr>
<th>INSPECTION FREQUENCY CHART</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feature</strong></td>
</tr>
<tr>
<td>Roof</td>
</tr>
<tr>
<td>Chimneys</td>
</tr>
<tr>
<td>Roof Drainage</td>
</tr>
<tr>
<td>Exterior Walls and Porches</td>
</tr>
<tr>
<td>Windows</td>
</tr>
<tr>
<td>Foundation and Grade</td>
</tr>
<tr>
<td>Building Perimeter</td>
</tr>
<tr>
<td>Entryways</td>
</tr>
<tr>
<td>Doors</td>
</tr>
<tr>
<td>Attic</td>
</tr>
<tr>
<td>Basement/Crawspace</td>
</tr>
</tbody>
</table>

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.

**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 (Fig. 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.
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.

• 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 over-splash 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.

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 Blandell.
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 roof manufacturer and industry guidance on inserting and attaching replacement units (Fig 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. 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 (Fig 5).

**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 (Fig 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 (Fig 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 (Fig 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

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.

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.

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.
scheduled times for cleaning for cosmetic purposes to reduce frequency (Fig 9). When cleaning, use the gentlest means possible; start with natural bristle brushes and water and only add 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 ½ 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 (Fig 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.

- 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...
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.

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
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.

- 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.

**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.
• 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.

• 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 (Fig 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.

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.
• Remove debris beneath window air conditioning units and ensure that water from units does not drain onto sills or wall surfaces below (Fig 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.

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 an 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 (Fig 14);
- damaged lamps, unsafe electrical outlets or deteriorated seals around connections;
- loose marker plaques, sign, or mail boxes; and

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.

- 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 (Fig 15).

• Reattach loose brackets, lamps, or signs. With electrical boxes for outlets or lighting devices, ensure that cover plates are 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.

**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;

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 contactor experienced in sealant installation may be needed. In either case, the sealant manufacturer should be consulted on proper sealant selection, preparation, and installation procedures.

- 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 (Fig 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 (Fig 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.

Conclusion

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.

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.

Endnotes


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.
Further Reading


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