Fall 1997

Bethel A. M. E. Church

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Rev. S.S. Giddings  Pastor

BETHEL
AFRICAN METHODIST EPISCOPAL CHURCH
4683 BELL ST

SUNDAY SCHOOL 9:45
MORNING WORSHIP 11:00
Historic Structure Report
for
Bethel A.M.E. Church
Acworth, Georgia

Prepared by
Julia Bonds
Jennifer Dickey
Jean Kasperbauer
Dana McGee
and
Tevi Taliaferro

for
History 805
Georgia State University
Professor Tommy Jones
Professor Richard Laub

December 1, 1997
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for
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1 Introduction

For over a century, Bethel A.M.E. Church has stood imposingly at the corner of Bell and School Streets, as a beacon for the African-American community in Acworth, Georgia. During this time, Bethel A.M.E. Church and its members have contributed to the unique character that comprises the spirit of Acworth. Bethel A.M.E. Church's history and position as an invaluable and irreplaceable asset to the A.M.E. Church and the town of Acworth in Cobb County make the building eligible for listing on the National Register of Historic Places.

However, actions must be taken to preserve the church to ensure its future. Listings and designations alone will not be enough. The church is more than a building that has witnessed countless Sunday services for more than 100 years. It is also a monument to the spirit that created the Bethel A.M.E. Church movement at a time when African-Americans were unwelcome amongst the white congregations across the country.

As a physical structure, the building has had two additions since its original construction, one of which is historic. The exterior has been painted, and the interior slightly remodeled to meet the needs of its members. Yet much of the original structure remains intact—the beaded, tongue-and-groove, paneled ceiling appears today much as it did 100 years ago, and the walls are still covered with the original plaster and wainscoting. Beneath the 20th-century paneling in the vestibule and towers lie hidden the brick walls, largely unchanged since the front addition was built in 1895.

The church reflects the conditions and membership today as it has throughout history. By preserving the building, the church members and other concerned citizens validate and recognize the importance of the vernacular components of the Acworth community. The contextual history of Bethel A.M.E. Church in Acworth depicts the roles of early church members in the community, as well as the status of both Acworth and Bethel A.M.E. Church today.

This Historic Structure Report was created as a collaborative effort by the members of the "Conservation of Historic Building Materials" class in Georgia State University's Master of Heritage Preservation Program under the direction of professors Tommy Jones and Richard Laub. The document, which could form the basis for a National Register application, provides overviews of the history of Acworth, the founding of the A.M.E. Church movement, and the establishment of the Bethel A.M.E. Church in Acworth, followed by a detailed assessment of the structure's existing condition. Although the church is structurally sound, there are several conditions that require immediate attention if the church is to be preserved. Recommendations are provided for the treatments for these conditions that threaten the structure, for long-term actions that should help ensure the structure's preservation and some options for restoration of the building, should that be a goal of the congregation.
2 Historical Overview

2.1 Background – Acworth Settlement and Development

Acworth, a small community about 40 miles northwest of Atlanta, is located in what was originally Cherokee Indian territory. In 1832, after a treaty with the Cherokee Nation, Georgia held the last of the land lotteries that distributed Cherokee land to its white citizens. That same year the state divided what had been Greater Cherokee County into ten smaller counties, creating, amongst others, Cobb County.

The city of Acworth is located in the 20th Land District of Cobb County. The present city limits include all or portions of 17 land lots. Bethel A.M.E. Church is located on land lot #32, which was originally granted to Berry Jones of Bulloch County in 1839. Today land lot #32 also includes the main business area of the town.

Among the first settlers in the area was Alexander Northcutt. Northcutt was granted land lot #30 and opened a store that became the stagecoach stop. By 1843 the settlement was known as Northcutt Station. The post office for the area was in Andersonville, a town located about two miles south of Northcutt Station.

The greatest impetus for growth in the area was the coming of the Western & Atlantic railroad in 1842. Joseph Gregg, a civil engineer with the US Army Corps of Engineers, worked on grading the railroad route and eventually settled in the area. Gregg is credited with renaming the town Acworth in 1843 after his hometown of Acworth, New Hampshire. On December 1, 1860, the town was incorporated as a circle extending a half-mile in every direction from the railroad depot. After the Civil War the town was reincorporated, and the Georgia General Assembly officially recognized the town as the “City of Acworth” in August of 1903.

From its earliest days until the onset of the Civil War, Acworth was a collection point for the farmers in the area who would bring their produce to be processed or sold. Access to the railroad also fostered industrial growth. Free factory sites, exempt from city and county taxes, with frontage on the rail lines was offered.

The pre-Civil War population of the town included shopkeepers, bankers, a hatter, a school teacher, a brick manufacturer, cotton broker, and real estate agent. Acworth, like the rest of the South, depended to some extent on slaves for the cultivation and harvesting of its agricultural products. The Federal census of 1860 showed that there were 3,829 slaves in Cobb County and about 240 in the 20th District, including Acworth. According to the 1851 tax digest for Cobb County some of the slave owners included prominent Acworth families, among them the Lemons, Awtreys, Graggs, Northcutts, and Masons. No one in the district owned many slaves; most had only one, with a few owning seven or eight.

Research shows that the few freed slaves in the county prior to the outbreak of the war left the area as soon as they were freed. Because of the paucity of information from that time, little is known of the slaves themselves. Oral histories point to a connection between former slaves and early members of the Bethel A.M.E. Church. Most of the former slaves and their children who did stay in the area became farmers and farm laborers. A few worked on the railroad.

The railroad made Acworth a strategic site for General W.T. Sherman’s Union forces on their march from Chattanooga to Atlanta. In an effort to control the rail lines, Acworth was taken over in June of 1864. Confederate troops and many of Acworth’s residents fled the area as the Union forces swept through. Much of the town was destroyed by the Union troops before they moved on to Kennesaw. Reportedly only the Methodist Church and some “war widows” homes were spared.
The Reconstruction period was hard on the South, and the city of Acworth was no exception. However, by 1879, the city had begun to prosper as the result of increased cotton production and the acquisition of a cotton gin. Along with the gin, there were two flour mills and a tannery. Cotton, however, became the main source of income in Acworth. From 1905 through 1920 cotton reigned in the area.

After World War I and the devastation of cotton by the boll weevil, the emphasis in the area changed from farming to factory work, making it harder for blacks, who were mostly uneducated and unskilled, to find work. The early-to-mid 20th century saw thousands of blacks leave the rural South where their opportunities were severely limited by segregation and the oppressive Jim Crow laws. Many moved to cities in the South, but many more migrated north looking for better opportunities in cities such as Chicago and Detroit. These migrations split families and church congregations as young people left parents and grandparents behind.

By the early 1920's African-American businesses were located on North Main Street and Cherokee Street. The Bethel A.M.E. Church is also located in this area on the corner of Bell Street and School Street. Among the early black businessmen were John F. Buffington, who ran an ice cream parlor; Henry Williams, who had a hardware store; and Jeff McConnell, who had a cobbler shop and a café on Cherokee Street. The census statistics from the early part of the century indicate that most African-Americans in the area were still farm workers.

### 2.2 Acworth Development Today

With the creation of Lake Allatoona in the 1940's and early 1950's, Acworth prepared for an onslaught of recreational visitors to the area. However, the construction of Interstate 75 from Atlanta to Chattanooga, which began in the 1950's and was completed in the late 70's, diverted traffic away from the U.S. Highway 41, which was Acworth's main street. Travelers on the new interstate system now bypassed this once-busy thoroughfare, and the downtown business district began to decline.

Today the city of Acworth has evolved into a “bedroom” community for the metropolitan Atlanta area. There are no farmers in the city, and the principle businesses revolve around the automobile industry. The population grew from about 50 residents in 1840 to 937 at the turn of the century. The 1990 census showed 4,519 residents, and the year 2000 census is expected to show further. However, most of the residents commute to jobs outside of Acworth in the Atlanta metropolitan area. The railroad still runs through the heart of Acworth, although it no longer plays a vital role in the town’s economy.

### 2.3 A.M.E. Church History

The African Methodist Episcopal Church (A.M.E.) was started in 1787 in Philadelphia, Pennsylvania, by a group of Americans whose forefathers came from Africa. The leader of this group was Richard Allen, a 27-year-old freed slave. The A.M.E. Church is a member of the family of Methodist Churches. Allen was inspired to form a separate congregation following a move by the white congregation of the St. George’s Methodist Episcopal Church in Philadelphia that forced the Africans to sit in the gallery of the church. Allen declared that this segregation placed a badge of inferiority on the Africans, withdrew from St. George’s, and formed the A.M.E. Church.

Allen believed in a philosophy of self-help through education and developed a program of night-school classes to further this cause. This emphasis on education can still be seen today in the educational programs of the local churches and the 11 institutions of higher education operated by the A.M.E. Church.

Allen and his supporters managed to buy an old blacksmith shop, which they moved to the corner of Sixth and Lombard Streets in Philadelphia, Pennsylvania, to serve as a meeting place for the newly formed congregation. This building, now known as “Mother Bethel”, still stands in Philadelphia as a historic shrine. Other churches were soon started in Baltimore, Maryland; Salem, New Jersey; Attleboro,
Pennsylvania; Wilmington, Delaware and other places throughout the United States, and in 1816, these churches came together to form the A.M.E. Church with Allen as the first active bishop.

Today the A.M.E. Church has 18 active bishops and more than a million members scattered throughout the United States, Canada, South America, West Africa, South Africa, and the West Indies. Headquarters for the Bethel A.M.E. Church Review Historical Society is in Nashville, Tennessee.

2.4 Bethel A.M.E. Church History

The Bethel A.M.E. Church in Acworth, Georgia was formed in 1864. At that time the congregation shared a church building with the Zion Hill Baptist Church, with each congregation meeting on alternate Sundays. In 1871 several trustees of the Bethel A.M.E. Church, George McConnell, Benjamin Davenport and Mitchell Saddler, purchased one acre of land with right of way on the east and south in district 20 from I.L. Robertson for the sum of $27. Another deed indicates that a parcel of land, lot 32 in district 20, was deeded in 1882 by Colonel E. L. Shuford and Kate Shuford for the sum of $90 to the trustees of the A.M.E. Church: John Buffington, Wyeth (Wyatt) Dobbs, Henry Hesterly, Ezekiel Buffington, and Peter Carter. The deed states that a building referred to as the A.M.E. Church was already standing on that property in the year 1882, although the deed was not recorded until 1884. The lot measured on front (north to south) 140 feet and from east to west 220 feet. (See Appendix A for copies of these deeds.)

The marble cornerstone, which is affixed into the masonry of the northeastern tower, has the date April, 1895 inscribed as well as the following names:

Bethell A.M.E. Church
J. R. FLEMING PASTOR
J. T DOBBS
R. NELSON, Con.

Research indicates that J.R. Fleming was ordained as a deacon in 1890 and as an Elder in 1894. He was assigned to several churches, all within the state of Georgia. He was the appointed pastor of the Acworth Bethel A.M.E. Church from 1895 through 1897. Fleming was responsible for the erection of churches in several other communities such as Stone Mountain and Jamesboro.

Bethel A.M.E. Church has had approximately 31 pastors over the years since the departure of Rev. J. R. Fleming. The actual membership of the Church over the years is difficult to document because no church rolls are available. As of 1997, the Church has a congregation of between 40 and 60 members. Bethel A.M.E., like many other older congregations, exists in an area of little economic growth. It’s aging membership has waned in recent years.

Some members of the Church stated that the A.M.E. Church required that there be two bell towers at the front of its churches. According to Dr. Dennis Dickerson, historiographer of the A.M.E. Church, there were no architectural regulations until 1908. At that time, John Langford, an architect, was elected by the A.M.E. Church to oversee all future construction.

The discrepancy between the dates of the deeds and the cornerstone is most likely the result of the two-phased construction of the building. The A.M.E. historical society in Nashville confirmed that it was a common occurrence for congregations to delay construction of a church after purchasing land, primarily for monetary reasons. The 1871 deed indicates that the Trustees of the Bethel A.M.E. Church purchased the land where the church now stands. The 1882 deed indicates that the building stood on the lot at that time. Therefore, it is reasonable to assume that the main part of the Church, referred to as the sanctuary, was built between 1871 and 1882. The vestibule and two towers were then added in 1895, and the cornerstone was placed at that time.
The two towers abut the exterior brick of the sanctuary. There are slight variations in the style of the masonry construction of the sanctuary and the towers and vestibule. The doors leading into the sanctuary from the towers offer other reasons to believe that the towers and vestibule were built some time after the sanctuary. There is a door at the base of each tower that enters into the sanctuary. These doors are typical of late 19th-century doors with rim lock hardware and vertical panels. The doors replace windows that were extant prior to 1895. Traces of these windows are visible inside the towers above the 20th-century paneling. The swinging doors, which function as the main entrance into the sanctuary from the tower/vestibule addition, have 20th-century horizontal panels. Most of the windows still contain their historic wood framing, sashes, and muntins, but the green Plexiglas lights are 20th-century additions.

Other aspects of the interior show the evolution of the structure. There are three different styles of pews in the church. The slatted-wood pew reputed to be an original pew stands in the vestibule. The sanctuary contains twenty-two modern wooden pews covered in a dark red, woven burlap fabric, eighteen for the congregation and three in the chancel. The three pews on the choir platform appear to be of late 19th or early 20th-century vintage.

Other historic furniture within the building includes the pulpit and a chair. The pulpit, which is 45 inches tall, stands in excellent condition just behind the communion table. The chair has an oak frame with leather upholstery over burlap and quilt batting. The leather on the seat is completely deteriorated. These two pieces are reputedly original furnishings for the church, dating from the period 1872-1895.

Other 20th-century additions include carpet in the sanctuary and the linoleum floor in the rear addition, both of which were added in 1994-95. The rear addition itself, which contains a foyer, restrooms, and a kitchen, was constructed some time after World War II.
3 Existing Conditions Report

The current conditions and problems of repair of Bethel A.M.E. Church are broken down into four categories for presentation—exterior, interior, mechanical systems, and grounds. Detailed descriptions of the building and its materials are provided, and the problems of the structure are identified.

3.1 Exterior Conditions – General Description

The Bethel A.M.E. Church is a masonry structure in the Romanesque-revival style with solid, load-bearing walls on a brick foundation and an end-gabled roof. The church consists of three major sections: the vestibule, the sanctuary, and the rear addition. Each of these sections was built at a different time as evidenced by differences in building materials. The sanctuary and vestibule, which includes two bell towers, are constructed of solid brick walls, three withes thick. The bonding pattern is a six-course common bond with flush joints. The rear edition is constructed of concrete blocks.

The exterior of the sanctuary is approximately 57 feet long and 40 feet wide. The vestibule and towers abut the front, or east end of the sanctuary. The two towers, each ten feet square, are connected by the vestibule, which spans 23 feet 9 inches between the two towers. The cement block addition abuts the rear, or west end of the sanctuary, extending back 16 feet. The addition is 39 feet 5 inches wide, covering almost the entire width of the back wall of the sanctuary.

The exterior of the building is painted a cream color. Windows and doors are painted white, and the eaves are painted the same cream color as the brick and cement-block portions of the building. The building faces east. The gabled roof is covered with asphalt shingles.

Access to the crawl space under the sanctuary is located at the base of the short tower on the north side of the church (3’ 6” from the east corner). The 2’ 4” wide opening is covered by a piece of unpainted plywood. On the ledge of the opening, one of the bricks bears an imprint of the name “Rockmart.”

The foundation includes two brick walls approximately ten inches high that run the full length of the middle of the sanctuary. The 2’x12” floor joists rest on top of the brick walls and attach to the outer brick walls at intervals of 24 inches.

The exterior brick walls of the sanctuary are set back the width of one brick approximately 2 feet below each window, which forms a ledge approximately 4” wide to catch the joists. Brick pilasters 1” deep and 20” wide create four equally-sized bays on each side of the building with a Roman-arched window in each bay. A string course of brick extending out approximately 2” surrounds the building. Just below the eaves, the top six courses of brick are corbeled out from the wall the width of one brick.

The sanctuary features four Roman-arched windows on each side, the north and south sides, of the building. The eight windows are each 2’9”x9’6”, have 4-inch wooden sills, and a 2 1/2” exterior casing. These four over four, double hung windows have rope sash pulleys and textured, green Plexiglas panes. The windows originally had clear glass panes like that which survives in the upper windows of the
bell towers. The date of the green Plexiglas installation is unknown. All of the windows have been nailed shut, with the exception of two windows, which hold window-unit air-conditioning systems. The front window on the south side of the sanctuary has had the muntins removed and the green Plexiglas has been replaced with clear Plexiglas.

As originally constructed, the sanctuary had two windows on both the front and back walls as well with double doors opening into the center aisle at the front of the church. The front windows were modified into doors for access to the base of the two bell towers when they were added to the building in 1895.

The lower sash of the window on the north side of the rear wall was removed and a door installed in its place to allow access into the kitchen when the rear section was added, most likely in the 1970's. The upper sash of the window remains in place. The rear window on the south side remains in place looking into the kitchen, although the ceiling of the kitchen has blocked much of the top sash.

The bell towers and vestibule also feature double hung, four over four Roman-arched windows. The front façade includes four windows that match the size, shape, and color of the sanctuary windows, as well as a double door with a Roman-arched fanlight in line with the arch of the windows. The north tower, which is the shorter of the two, has a shorter (2'9"x6'5") Roman-arched window approximately six feet above the ground-floor window. This upper window has been covered with plywood, which has been painted white. The south tower is approximately 10 feet taller than the north tower and has two of the shorter, 6'5", Roman-arched windows, one above the other. The ground floor window on the south tower has green Plexiglas panes. The next window up has been covered with plywood as on the north tower. The openings at the top of the south tower are closed with louvered shutters. The windowsills on all the lower windows are poured concrete. The upper windows on the towers have wooden sills.

The north side of the shorter tower has the same window configuration as the front side of the tower— one ground floor window with green Plexiglas and one upper window, although the upper window is not covered with plywood. The south side of the tall bell tower has a Roman-arched door at ground level and two windows up above that match the two windows on the front of the tower. The north and west sides of the tower each have a shuttered opening near the top in line with the shuttered openings on the south and east sides. Both towers are capped with seven-foot, metal-roofed, octagonal steeples. A듯 the north steeple is a flame and the south steeple a cross.

The front gable of the sanctuary features brick corbeling along the eaves. A round window, 52 inches in diameter, is centered in the gable. The window is covered by a round piece of tin. Examination of the interior of the attic shows that this window was originally a Roman-arched window.

Seven concrete steps lead from Bell Street up to the grounds of the church. A simple black iron railing has been added for safety. A set of five poured, concrete steps lead up to the double front doors. According to oral interviews these cover an earlier rounded series of steps that were probably built in 1895. Black metal handrails have been added to both sides of these steps. Modern 7-foot doors have replaced the original 1895 doors which were 9' tall. Above the doors are two rectangular panels of amber glass. The glass fanlight at the top of the doorway has been painted white.

A cornerstone, located on the outer corner of the north tower, bears the following inscription on the east side:
The north side of the cornerstone is inscribed as follows:

Erected
April, 1895

The kitchen is constructed of concrete block with a gabled roof covered with asphalt shingles. The concrete block rises to a height of 7 feet where it meets the eaves on the sides. The gable is clapboard from the concrete blocks to the eave. The south wall features two aluminum-sash windows, the west wall has a door and four aluminum-sash windows, and the north wall has a door that serves as the rear entrance to the building.

3.2 Exterior Conditions – Problems of Repair

Although structurally sound, the Bethel A.M.E. Church has several problems of repair that could result in serious damage to the building if left unattended. The asphalt shingles are worn and decayed, particularly on the south side of the building. Several shingles dangle precariously off the northwestern corner of the sanctuary. Much of the paint has peeled off of the eaves on the rear addition, and the wood is rotten, or in some cases, missing entirely. This is caused by deterioration of the roof over time, which allows moisture to seep through to the decking material. A large tree shades this side of the building; therefore, the roof stays damp much of the time. Practically all of the paint has peeled off the clapboard siding on the rear addition and some of the boards are warped and have begun pulling away from the studs.

The metal roofing on the steeples atop the two towers is rusted, and the eaves on the front of the church have rotted where they abut the towers. The rotting is the result of rainwater pouring across these valleys where there are no gutters or flashing to direct the water away from the structure. The mortar in this area has also deteriorated. Rainwater pours off the upper roof, down the sides of the towers to the vestibule roof and then along the front corners of the towers to the ground. This water flow has caused deterioration of the pointing, or mortar, and fostered the growth of mildew, particularly along the inner edge of the tall tower because it is shaded in the afternoon.

Several other areas suffer from the same malady, deteriorated mortar as the result of rainwater runoff, most notably the corner of the sanctuary where it meets the rear addition on the north side. A piece of wood has fallen off of the eave on the north side of the sanctuary where it abuts the tower. The paint on the eaves all around the building is peeling.
The north side of the building suffers from rising damp, which is caused by the absorption of rainwater runoff. Because there are no gutters on the building to direct rainwater away from the structure, the runoff pours straight down and collects at the base of the building. The brick then absorbs this water. Shielded from the afternoon sun, the brick stays moist long enough to allow the growth of mildew and to contribute to the deterioration of the mortar between the bricks. This is best seen at the corner of the sanctuary where it joins the cement block addition. The runoff has also eroded the soil around the foundation, exposing the footing towards the front of the sanctuary. Runoff has also caused erosion around the southwest corner of the rear addition.

Although the wooden window frames and sash remain in relatively sound condition, they all have peeling paint, deteriorated caulking, and missing putty around the windowpanes. These problems are particularly acute on the south side windows. The house next door to the church burned earlier in 1997 and the Plexiglas panes warped from the heat. Some of the panes are now held in place by tape. The window closest to the front of the sanctuary on the south side has had the muntins removed and the green Plexiglas replaced with clear Plexiglas.

Part of the casing and sill are missing on the front window to the left of the front door. The sill on the upper window on the north side of the short tower appears to be detached. The shutters on the upper windows of the tall tower have missing louvers and the sills are warped and split. Very little paint remains on the shutters and the sills.

The front doors have a loose knob and warped side lock. The molding on the fanlight is deteriorated, and the paint is peeling.

Slight cracks in the masonry have appeared above several of the sanctuary windows, most notably the windows near the front of the building. This is probably caused by settling of the building, and, while not severe at this time, should be monitored to determine if further settling is occurring.

A gap of almost two inches between the brick wall and the fascia can be seen on the west end of the building. This too is probably the result of settling, but does not appear to be a serious problem.

### 3.3 Interior Conditions – General Description

The interior of the sanctuary has a coffered ceiling made of 3 1/2" beaded, tongue-and-groove boards stained dark brown and coated with varnish. The flat part of the ceiling is approximately 15'x40'4". The angled portion of the ceiling descends from the flat ceiling area at approximately 150 degrees and is approximately 11 feet wide from the flat ceiling to the wall. The walls themselves are plaster with a 36" beaded, tongue-and-groove wainscoting capped by a 2 inch chair rail. The walls are painted flat white, and the doors,
doorframes, window casings, wainscoting, and chair rail are stained dark brown and covered with varnish. The window sash are painted white as are the pews in the choir platform, the pulpit, and the rail around the pulpit. The second window from the front on each side of the sanctuary has a window-unit air-conditioner.

The main entrance to the sanctuary from the vestibule is through 5'x6'8" double swinging doors that were probably installed in the early 20th century. These doors are hung in a 5'x9' doorframe. Hinge marks on the doorframe indicate that 9' doors once hung there. The 2' transom has two 26"x9" rectangular panels, one glass, one cardboard, which are painted with high-gloss, white, oil-base paint. Above the transom is a 26" fanlight, also painted white.

Two smaller doors located 10'5" on either side of the double doors, open into the ground floor of each of the towers. These 3'x7' doors have the same arched molding as that of the window casings. Further inspection has revealed that, prior to the addition of the vestibule and towers, there were two 2'9"x9'6" windows located approximately two feet in closer to the double doors. These windows were removed when the towers were added, and, presumably, the casings were reused as doorframes for the two doors that provide access to the towers. The tower-access doors probably date to the construction of the bell towers in 1895 and are considerably older than the double doors that provide the main access to the sanctuary.

The west wall of the sanctuary has a 2'9"x9'6" window 7'7" from the southwest corner. This window now looks into the kitchen. What was once a matching window 7'7" from the northwest corner is now a door that provides access to the rear foyer and kitchen. The upper sash of the window is still intact; however, the lower sash has been removed and the opening altered for a door that opens out into the rear foyer.

A semicircular platform, 7" high with an 8'3", radius is located against the west wall of the sanctuary. A 2'-high railing runs the outer perimeter of this platform beginning 6'6" from the west wall. A smaller, semicircular platform 12" high with a 4'4" radius extends from the wall atop the larger platform. The platform extends south to the southern wall of the sanctuary, providing a platform in the southwest corner for the choir. The three choir pews sit behind a 24" high, L-shaped wall in the southwest corner. The pulpit, 19'Dx46"Wx45"H, sits 6" back from the front edge of the center of the small platform. Three large crosses, decorated with bull's-eye molding, are hung on the wall behind the pulpit.

Eighteen modern pews are aligned on either side of a 5'6" center aisle for the congregation. The pews, measuring 2'Dx13'Lx32"H, are upholstered with red fabric. The pew nearest the pulpit on the south side of the aisle is 11' in length, and the pew nearest the pulpit on the north side of the aisle is 9' in length. Two 9' pews are arranged perpendicular to the rest of the congregation pews against the north wall in the northwest corner of the church. A 7' pew sits in front of one of these pews, also perpendicular to the congregation pews. Another 9' pew sits perpendicular to the choir platform 6' from the south wall, and the organ is situated behind this pew in front of the choir platform.

The floor of the sanctuary is a tongue-and-groove pine floor that is now covered with red, industrial carpet. The southeast corner of the sanctuary, a square hole roughly 12"x12" has been cut in the floor, presumably to allow access to gas pipes that enter the crawl space in that area. The hole has been covered by a piece of plywood, and the carpet is laid over the plywood.

The vestibule, which was altered significantly in the 1960's or 1970's, is a rectangular space, 23'6"x4'6" with a stippled, sheetrock ceiling and light-beige, wood paneling on the walls. The dropped ceiling obscures the fanlights of both the front door and the door into the sanctuary, as well as the top half of the upper sash of the two 33"x9'6" windows. The floor is brick-patterned linoleum. One of the original, hand-made, slatted pews (c. 1882) sits in the southeast corner of the vestibule. One end of the pew features simple ornamentation and an armrest, while the other end has neither armrest nor ornamentation. It seems probable that this
pew has had two to three inches cut off one end in order to fit in the vestibule corner. A chair reputed to be the original pastor’s chair also sits in the vestibule. The leather upholstery on the seat of the wooden chair has completely deteriorated, revealing the springs and stuffing material.

At the north end of the vestibule, a hollow, plywood door opens into what is the base of the short tower. This room, which now serves as the pastor’s study, also has a sheetrock ceiling, though not stippled, and paneled walls. The floor is covered with red pile carpet. As in the vestibule, the dropped ceiling obscures the top half of the upper sash of the two windows. The room is approximately 7’8” square. The wall between the vestibule and the office is 16” thick, and the doorframe has hinge grooves and rim lock plates on both sides of the 16” span. The door on the southwest corner of the room opens into the sanctuary.

A square hole has been cut in the ceiling above the desk, allowing a view of the next level of the tower. The interior of the tower has been painted white, but the brick arch of the original façade windows can still be clearly seen. There is a marked difference in the neatness of the mortar joints between what was the original façade and the interior walls of the tower that was added some years later. A ragged gap can be seen where the tower abuts the original structure. A beaded, tongue-and-groove ceiling is at the top of the tower.

On the south side of the vestibule, a hollow, plywood door opens into the base of the tall bell tower. This room is used for storage. The walls are covered with the same paneling as the vestibule walls, and the room has a plywood ceiling. The rope for the bell hangs down through a hole in the center of the ceiling. The door that accesses the sanctuary has been covered with a Masonite panel. The floor is covered with red pile carpet. The room is roughly 7’8” square. The plywood ceiling obscures the top half of the upper sash of the windows on the east and south sides of the tower. In the northeast corner of the room, a makeshift ladder leads up into the tower.

Above the plywood ceiling the brick is unpainted and traces of penciling, white markings that highlight the mortar, can be seen. This indicates that the original building was an unpainted brick structure with pencilled mortar joints. As in the short tower, the arched bricks from the original window can still be seen, and a ragged gap is visible where the tower abuts the original façade. A tongue-and-groove ceiling separates this level from the next level in the tower.

Above the tongue-and-groove ceiling are two windows that have been covered on the outside with plywood. Most of the glass has been broken out of the windows, although remnants of clear glass remain intact. A 26”x22” hole has been knocked in the brick of the original façade just below the corbelling to allow access into the crawl space above the sanctuary ceiling.

The top level of the bell tower is accessed by a stepladder that extends from the top of the tongue-and-groove ceiling up to the platform upon which the cast-iron bell is situated. This top level has four 2’9”x6’5” shuttered window openings. The wooden decking of the octagonal steeple can be seen from this level.

In the crawl space above the sanctuary, the truss system is clearly visible. The tongue-and-groove boards of the coffered ceiling are nailed directly onto 1 1/2”x5” rafters that attach to 2”x8” joists and 2”x8” center beams. The rafters are spaced approximately 24” on centers. Two brick chimneys, which once served the stoves of the original heating system, can be seen near the middle of the ceiling. The decking is made of 8” boards.
There is evidence to suggest that the round window on the front façade, which is now covered with a piece of metal, was originally a Roman-arched window that was later changed to the round configuration. This determination was made based on the irregular shape of the window as viewed from inside the crawl space and from the apparent filling-in of what was presumably the square, bottom portion of the window.

The rear addition is divided into three different areas—the foyer, the restrooms, and the kitchen. The outer walls are cement block. The wall that adjoins the sanctuary is the original brick wall of the building. It has been painted with semi-gloss white paint as have all the walls in the rear addition. Sheetrock walls separate the men's and women's restrooms from each other and from the foyer and kitchen. A modern water fountain is located on the wall between the restrooms. The floor throughout the rear addition is patterned linoleum over plywood. The entire addition measures 38'4"Wx15'6"D and covers almost the entire west wall of the original building.

From the crawl space above the rear addition, the unpainted brick wall of the original building can be seen. This indicates that the building was unpainted at the time the rear addition was constructed, perhaps as late as 1972. The truss system of the rear addition is a simple structure with 2"x8" braces supporting 2"x8" rafters. The pitch of the roof is approximately 140 degrees.

3.4 Interior Conditions – Problems of Repair

The tongue-and-groove ceiling has buckled slightly in the area just above the front entrance of the sanctuary. This was probably caused by the weight of debris, including pieces of brick, which has accumulated on the ceiling in the crawl space. Similar buckling has occurred on the other end of the ceiling just above the choir platform. In the southeast corner a piece of one board has broken off, leaving a hole in the ceiling.

The plaster walls are in good condition. A small piece of plaster has broken off just above the wainscoting near the rear door of the sanctuary. The paint on the plaster walls is peeling in some areas, most notably on the west wall above the pulpit. This wall is shaded on the exterior by a tree and by the rear addition, which could be inhibiting the evaporation of moisture on the exterior of the building. This moisture retention could be contributing to the problem of the peeling paint on the plaster wall.

The sash cords on several of the sanctuary windows are broken. In some cases, the cords are hanging down along window casing. Although the windows have been nailed shut, several of the top sashes have slipped down a fraction of an inch, leaving a gap at the top of the windows.

Semi-gloss latex paint was applied over varnish and oil-based paint on the choir pews and the pulpit rail. Peeling of this paint is particularly acute on the choir pews where large sheets of paint have peeled off, revealing the original, dark-brown, varnished finish of the pews.

Termite damage is visible through the hole in the floor on a joist near the southeast corner of the sanctuary.

The front doors in the vestibule scrape the floor when opened, making it difficult to fully open the doors.

The linoleum in the vestibule is worn and peeling and has been patched with different colored linoleum in front of the door.

The hole in the ceiling of the pastor's office is uncovered.

The ladder in the tall bell tower is rickety and the rungs are irregularly spaced.
The entry door to the rear addition from outside scrapes the floor and the doorframe and is difficult to open.

There is evidence of water damage in the women's restroom. Part of the plywood wall has been cut away around the pipes, presumably to repair a broken pipe.

### 3.5 Mechanical Systems – General Description

Three historic brass light fixtures hang from the ceiling. Two of the fixtures extend approximately 6' from the ceiling on a brass rod. These two fixtures are similar in design with four arms each and round glass globes. The fixture nearest the main entrance has four globes and a brass centerpiece. The other fixture has five round globes, the fifth one in the center. Over the chancel hangs a brass light with two tulip bulb covers which hang straight down almost directly over the altar. The sanctuary lights are turned off and on from the main breaker box, which is located in the rear addition.

Five gas heating units, four of which are located across the east wall of the sanctuary, heat the church. The fifth unit is located on the north wall between the two pews, which sit perpendicular to the congregation pews. The heaters are all connected to the gas line by copper piping.

The second window from the front entrance of the sanctuary on both the north and south side of the building have window-mounted, air-conditioning units installed. Wooden frames have been constructed on the outside of both windows to support the air-conditioning units. Electrical conduits that supply the electrical connections for the air conditioners run along the outside wall. Holes have been made in the brick beneath the air conditioning units to allow the conduit to enter the building.

The vestibule is lit by a modern double-bulb, ceiling light fixture with a string pull. The short tower has a single-bulb-ceiling fixture that is controlled from a wall switch. The tall bell tower has no light fixtures.

The foyer of the rear addition is lit by a single bulb fixture that is controlled from a wall switch as are both of the restrooms. The kitchen has five horizontal fluorescent fixtures that are controlled from a wall switch.

The only plumbing in the building is in the restrooms and kitchen.

### 3.6 Mechanical Systems – Problems of Repair

Electrical conduits running along the exterior walls of the sanctuary are unpainted. Several bricks have been broken where the conduit enters the brick wall beneath the air conditioners.

Covers are missing from the light fixtures in the vestibule, pastor's office, and rear foyer.

### 3.7 Grounds – Existing Conditions

A brick and plywood sign stating the Church's name, address, and hours of worship sits on the northeast corner of the lot. At one time a wood-frame parsonage stood where the sign is now located. This house fell into disrepair and was torn down after World War II. A well was located behind the parsonage. No evidence of either of these structures is visible.

A poured concrete driveway arcs across the northeast corner of the lot, providing ingress and egress to the church lot from both Bell Street to the east and School Street to the north. Gravel has been spread on either
side of the driveway to designate parking areas. Much of the northeast corner of the lot is covered grass with a steep slope to the street.

The front lawn is a short, but steep slope to Bell Street. Several rose bushes have been planted on the north side of the front steps next to the building.

Beneath a large pecan tree to the rear of the church sits a remnant of what is said to be part of the original steps from the front of the church. These steps are made of poured concrete.

A few roses and remnants of a privet hedge straddle the property line on the south side of church. The lot just south of the building was cleared in October of 1997 following a fire that destroyed the house on the lot.

3.8 Grounds – Problems of repair

Soil has eroded beneath the foundation in several areas.

The gravel parking area has eroded, particularly around the edges of the concrete driveway.

1. Use the property as it was historically used.
2. Retain and preserve the historic character of the property.
3. Recognize the property as a physical record of its time, place, and use.
4. Retain and preserve changes to the property that have acquired historic significance in their own right.
5. Preserve distinctive materials, features, finishes, and construction techniques that characterize the property.
6. Match original materials in composition, design, color, and texture when repairing or replacing distinctive features.
7. Do not use treatments that cause damage to historic materials, such as sandblasting or the use of harsh chemicals.
8. Protect and preserve archaeological resources.

These standards form the basis for the following recommendations for the treatment of the Bethel AME Church.

4.2 Recommendations

Treatment recommendations have been divided into two categories—stabilization, preservation, and restoration—in an effort to reflect the urgency of the need for the treatment activity. Stabilization treatments are those that should be carried out as soon as possible in order to repair or prevent damage to the building that could cause major structural or problems or result in the significant loss of historic material. Preservation treatments are those that should be undertaken as resources become available. Preservation treatments are the longer-term stabilization activities that will prevent future decay of the building. Restoration treatments are those considered restore or return modified sections of the building to an earlier, historic period.
4 Treatment

Recommendations for treatment are based on standards set by the Secretary of the Interior for the preservation of historic buildings. A general statement of this philosophy is presented followed by detailed recommendations for the application of this philosophy at the Bethel AME Church.

4.1 Statement of Philosophy

The Secretary of the Interior has established standards for preservation of historic properties listed in or eligible for listing in the National Register of Historic Places. These standards emphasize repair over replacement and limited rather than wholesale change to accommodate new uses. The objective of the standards is to ensure the preservation of those qualities for which the property is deemed eligible for listing in the National Register.

Whether listed in the National Register or not, the Secretary of the Interior's standards are guidelines that should be followed for preservation of any historic property. The standards for preservation as specified by the Secretary of the Interior include the following eight recommendations:

1. Use the property as it was historically used.
2. Retain and preserve the historic character of the property.
3. Recognize the property as a physical record of its time, place, and use.
4. Retain and preserve changes to the property that have acquired historic significance in their own right.
5. Preserve distinctive materials, features, finishes, and construction techniques that characterize the property.
6. Match original materials in composition, design, color, and texture when repairing or replacing distinctive features.
7. Do not use treatments that cause damage to historic materials, such as sandblasting or the use of harsh chemicals.
8. Protect and preserve archeological resources.

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4.2.1 Stabilization/Immediate Action – Exterior

Roof: The asphalt shingles on all sections of the roof should be replaced as soon as possible. The new roof should not be installed over the old roof, rather the current asphalt shingles should be removed. Half-round, roof-hung gutters and downspouts should be installed along the sides of the roof and along the front of the vestibule roof to direct rainwater runoff away from the building. This will help resolve the erosion problems, as well as the rising damp problem and will reduce the probability of termite infestation. In the valleys where the sanctuary roof abuts the towers, flashing should be installed to direct the rainwater runoff. A metal drip-edge should be installed along with the new roof.

The eaves in the area where the sanctuary roof and the vestibule roof abut the towers have rotted, again the result of rainwater runoff. The source of the problem should be eliminated with the installation of the crickets and gutters. However, the rotten wood should be replaced. Care should be taken to match the size and shape of the molding.

Parts of the eaves have rotted in other areas around the building as well, most notably on the corners of the rear addition. This wood should be replaced and gutters installed to remove the source of the problem that caused the deterioration. All of the eaves should be scraped and painted.

The galvanized metal roofing material on the steeples should be cleaned and painted to prevent further deterioration.

Windows: All of the windows should be scraped, putted, caulked, and painted. The Plexiglas panes in the windows on the south side of the sanctuary are warped as the result of the fire that destroyed the house next door. These panes should be replaced. Care should be taken to preserve the muntins in all windows. The muntins that have been removed from the window in the southeast corner of the sanctuary should be replaced, preferably using the original muntins that were recently removed. If the removed muntins have been destroyed or disposed of, then replacement muntins that match those of the other windows should be installed.

Several panes in the window in the northwest corner of the sanctuary are cracked and should be replaced. The green Plexiglas panes are not historic and need not be preserved. Therefore, wholesale replacement of all the Plexiglas windowpanes can be considered. Evidence indicates that the original windowpanes were clear glass, so installation of clear glass panes, or even clear Plexiglas panes would be viable alternatives. However, great care should be taken to preserve the wooden structure of the windows, as this is historic material that contributes to the distinctive style and character of the building.

The windowsill of the upper window in the short tower has split and separated from the wall. This should be repaired, if possible, using some sort of consolidant such as epoxy. The sills on all the upper windows of both towers are deteriorated, though not to the same extent as the one on the north side. These sills should be repaired in place, if possible, using consolidants and painted.

Several pieces of the casing on the window to the south of the front door have broken off and should be replaced. Care should be taken to match the size and shape of the existing casing.

More detailed information on the repair and preservation of wooden windows is presented in Preservation Brief #9, The Repair of Historic Wooden Windows, which is included in Appendix F. This brief provides information on the importance of preserving original materials of historic windows, and how to do so.

Walls: Although the outer walls of the structure are in relatively good condition, some problem areas do exist. The most notable problems are the areas where rising damp and rainwater runoff have caused the mortar between the bricks to deteriorate. This problem can be seen on the northwest corner where the rear addition joins the sanctuary and in several places on both of the towers. Rising damp and runoff have also lead to mildew along the north wall of the sanctuary. The source of the problem should be eliminated by
the installation of gutters. The mortar should be repaired, a process known as repointing, using a mortar compound that matches the current mortar in constituent composition, proportions, color, and texture. It is important to note that extremely hard mortar can be very destructive to a building. Detailed information on repointing is presented in Preservation Brief #2, *Repointing Mortar Joints in Historic Brick Buildings*, in Appendix F.

In the areas where runoff has caused erosion, the eroded areas should be built up to provide support beneath the footing. This problem is most prominent on the north side of the sanctuary in the area near the tower and on the southwest corner of the rear addition. Concrete pads should be poured to provide support in the areas where the footing is exposed, and new dirt should be added to level the grade. Again the importance of installing gutters is highlighted since the absence of gutters has caused the erosion problem in these areas.

**Doors:** The front and rear doors should be shaved down slightly to eliminate the problems of sticking and scraping the floor. This procedure might not be necessary in the vestibule if the linoleum is removed as part of the restoration of that section of the building. The loose doorknob and the side lock on the front door should be replaced. The rotted wood on the fanlight above the front door should be replaced.

4.2.2 Stabilization/Immediate Action – Interior

**Ceiling:** Debris should be removed from the crawl space above the sanctuary ceiling since this appears to be causing parts of the ceiling to buckle. The loose boards can then be reattached to the rafters. The broken board in the southeast corner should be replaced with a piece of wood that matches the existing material.

**Walls:** In the places where the plaster has cracked, such as the area above the wainscoting by the rear sanctuary door, the plaster should be repaired using compatible material. Since most of the cracks are small, an all-purpose drywall joint compound would be acceptable. Detailed information on repairing plaster walls, including recommendations for patching materials, is presented in Preservation Brief #21, *Repairing Historic Flat Plaster—Walls and Ceilings*, in Appendix F.

The peeling paint, such as that on the west wall of the sanctuary, should be scraped and the walls primed and repainted.

4.2.3 Preservation/Long-Term Maintenance – Exterior

**Roof:** Although the installation of gutters should help eliminate many of the problems associated with rainwater runoff, it is imperative that the gutters be kept clean. Failure to keep the gutters clean could lead to clogged gutters, which could cause water to seep into the eaves of the roof, causing damage to the eaves and the walls of the structure.

**Walls:** Following completion of the repointing, the walls should be cleaned to remove dirt, mildew, and loose paint and then repainted. Abrasive techniques, such as sandblasting, should never be used to clean the brick walls. The “gentlest means possible” should be used to remove the dirt and mildew. Such methods include low-pressure water combined with scrubbing using a natural bristle (never metal) brush. Preservation Brief #6, *Dangers of Abrasive Cleaning of Historic Buildings*, included in Appendix F, provides a good overview of the methods that should and should not be used.

**Windows:** The caulking and putty on the exterior of the windows should be repaired or replaced as needed over time. The windows should be painted as often as necessary to keep a solid coat of paint on all the surfaces. The paint provides a protective coating that prolongs the life of the putty, caulking, and wood. Consideration should be given to removing the plywood covers from the tower windows. The windows
should be repaired, taking care to preserve as much of the original materials as possible. The missing louvers on the shuttered windows should be replaced. Deteriorated parts of the shutters should be repaired using a consolidant, and the shutters should be repainted.

Miscellaneous: The building should be inspected for termite infestation a regular basis and treated as necessary.

### 4.2.4 Preservation/Long-Term Maintenance – Interior

**Ceiling:** The open hole in the pastor’s study should be framed and covered.

**Walls:** The plaster walls of the sanctuary should be monitored for cracks and spalling that could indicate structural problems or problems related to uncontrolled moisture.

The hole in the plywood wall in the women’s restroom should be repaired.

**Windows:** The ropes and weights on the windows should be repaired.

**Floor:** The hole in the southeast corner of the sanctuary should be repaired using planks that match the size and shape of the existing flooring.

Miscellaneous: The choir pews and pulpit railing should be scraped to remove the layer of latex paint that is peeling away in sheets. These fixtures can then be lightly sanded, primed, and repainted, preferably with an oil-based paint.

### 4.2.5 Stabilization/Immediate Action – Mechanical Systems

A qualified electrician should inspect the electrical system.

The electrical conduits that run along the outside of the building should be painted to match the building. The holes left in the brick where the conduit enters the wall should be repaired using the same mortar compound used in the repointing process.

The globes should be replaced on the light fixtures in the vestibule and rear foyer.

### 4.2.6 Preservation/Long-Term Maintenance – Mechanical Systems

A central heating, ventilation, air-conditioning system (HVAC) could be installed to replace the gas heaters and window air-conditioning units. Such a system would have the advantage of allowing greater control over the climatic conditions inside the building, including the towers and vestibule which currently have no heat or air conditioning.

### 4.2.7 Stabilization/Immediate Action – Grounds

The eroded areas around the driveway and around the foundation of the church should be filled in.
4.2.8 Restoration

The interior of the sanctuary is in much the same condition today as when it was originally constructed in the late 1800's. The vestibule and bell towers, however, have been significantly altered on the inside. Fortunately, the alterations appear to be reversible, and consideration should be given to restoring these sections to their earlier appearance. This would entail removal of the sheetrock and plywood ceilings to reveal the higher, tongue-and-groove ceilings in the towers. The sheetrock ceiling in the vestibule would also be removed, along with the paneling in the vestibule and towers. This would have the effect of increasing the natural light in the area by exposing the full height of the windows in the tower and vestibule. The linoleum floor would be removed to reveal the historic tongue-and-groove pine floor.

4.3 Summary

Much of the damage to the building can be attributed to the decayed condition of the roof and the absence of gutters on the building. Indeed, the absence of gutters has caused the eaves to rot, the mortar to deteriorate, and the soil beneath the foundation to erode. Replacing the roof and adding gutters should be the highest priorities.

Painting the metal roofing on the steeples, which is rapidly deteriorating, should also be a priority. The windows need immediate attention as well, since most of the panes are on the verge of falling out, and very little paint remains on the wood surfaces. The importance of paint as a protective coating should not be underestimated. A coat of paint on the steeples and the windows could mean the difference between the preservation or loss of historic building materials. Proper surface preparation, which includes scraping, sanding, and priming, is vital to the successful application of paint.

Repointing of the brick with compatible mortar and gentle cleaning of the brick and cement surfaces should be carried out prior to repainting the exterior of the building.

Cracks in the sanctuary walls should be repaired. The walls should be gently scraped to remove peeling paint and then primed and painted.

In general, care should be taken at all times to preserve the features and materials of the original structure. Any intervention undertaken should be as unobtrusive as possible, and the gentlest possible cleaning methods should always be employed.
5 Appendices
5.1 Appendix A -- Chain of Title
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State of Georgia, Fulton County. On ... same as attesting witness also. Sufficient to be subscribed before me the 17th Dec. 1872. W. H. Pitts, J. P.

[Handwritten document continues]
20 Dec. 1852

A. L. Shurford

State of Georgia

Habersham County

To the African M. C. Church

at Acworth Ga

This indenture made

Eight years and Eighty two between A. L. Shurford and

John Huffing for the first part and

John Huffing for the second part and

W. F. Waverly for the third part and

This indenture made

A. L. Shurford of the first part and

W. F. Waverly of the second part and

John Huffing of the third part

Additionally, it was agreed that the said church

shall have the use of the said land for the purpose of a

church and parsonage at Acworth, Georgia.

Witnessee, then, to the said A. L. Shurford and

W. F. Waverly and John Huffing.

Recorded Jan. 25th, 1853

W. W. Montgomery, Esq.
William and affiants are heirs of the above-mentioned John and all other and every other heir of the said John Buffington, Hybrid Bosto, Harri Nastly, Cygal Buffington. Pet. Carlen, hunter for A. E. E. L. E. H. as executor and assignee for L. H. Smith and the said E. S. Shuford and Mrs. Kate Shuford to Lewis Cooner, and assignee of the said E. S. Shuford and Mrs. Kate Shuford. The land located to make the said John Buffington, Hybrid Bosto, Harri Nastly, Cygal Buffington, and Pet. Carlen. Lewis and Mr. Varnish and for ever defend the right and title thereof against themselves and against the claims of all other persons whatever. In witness whereof the said E. S. Shuford and Mrs. Kate Shuford have executed unto Lewis Cooner and assigned the same written and delivered in presence of
J. E. Cooper
W. Johnson

State of Georgia, Galt County.

Before the came J. E. Cooper, the true and lawful agent and with that to Earl E. S. Shuford and Kate Shuford, sign and declare the within deeds for the persons herein mentioned and that he signed the same as a witness unto and saw W. Johnson, do the same known to and subscribed before me this 22nd day of August, 1853.

E. L. Shuford

Clerk

1824

State of Arkansas, Hotston County.

In consideration of the sum of forty dollars to be paid and is paid, I, John O. Hard, do hereby give and convey unto J. Hard, the above-mentioned John O. Hard and every other heir of John O. Hard, deceased, the right, title, and interest in and to the land described as follows.

1. A tract of land in the town of Hotston, in the county of Hotston, in the State of Arkansas, described as follows:
   - Commenced at a point on the boundary line of the town of Hotston.
   - Containing one acre and forty feet.
   - Situated in the Hotston District, in the county of Hotston, in the State of Arkansas.

2. A tract of land in the town of Hotston, in the county of Hotston, in the State of Arkansas, described as follows:
   - Commenced at a point on the boundary line of the town of Hotston.
   - Containing one acre and forty feet.
   - Situated in the Hotston District, in the county of Hotston, in the State of Arkansas.

The above-described tracts of land are to be conveyed to John O. Hard, the above-mentioned John O. Hard, and every other heir of John O. Hard, deceased, according to law.
5.2 Appendix B -- Maps
5.3 Appendix C – Floorplan and Photographs
5.4 Appendix D – Summary of Oral Interviews

[Image: Photograph of a tree and a building]
5.4 Appendix D – Summary of Oral Interviews

Oral interviews were conducted on October 18, 1997, with several residents and members of the congregation.

Annie Echols
Age: 71 years old
Acworth native. Began attending the Bethel A.M.E. Church upon her marriage to Hilliard W. Echols over 50 years ago.

- A parsonage stood where the church sign is currently located on the northeast corner of the lot until the 1950s.
- The church was painted forty years ago.
- The rear addition, consisting of the kitchen, restrooms, and foyer, was built in the 1950s.
- The current pews were installed 35-40 years ago.
- The current carpet was installed five years ago.

Hilliard W. Echols
Age: 79 years old
Acworth native. Joined Bethel A.M.E. Church at age 17.

- The church is 133 years old.
- Mr. Echols' grandfather helped build the sanctuary.
- A well was located near the non-dismantled parsonage, and is now since been filled in (no longer a distinguishable feature of the landscape).
- Reverend Perry added the word "Gazette" to the name of the church during his tenure. The prefix was dropped after his departure.
- Ernest Morris, now deceased, put in the steps at the front of the church.
- The parsonage was a wooden-frame structure, torn down approximately forty years ago due to its deteriorating condition.

Evelyn Gregg
Age: 90 years old
Acworth native
Member of Zion Baptist Church (her deceased husband was a member of Bethel A.M.E. Church)

- Bethel A.M.E. congregation was organized in 1864 and the Zion Baptist congregation in 1865.
- By 1865, alternate Sunday services were scheduled to allow the two congregations to share a facility.
- The location where Zion Baptist Church and Bethel A.M.E. Church met is near the Liberty Hill Cemetery on Cemetery Street.
- A wooden schoolhouse was located on the ground where Bethel A.M.E. Church is now located.
- The "original" pews in Bethel A.M.E. Church came from the Zion Baptist Church and a local white church.
- The church sold some of its property to LeRoy Echols in the 1950s; a lot he leveled and cleared to build a house (still standing).
- There were two potbelly stoves in the sanctuary until after World War II. One was located near the pulpit and the other in the left-hand corner.
- The existing front steps cover those put in by Ernest Morris.
- The current pews were installed in the 1970s.
- The rear addition was built, and the entire structure was painted for the first time in the 1970s.
Oral interview summaries

Oral interviews were conducted on October 18, 1997 with several residents and members of the congregation.

Annie Echols
Age: 71 years old
Acworth native, began attending the Bethel A.M.E. Church upon her marriage to Hilliard W. Echols over 50 years ago.
- A parsonage stood where the church sign is currently located on the northeast corner of the lot until the 1950s.
- The church was painted forty years ago.
- The rear addition, consisting of the kitchen, restrooms, and foyer, was built in the 1950s.
- The current pews were installed 55-60 years ago.
- The current carpet was installed five years ago.

Hilliard W. Echols
Age: 76 years old
Acworth native, joined Bethel A.M.E. Church at age 13
- The church is 133 years old.
- Mr. Echolls grandfather helped build the sanctuary.
- A well was located near the now-demolished parsonage, and has since been filled in (no longer a distinguishable feature of the landscape).
- Reverend Perry added the word “Greater” to the name of the church during his tenure. The prefix was dropped after his departure.
- Earnest Morris, now deceased, put in the steps at the front of the church.
- The parsonage was a wooden-frame structure, torn down approximately forty years ago due to its derelict condition.

Evelyn Gragg
Age: 90 years old
Acworth native
Member of Zion Baptist Church (her deceased husband was a member of Bethel A.M.E. Church
- Bethel A.M.E. congregation was organized in 1864 and the Zion Baptist congregation in 1865.
- By 1865, alternate Sunday services were scheduled to allow the two congregations to share a facility.
- The location where Zion Baptist Church and Bethel A.M.E. Church met is near the Liberty Hill Cemetery on Cemetery Street.
- A wooden schoolhouse was located on the grounds where Bethel A.M.E. Church is now located.
- The “original” pews in Bethel A.M.E. Church came from the Zion Baptist Church and a local white church.
- The church sold some of its property to LeRoy Echols in the 1950s; a lot he leveled and cleared to build a house (still standing).
- There were two potbelly stoves in the sanctuary until after World War II. One was located near the pulpit and the other in the left-hand corner.
- The existing front steps cover those put in by Earnest Morris.
- The current pews were installed in the 1970s.
- The rear addition was built, and the entire structure was painted for the first time in the 1970s.
Corrie Young
Age: 65

- J.R. Fleming was the minister at the time Bethel A.M.E. Church’s site was chosen and the sanctuary erected.
- The parsonage was torn down in the 1950s or 1960s.
- The church, front addition, sanctuary and rear addition, was painted 20 years ago.
- Rosetta Nichols, a former slave and longtime Sunday school teacher, “moved” with the church to its current site from the Liberty Hill location. She is pictured next to the “bride” in the Tom Thumb wedding picture taken behind the rear of Bethel A.M.E. Church over 75 years ago. The pecan tree in the background of the photograph is still standing. Ms. Nichols’ Bible was last known to be in the possession of Mr. And Mrs. Hartley Swanson.
5.5 Appendix E -- Cornerstone Rubbing
5.6 Appendix F - Preservation Briefs

L. Myers

Windows are frequently important visual focal points, and no site is more focused on than a window. The replacement of a window is a significant change to the character of the building. The process of selecting windows involves considering the function of the building, the architectural style, and the historical context.

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 a key step in planning for window treatments. A general understanding of the function and history of windows in the building is vital to making a proper evaluation. As a part of this evaluation, one must consider the 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 gain.

Historically, the first windows in early American houses were statement windows that are, they were hung at the side and uppermost levels. In the beginning of the eighteenth century, single- and double-hung windows were introduced. Subsequently many styles of these vertical sliding case 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. More specific, regionally oriented architectural comparisons should be made to determine the significance of windows in question. Although such comparisons may focus on specific window types and their details, the ultimate determination of significance should be made within the context of the whole building, whereas the windows are an 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 to the building, or reflect the original design intent for the building; 2) reflect period or regional styles or building traditions; 3) reflect changes to the building resulting from major periods or events; or 2) are examples of exceptional craftsmanship or design. Once this evaluation of significance has been completed, it is possible to pro-
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.

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-

Figure 1. Windows are frequently important visual focal points, especially on simple facades such as this mill building. Replacement of the multi- pane windows here with larger panes could dramatically change the appearance of the building. The areas of missing windows convey the impression of such a change. Photo: John T. Lowe
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-
The scope of the necessary repairs will be evident and a plan especially useful for checking sills where visual access to moisture will allow the manufacturer’s recommendations for application will be identified and eliminated, and all existing decay allowances will be made 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 should be initially loosened from the sash side to avoid visible scarring of the wood and then gradually pried loose using a putty knife). With the stop removed, the lower or interior sash may be withdrawn. 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 effective technique for removing paint from wood, particularly along the seam where these techniques fail, is to use a hot air gun. 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.

Painting 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
Figure 4a. 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

Figure 4b. 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

Figure 4c. Sash can be removed and repaired at a convenient work area. Paint is being removed from this sash with a hot air gun while an asbestos sheet protects the glass from sudden temperature change. Photo: John H. Myers

Figure 4d. 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

Figure 4e. 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

Figure 4f. Following the relatively simple repairs, the window is weather tight, 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 over the glass slightly to complete a weathertight 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 over the glass slightly to complete a weathertight

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
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 weather-stripping to reduce air infiltration. A wide variety of products are available to assist in this task. Felt may be fastened to the top, bottom, and meeting rails, but may have the disadvantage of absorbing and holding moisture, particularly at the bottom rail. Rolled vinyl strips may also be tacked into place in appropriate locations to reduce infiltration. Metal strips or new plastic spring strips may be used on the rails and, if space permits, in
the channels between the sash and jamb. 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
Repointing, also known as "tuck pointing" or simply "pointing," is the process of removing deteriorated mortar from the joints of a masonry wall and replacing it with new mortar. The selection of improper techniques or materials in the repointing of historic buildings not only can alter the visual aspects of a building but also can lead to further deterioration of the masonry. The purpose of this leaflet is to provide general guidance on the methods and materials for the repointing of historic brick buildings, for the benefit of building owners, architects and craftsmen.

**Identifying The Problems**

The decision to repoint usually is related to some perceptible problem, such as falling mortar, loose bricks or damp walls. The actual cause of the problem, however, may be unrelated to the visible effects, and for this reason the services of an architect or preservation consultant should be obtained at the earliest planning stages to prevent both visual and physical damage to the building.

The first step in planning a repointing project is to ascertain the true causes of problems which need attention. If the reason for repointing is to stop water penetration, the consultant should thoroughly investigate all possible sources of water. Damp walls may be caused by leaks from parapets, flashing, or roofs, and such leaks may show up some distance below in the masonry walls. Another source is rising capillary moisture which can cause dampness several feet above the ground. In either of these cases, repointing the outer masonry wall will not cure the problem. Similarly, if open joints or loose bricks are caused by foundation settlement or deterioration of materials, such structural problems should be corrected before beginning masonry work. After such an investigation, the consultant can inform the owner of necessary remedial actions and their costs, possibly including additional technical advice from foundation or soil engineers.

**Logistical planning:** It is important to recognize that repointing will be an expensive and time-consuming task due to the large amount of handwork and special materials required. Work cannot begin immediately, because research is required and some materials such as handmade bricks may have a long delivery time. Scaffolding will be in place for an extended period, possibly interfering with normal circulation patterns. The owner should remember that many communities will require a building permit before work can begin.

The architect/consultant also must recognize logistical considerations and the relationship of the repointing to other proposed work. For example, if paint is to be removed or gutters replaced, it may be logistically advisable to conduct research relating to these items before beginning to repoint. If water penetration is to be corrected, the repointing work probably should come early in the preservation project; if the building is watertight, it may be better to wait until after completion of exterior cleaning so that the existing and new mortars will weather simultaneously. Related projects, such as installing downsputs or painting (possibly separate contracts) should be scheduled to avoid conflict with the repointing work but at the same time to take maximum advantage of the scaffolding. Contractors should be made aware of these various architectural and logistical relationships in the early stages of project planning.

**Research**

The repointing work will possibly involve analysis not only of the mortar but also of the bricks and the techniques originally used in striking the joints.

**Mortar study or analysis** is necessary if the repointing mortar is to match the original mortar in color, texture, and other properties. The identification of the major constituents is relatively simple; it may be possible to arrive at an approximation of the mortar’s composition by observation (using low magnification) of an unweathered sample. (A more accurate method for performing this analysis is presented by E. Blaine Cliver in "Tests for the Analysis of Mortar Samples" in the Bulletin of the Association for Preservation Technology, Volume VI, Number 1, 1974. This article describes a methodology for separating a mortar sample into its various components.) Once the constituents have been separated and identified, the sand can be examined for the range of color, size and shape of the grains. Other insoluble materials also should be identified for inclusion in the repointing mortar.

**Pointing styles and the methods of producing them** should be studied. (Fig. 1) It is important to examine both the horizontal and the vertical joints to determine which were struck first and whether they are the same style. Some buildings, for example, have horizontal joints which were tooled concave while the vertical joints were finished flush with the surface of the brick, then stained to match the
Figure 1. A variety of joint types and brick bonding patterns are illustrated here. Note the difference in uniformity of the bricks in A and B, which are handmade, and those from C through F, which are machinemade. It is evident in A, B, and F that the vertical joints were struck before the horizontal joints. Also note in B and E that the vertical joints are narrower than the horizontals.
brick, creating the illusion of horizontal bands. This technique was used extensively in late 19th and early 20th century architecture.

Bricks should be studied so that any replacements which may be necessary will match the originals. Within a wall there may be a surprisingly wide range of colors, textures, and even sizes. Replacement bricks should match this range rather than a specific brick. Potential sources for replacement bricks should be considered at the first stages because of the length of time required for the manufacture of special bricks. It may be possible to obtain suitable bricks from salvage building materials suppliers, or, if of comparable hardness and color, bricks may be moved from unexposed areas in the building to exposed areas.

Planning The Work

Properties of mortar: In general, repointing mortars should match the original mortar in constituent composition and proportions as well as in color and texture. The importance of matching the composition frequently is overlooked, yet this match is necessary if the new and old mortars are to have the same physical characteristics.

It is a common error to assume that hardness or high strength is a measure of durability. Stresses within a wall caused by expansion and contraction or by settlement must be accommodated in some manner; in a masonry wall these stresses should be relieved by the mortar rather than the brick. A mortar which is stronger and harder than the masonry units will not “give,” thus causing the stresses to be relieved by the masonry units, usually in the form of cracking and spalling. (Fig. 2) Uneven movement in the masonry also can break the bond between the mortar and the brick, opening hairline cracks to water penetration.

Mortars with a high percentage of portland cement can have the above described deleterious effects. Additional information on this problem is contained in Studies of Stone-Setting Mortars; Building Materials and Structures Report 139, published by the National Bureau of Standards in 1953. Porous mortar permits water within the wall to migrate and escape. Mortar with a high cement content does not permit this movement, and the water trapped within the wall may be subjected to freeze-thaw cycles which can spall soft, older brick.

“Workability” or plasticity of the mortar also is important. The new mortar should have both cohesive and adhesive qualities to make complete physical contact with the masonry and old mortar.

It should have the maximum amount of sand consistent with such workability to help reduce shrinkage while drying. The mortar must not be sticky or gummy and must handle readily on the pointing tool. Finally, the newly applied mortar must have good water retention to resist rapid loss of water through absorption by the brick or old mortar while setting.

Advantages of using high lime mortar: These facts lead to the conclusion that a high lime mortar generally is best for most historic structures, even those originally constructed with cement mortars. High lime mortar is soft and porous, and has the lowest volume change due to climatic condition. In addition, lime mortar is slightly soluble in water and able to self-seal small cracks and voids that may develop. In this phenomenon, a slight amount of the mortar dissolves in rain water and is precipitated in the void during the drying process, thus sealing the crack. Even straight lime mortar is more durable than generally recognized as long as the wall is protected from water penetration with sound roofing, gutters, flashing, etc. A small amount of white portland cement may be desirable, however, to accelerate setting.

| A. Flexible mortar  
| Lime | |  
| Normal | Hot (bricks expand) | Cold (bricks contract) |
| Mortar compresses | Mortar flexes |  
| Spalling | Cracks open up |

B. Inflexible mortar  
| Cement |  
| Normal |  

Figure 2. Diagrammatic sketches showing effects of temperature change upon masonry. Flexible mortar (A) expands and contracts with temperature changes. Bricks bonded by inflexible mortar (B) tend to spall at the edges (the area of greatest stress) in hot weather and separate from the mortar when it is cold. This latter condition opens cracks, permitting the entry of water and causing additional deterioration.

Even if the building originally was constructed with cement mortar, it usually is best to use a high lime mortar rather than match the original. High lime mortar will reduce potential stresses at the edges of the masonry and also help minimize shrinkage, which leads to hairline cracking.

Matching color and texture: Although the use of proper materials and techniques will give a watertight job, appearance is also important. Both color and texture most often can be matched through the careful selection of lime and sand and other aggregates. Every reasonable effort should be made to use these natural sources of color and texture in matching the mortar. If the original sand borrow pit is no longer available, the masonry contractor may know of similar sand available in the region.

If it is not possible to obtain a proper match through the use of natural materials, it may be necessary to use a mortar pigment. Of course, some late 19th and early 20th century mortars contained such colors. These pigments are available as a separate ingredient or already mixed with mortar cement and lime; the premixed mortars usually are not suitable for use on older structures due to the high portland cement content. Only chemically pure mineral oxides that are alkali-proof and sun-fast should be used; natural earths have low tinting values, organically based colors fade in direct sunlight, and carbon black dissolves out of mortars which are not impervious to moisture.

Texture of the mortar also affects the visual characteristics. Modern mortars are finely ground and thus present a uniform texture as well as color; early mortars were not as finely ground, however, and may contain lumps of oyster shell or incompletely burned lime. The size, color, and composition of these lumps should be determined as part of the mortar analysis, and they should be duplicated in the repointing mortar. These particles can be duplicated in kind with new oyster shells or lumps of lime, or they can be made by grinding the old mortar removed during the joint preparation and adding it to the new mortar.

**Materials Specifications**

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.

**Lime** should conform to ASTM C 207, Type S, Hydrated Lime for Masonry Purposes, or Federal spec SS-L-351B. This lime is designed to assure high plasticity and water retention with a safe degree of strength. The use of quicklime with the necessity of slaking and soaking does not provide better results.

**Cement** should conform to ASTM C 150, Type I or II, or Federal spec SS-C-192G(3). It should have not more than 0.60% alkali (expressed as sodium oxide) or not more than 0.15% water soluble alkali by weight (in the combination of lime and cement). This low alkali content is necessary to help avoid efflorescence. Non-staining white cement is quite expensive but frequently will be required in lieu of the usual grey cement to provide the proper color.

**Sand** should conform to ASTM C 144, or Federal spec SS-A-281B(1) para. 3.1, to assure proper gradation and freedom from impurities. Sand color, size, and texture should match the original as closely as possible to provide the proper visual characteristics without other additives. A sample of the sand is necessary for comparison to the original, and should be approved by the consultant before beginning repointing work.

**Water** should be clean and free from deleterious amounts of acids, alkalis, or organic materials.

**Special additives** will require writing new specifications for each project. If possible, suggested sources for the special materials should be included. For example, crushed oyster shells frequently can be obtained in a variety of sizes from poultry supply dealers.

**Mortar mix:** As mentioned previously, the new mortar usually should match the existing mortar as closely as possible, and the best way to insure a match is through careful analysis of the existing mortar. If an accurate chemical match of the original mortar is not feasible, or if the original mortar is too hard for repointing work, the following mixes may provide a starting point for the development of a mortar which is visually and physically acceptable. If the original mortar was nearly all lime and sand, try by starting with the following mix:

1 bag hydrated lime
¼ bag white portland cement
3 cubic feet of sand to match the original

If the mortar originally contained cement, or for extreme weather exposures such as parapet walls, try:

1 to 1½ bags hydrated lime
1 bag portland cement
5 to 6½ cubic feet of sand

Keep in mind that the above mixes are only given to suggest the basic range of lime-to-cement ratios. It is likely they will require modification or additional constituents before they produce a mortar that matches the visual and physical character of the original.

**Execution Of The Work**

**Supervision:** Repointing work on historic structures will require significantly more supervision than work on contemporary buildings in order to prevent unintentional damage to the brick. Craftsmen, contractors, and job supervisors should understand the reasons for the repointing work and the damage which can arise from improper techniques. Craftsmen must realize that the preservation of the bricks is more important than strong mortar or rapid progress, and that a great deal of hand labor will be required. Contractors should be aware that some materials may require long delivery periods while others may not be available through builders' supply companies at all. Contractors must also understand that "stop orders" may be authorized by the owner to permit further architectural research should unexpected conditions be revealed during the course of the project. Only after considering these factors will contractors be able to submit accurate bids which will afford a reasonable profit without pushing the craftsmen to produce a hasty job.

**Joint preparation:** Generally old mortar should be cut out to a minimum depth of one inch to insure an adequate bond between the new mortar and the existing masonry and to prevent mortar "popouts." For joints less than three-eighths of an inch thick, cutting the mortar back one-half inch usually is sufficient if the mortar behind that point is in good condition. Any loose or disintegrated mortar beyond this minimum depth should be removed (Fig. 3). Unless the mason is unusually skilled and extremely careful, the use of power tools for mortar removal inevitably will damage the brick. (Fig. 4) Damage to the edges of the brick will significantly affect the character of the brickwork; in addition, absorption of water is increased since the softer inside of the
brick is no longer protected by the hard burned outer surface. Where joints are uniform and fairly wide, and the bricks were machine made with straight edges, it may be possible to use a grinder. A test patch will establish the feasibility of using a grinder. If there is any chance of damage occurring, however, hand methods should be used exclusively. Although hand work is slower, it is easier to control and is less likely to cause irreversible damage.

The mortar should be removed cleanly from the brick leaving square corners at the back of the cut. Before pointing is started all loose particles should be removed from the joint with a jet of air. The masonry and old mortar should be wetted at the time of repointing but no excess water should be present.

Mortar preparation: Mortars should be mixed thoroughly to obtain uniformity of both visual and physical characteristics. Dry ingredients should be mixed before adding the water. The mixture should be pre-hydrated to help prevent shrinkage on drying. To pre-hydrate the mortar, sufficient water is added to the dry mix to make a damp, stiff mortar. After one to two hours the mortar is remixed with additional water to give the desired consistency.

The use of anti-freeze compounds during cold weather is not recommended. Their effectiveness with high lime mortars is questionable. Furthermore, they may contain salts which would be a source of later efflorescence. A better practice is to heat the water and sand, with care taken to prevent scorching of the sand. The masonry then should be protected from freezing.

The use of air entraining agents also is discouraged. These agents are used with concrete to resist frost action and increase plasticity. The air which these agents incorporate into mortar, however, has a detrimental effect on both bond and strength of repointing mortar. Air entraining agents are considered unnecessary in high lime mortars because of their natural plasticity. Air entrainment of 10 to 16 percent, however, may be desirable in areas of extreme exposure where high strength mortars are used.

Use of bonding agents: The use of chemical agents to increase the bond of the new mortar to the old mortar and masonry units should be avoided. These agents generally are unnecessary and can be harmful.

If the joint is properly prepared and moistened prior to placing the new mortar and if the mortar is properly prepared and applied, there will be a good bond between the new mortar and the adjacent surfaces; chemical agents will not significantly improve this bond. If chemical agents are used, there may be a tendency to neglect proper joint preparation in the thought that the agent will make adequate bonding. In actuality, deteriorated mortar or dirt may remain in the joint, and bonding to these materials will not keep the mortar from coming loose. Chemical agents cannot substitute for adequate joint preparation and proper mortar mixing. In addition, some of the chemical agent inevitably will become smeared on the exposed face of the masonry and, due to the nature of the material, its removal will be difficult. This situation is especially likely on walls with thin mortar joints.

Filling the joints: Where existing mortar has been removed (or has fallen out) to a depth greater than one inch, these deeper places should be filled first, compacting new mortar in several layers. Once this has been completed, the back of the entire joint may be filled by applying approximately one-fourth inch of mortar and packing and back corners of the joint. This application may extend for several feet. As soon as the applied mortar has reached thumb print hardness, another layer of mortar of approximately the same thickness may be applied. Several layers will be needed to fill the joint flush with the outer surface of the brick. It is important to allow each layer time to lose much of the water and become stiff before the next layer is applied.

The rate of stiffening can be controlled by dampening the brick and old mortar before beginning to fill the joint. Free water or excessive dampness in the joint must be avoided; too much water will delay the tooling or cause excess shrinkage. If the joint is too dry, water will be absorbed from the mortar before it is properly set, thus reducing bond strength and increasing the probability of leaks. When the final layer of mortar is thumb print hard, the joint is tooled in a manner to match the appearance of the old mortar. Tooling the finished joint at the right stage of firmness is important for uniform color. If finished while too
soft, the color will be lighter than expected and hairline shrinkage cracks are likely to occur. If tooled when too hard, there may be dark streaks called tool burning, and good closure of the mortar against the brick will not be achieved.

If the old bricks have worn, rounded corners, it usually is best to recess the final mortar surface slightly to avoid leaving a joint which is visually wider than the actual historical appearance; it also will avoid creation of a large, thin featheredge which is easily damaged, thus admitting water. (Figs. 5 and 6)

Following tooing, it frequently is necessary to remove excess mortar from the edge of the joint by brushing with a bristle brush. The lower portion of the brickwork shown in the title block photograph has been brushed while the middle area has not. (Also see discussion on cleaning below.)

"Aging" the new mortar: Even with the best efforts at matching original mortar color, texture, and materials, there usually will be a visible difference between the old work and the new, partly because the new mortar has been matched to the unweathered portions of the original mortars. Another reason for a slight mismatch may be that the mortar sand may be more exposed in the old mortar due to the slight erosion of the lime or cement. Several methods of treatment have been attempted in an effort to overcome these differences. As with all work, however, any proposed treatment should be carefully considered and tested prior to implementation.

One method of aging the new mortar is a light brushing with a stiff natural brush immediately after tooing. This brushing will roughen the surface slightly, thus producing a weathered look.

Another relatively safe treatment is to fine spray the mortar with low pressure water after completion of tooing. This spray will wash away part of the cement and lime before it is fully hardened, leaving the grains of sand more exposed on the outer surface of the joint as in natural weathering.

Efforts to artificially stain the new mortar may give an initial color match but can cause the new and old mortars to change color at a different rate during the natural aging process. In addition, the mixtures used to stain the mortar may be dangerous to the masonry; some mixtures, for example, can introduce salts into the masonry which then can cause efflorescence. If the mortars have been properly matched, the best treatment for surface color differences is to let the mortars age naturally.

Cleaning: If repointing work is carefully executed, there will be little excess mortar to clean from the walls. A conscientious mason will remove most extraneous mortar particles with a bristle brush after the mortar dries but before it hardens. Hardened mortar can be removed with a wooden paddle or, if necessary, a chisel.

Further cleaning is best accomplished with the use of plain water and bristle brushes. If chemicals must be used, the selection must be made with extreme caution to avoid damage to either the mortar or the masonry. Selection of an improper cleaner can lead to deterioration of the masonry units or the mortar, mortar smear, and efflorescence. The use of acid or any agent containing acid should be a last resort, for acid can destroy the featheredge closure between the finished mortar joint and the brick. Chemical solutions should be used only once and should be flushed freely with plain water to remove all traces of the chemicals.

Several precautions should be taken when cleaning with plain water or with cleaning solutions. The mortar should be fully hardened before cleaning; usually thirty days is sufficient, depending upon weather or exposure. Test cleaning should be conducted on a small section before proceeding with the rest of the building. Both the area to be cleaned and the wall below should be presoaked with water. Cleaning the walls of excess mortar should begin at the top and work to the bottom. As the cleaning proceeds, it is important to flush the area with water. Stiff natural brushes should be used for all surfaces except glazed or polished surfaces, for which only soft cloths should be used.

New construction "bloom" or efflorescence occasionally appears within the first few months after repointing and generally disappears through the normal process of weathering. If efflorescence is not removed by natural processes, the safest way to remove it is by dry brushing with bristle brushes followed with a brief water rinse. Chemical cleaners, especially muriatic acid, should be avoided in the removal of efflorescence since the chemicals can create additional salts which may lead to added efflorescence.


Summary

For the owner: It is important for the owner or administrator of an historic building to be aware that repointing is likely to be a slow and expensive project. Schedules for both the repointing work and other activities will require careful coordination in order to avoid unanticipated conflicts. The work cannot be rushed or overly economized if the building is to retain the proper visual characteristics and if the job is to be durable and watertight.
While careful preservation, restoration and maintenance can hold back deterioration, it is important to understand that repointing work probably will not last the life of the structure. Nevertheless, if the first mortar joint has proved durable for many years, careful repointing should also have a long life. Additional repointing jobs can be undertaken as needed without altering structural soundness and original appearance.

For the architect/consultant: The architect must assist the owner with planning for the logistical problems relating to research and construction. The architect also must realize that older buildings have special problems not usually encountered in modern construction, so extra research will be required, and other than standard materials and procedures will need to be specified. The qualifications of potential contractors must be carefully evaluated based on previous experience with historic structures, and the contractor must be given special instructions prior to starting the work.

For the contractor/craftsman: The requirement for large amounts of slow handwork must be recognized if the contract is to submit a bid which will reflect these expensive methods. The contractor must explain the special nature of the project to the craftsmen so they will not rush the project. Understanding the potential problems will not only help the contractor in evaluating the project but will also help the masons to understand the reasons that specific methods should or should not be used.

Information for this brief was based in part upon:


Additional readings on the subject of repointing are listed below:


Loth, Calder. “Notes on the Evolution of Virginia Brickwork from the Seventeenth Century to the Late Nineteenth Century,” Bulletin of the Association for Preservation Technology, Volume VI, Number 2, 1974, pp. 82–120.


The line illustrations for this brief were prepared by Robert C. Mack and David W. Look, Interagency Historic Architectural Services Program; and the photographs are by Calder Loth, Architectural Historian.

This publication has been prepared pursuant to Executive Order 11593, “Protection and Enhancement of the Cultural Environment,” which directs the Secretary of the Interior to “… develop and make available to Federal agencies and State and local governments information concerning professional methods and techniques for preserving, improving, restoring and maintaining historic properties.” Preservation Briefs: No. 2 has been developed under the technical editorship of Lee H. Nelson, A.I.A., Interagency Historic Architectural Services Program, Office of Archeology and Historic Preservation, National Park Service, U.S. Department of the Interior, Washington, D.C. 20240. April 1976.
### Planning for Repointing of an Historic Brick Building

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Historical Background

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

Not only did the basic plastering material change, but the method of application changed also. In early America, the windows, doors, and all other trim were installed before the plaster was applied to the wall (Fig. 5). Generally the woodwork was prime-painted before plastering. Obtaining a plumb, level wall, while working against built-up moldings, must have been difficult. But sometime in the first half of the 19th century, builders began installing wooden plaster "grounds" around windows and doors and at the base of the wall. Installing these grounds so that they were level and plumb made the job much easier because the plasterer could work from a level, plumb, straight surface. Woodwork was then nailed to the "grounds" after the walls were plastered (Fig. 5). Evidence of plaster behind trim is often an aid to dating historic houses, or to discerning their physical evolution.

Lime Plaster

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

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

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

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

**Gypsum Plaster**

Gypsum begins to cure as soon as it is mixed with water. It sets in minutes and completely dries in two to three weeks. Historically, gypsum made a more rigid plaster and did not require a fibrous binder. However, it is difficult to tell the difference between lime and gypsum plaster once the plaster has cured.

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

In rehabilitation and restoration projects, one should rely on the plasterer's judgment about whether to use lime or gypsum plaster. In general, gypsum plaster is the material plasterers use today. Different types of aggregate may be specified by the architect such as clean river sand, perlite, pumice, or vermiculite; however, if historic finishes and textures are being replicated, sand should be used as the base-coat aggregate. Today, if fiber is required in a base coat, a special gypsum is available which includes wood fibers. Lime putty, mixed with about 35 percent gypsum (gauging plaster) to help it harden, is still used as the finish coat.

**Lath**

Lath provided a means of holding the plaster in place. Wooden lath was nailed at right angles directly to the structural members of the buildings (the joists and studs), or it was fastened to non-structural spaced strips known as furring strips. Three types of lath can be found on historic buildings (Fig. 6).

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

![Fig. 6. Top to bottom: Hand-riven lath, machine-sawn wood lath, expanded metal (diamond mesh) lath, and perforated gypsum board lath. Profile views of their keying characteristics are shown to the right. For plaster repairs or replastering, galvanized metal lath is the most reliable in terms of longevity, stability, and proper keying. Drawing: Kaye Ellen Simonson.](image-url)
Plaster in a historic building is like a family album. The handwriting of the artisans, the taste of the original occupants, and the evolving styles of decoration are embodied in the fabric of the building. From modest farmhouses to great buildings, regardless of the ethnic origins of the occupants, plaster has traditionally been used to finish interior walls.

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

Plaster could be treated in any number of ways: it could receive stenciling, decorative painting, wallpaper, or whitewash. This variety and the adaptability of the material to nearly any building size, shape, or configuration meant that plaster was the wall surface chosen for nearly all buildings until the 1930s or 40s (Fig. 1).

Fig. 1. Left: Schifferstadt, Frederick, Maryland, 1756. Right: First Christian Church, Eugene, Oregon, 1911. Although these two structures are separated in history by over 150 years and differences in size, ethnic origin, geography, construction techniques, and architectural character, their builders both used plaster as the interior surface coating for flat and curved walls. Photo left: Kay Weeks. Photo right: Kaye Ellen Simonson.
and durability. It resists fire and reduces sound transmission. Next, replacing plaster is expensive. A building owner needs to think carefully about the condition of the plaster that remains; plaster is often not as badly damaged as it first appears. Of more concern to preservationists, however, original lime and gypsum plaster is part of the building's historic fabric—its smooth-troweled or textured surfaces and subtle contours evoke the presence of America's earlier craftsmen. Plaster can also serve as a plain surface for irreplaceable decorative finishes. For both reasons, plaster walls and ceilings contribute to the historic character of the interior and should be left in place and repaired if at all possible (Fig. 2).

Fig. 2. A hole in the wall of a 1760s Custom House in Chestertown, Maryland illustrates the evolution of the room. (a) The original plaster was applied directly to an exterior masonry wall and the chair rail (missing here, see arrow) was in place before the wet plaster was applied to the wall. Sometime later when the interior was modified, the masonry was furred out. Machine-sawn wood lath (b) was nailed to the furring strips and (c) new three-coat plaster was applied. Photo: Maryland Historical Trust.

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

To repair plaster, a building owner must often enlist the help of a plasterer. Plastering is a skilled craft, requiring years of training and special tools (Fig. 3). While minor repairs can be undertaken by building owners, most repairs will require the assistance of a plasterer. 

Fig. 3. Many of these traditional plastering tools are still used today: (a) screen to separate coarse sand from fine sand; (b) lime screen to remove unslaked particles of lime; (c) hoe; (d) shovel; (e) hawk to hold small amounts of plaster; (f) angle float to apply finishes to inside angles; (g), (h), (i) assorted trowels to apply base-coats and finish coat; (j) padded float to level off humps and fill in hollows caused by other tools; (k) a two-handled float or "darby" to float larger surfaces; (l) a simple straight edge; (m) a square to test the trueness of angles; (n) plumb to check verticality of plastered surfaces; (o), (p), (q), (r) jointing and mitering tools to pick out angles in decorative moldings; (s) comb made of sharpened lath pieces to scratch the basecoat of plaster; (t) brush to dampen plaster surfaces while they are worked smooth; (u) template made of wood and metal to cut a required outline for a fancy mold.
Metal Lath. Metal lath, patented in England in 1797, began to be used in parts of the United States toward the end of the 19th century. The steel making up the metal lath contained many more spaces than wood lath did contain. These spaces increased the number of slits; metal lath was better able to hold plaster than wood lath had been.

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

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

Common Plaster Problems

When plaster dries, it is a relatively rigid material which should last almost indefinitely. However, there are conditions that cause plaster to crack, effloresce, separate, or become detached from its lath framework (Fig. 7). These include:

- Structural Problems
- Poor Workmanship
- Improper Curing
- Moisture

Structural Problems

Overloading. Stresses within a wall, or acting on the house as a whole, can create stress cracks. Appearing as diagonal lines in a wall, stress cracks usually start at a door or window frame, but they can appear anywhere in the wall, with seemingly random starting points.
Builders of now-historic houses had no codes to help them size the structural members of buildings. The weight of the roof, the second and third stories, the furniture, and the occupants could impose a heavy burden on beams, joists, and studs. Even when houses were built properly, later remodeling efforts may have cut in a doorway or window without adding a structural beam or "header" across the top of the opening. Occasionally, load-bearing members were simply too small to carry the loads above them. Deflection or wood "creep" (deflection that occurs over time) can create cracks in plaster.

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

**Settlement/Vibration.** Cracks in walls can also result when houses settle. Houses built on clay soils are especially vulnerable. Many types of clay (such as montmorillonite) are highly expansive. In the dry season, water evaporates from the clay particles, causing them to contract. During the rainy season, the clay swells. Thus, a building can be riding on an unstable footing. Diagonal cracks running in opposite directions suggest that house settling and soil conditions may be at fault. Similar symptoms occur when there is a nearby source of vibration—blasting, a train line, busy highway, or repeated sonic booms.

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

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

**Poor Workmanship**

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

**Poorly proportioned mix.** The proper proportioning and mixing of materials are vital to the quality of the plaster job. A bad mix can cause problems that appear years later in a plaster wall. Until recently, proportions of aggregate and lime were mixed on the job. A plasterer may have skimped on the amount of cementing material (lime or gypsum) because sand was the cheaper material. Oversanding can cause the plaster to weaken or crumble (Fig. 8). Plaster made from a poorly proportioned mix may be more difficult to repair.

Fig. 8. Too much aggregate (sand) and not enough cementing material (lime or gypsum) in the base coat has made this plaster surface weak and crumbly. Besides losing its key with the lath, the layers are disintegrating. It will most likely need to be totally removed and replaced with all new plaster. Photo: Marylce MacDonald.

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

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

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

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

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

Improper Curing

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

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

Moisture

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

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

Repairing Historic Plaster

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

Canvassing Uneven Wall Surfaces

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

Filling Cracks

Hairline cracks in wall and ceiling plaster are not a serious cause for concern as long as the underlying plaster is in good condition. They may be filled easily with a patching material (see Patching Materials, page 13). For cracks that re-open with seasonal humidity change, a slightly different method is used. First the crack is widened slightly with a sharp, pointed tool such as a crack widener or a triangular can opener. Then the crack is filled. For more persistent cracks, it may be necessary to bridge the crack with tape. In this instance, a fiberglass mesh tape is pressed into the patching material. After the first application of a quick-setting joint compound dries, a second coat is used to cover the tape, feathering it at the edges. A third coat is applied to even out the surface, followed by light sanding. The area is cleaned off with a damp sponge, then dried to remove any leftover plaster residue or dust.

When cracks are larger and due to structural movement, repairs need to be made to the structural system before repairing the plaster. Then, the plaster on each side of the crack should be removed to a width of about 6 inches down to the lath. The debris is cleaned out, and metal lath applied to the cleared area, leaving the existing wood lath in place. The metal lath usually prevents further cracking. The crack is patched with an appropriate plaster in three layers (i.e., basecoats and finish coat). If a crack seems to be expanding, a structural engineer should be consulted.
Replacing Delaminated Areas of the Finish Coat

Sometimes the finish coat of plaster comes loose from the base coat (Fig. 9). In making this type of repair, the plasterer paints a liquid plaster-bonding agent onto the areas of base-coat plaster that will be replastered with a new lime finish coat. A homeowner wishing to repair small areas of delaminated finish coat can use the methods described in Patching Materials.

Patching Holes in Walls

For small holes (less than 4 inches in diameter) that involve loss of the brown and finish coats, the repair is made in two applications. First, a layer of basecoat plaster is troweled in place and scraped back below the level of the existing plaster. When the base coat has set but not dried, more plaster is applied to create a smooth, level surface. One-coat patching is not generally recommended by plasterers because it tends to produce concave surfaces that show up when the work is painted. Of course, if the lath only had one coat of plaster originally, then a one-coat patch is appropriate (Fig. 10).

For larger holes where all three coats of plaster are damaged or missing down to the wood lath, plasterers generally proceed along these lines. First, all the old plaster is cleaned out and any loose lath is re-nailed. Next, a water mist is sprayed on the old lath to keep it from twisting when the new, wet plaster is applied, or better still, a bonding agent is used. To provide more reliable keying and to strengthen the patch, expanded metal lath (diamond mesh) should be attached to the wood lath with tie wires or nailed over the wood lath with lath nails (Fig. 11). The plaster is then applied in three layers over the metal lath, lapping each new layer of plaster over the old plaster so that old and new are evenly joined. This stepping is recommended to produce a strong, invisible patch (Fig. 12). Also, if a patch is made in a plaster wall that is slightly wavy, the contour of the patch should be made to conform to the irregularities of the existing work. A flat patch will stand out from the rest of the wall.
Repairs are being made to the historic plaster in an early 19th century residence in Tennessee. A fairly sizeable hole in three-plaster extends to the wood lath. Expanded metal lath has been fitted to the hole, then attached to the wood lath with a tie-wire. Ready-mix gypsum base coats are in the process of being applied. After they set, the finish coat will be smooth-troweled gauged to match the existing wall. Photo: Walter Jowers.

Patching Holes in Ceilings

Hairline cracks and holes may be unsightly, but when portions of the ceiling come loose, a more serious problem exists (Fig. 13). The keys holding the plaster to the ceiling have probably broken. First, the plaster around the loose plaster should be examined. Keys may have deteriorated because of a localized moisture problem, poor quality plaster, or structural overloading; yet, the surrounding system may be intact. If the areas surrounding the loose area are in reasonably good condition, the loose plaster can be reattached to the lath using flat-head wood screws and plaster washers (Fig. 14). To patch a hole in the ceiling plaster, metal lath is fastened over the wood lath; then the hole is filled with successive layers of plaster, as described above.

Photo: John Obed Curtis.

Fig. 13. This beaded ceiling in one of the bedrooms of the 1847 Lockwood House, Harpers Ferry, West Virginia, is missing portions of plaster due to broken keys. This is attributable, in part, to deterioration of the wood lath. Photo: Kaye Ellen Simonson.

Fig. 14. In a late 18th century house in Massachusetts, flat-head wood screws and plaster washers were used to reattach loose ceiling plaster to the wood lath. After the crack is covered with fiberglass mesh tape, both the taped crack and the plaster washers will be skim-coated with a patching material. Photo: John Obed Curtis.
Establishing New Plaster Keys

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

Loose, damaged plaster can also be re-keyed when the goal is to conserve decorative surfaces or wallpaper. Large areas of ceilings and walls can be saved. This method requires the assistance of a skilled conservator—it is not a repair technique used by most plasterers. The conservator injects an acrylic adhesive mixture through holes drilled in the face of the plaster (or through the lath from behind, when accessible). The loose plaster is held firm with plywood bracing until the adhesive bonding mixture sets. When complete, gaps between the plaster and lath are filled, and the loose plaster is secure (Fig. 15).

Replastering Over the Old Ceiling

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

When Damaged Plaster Cannot be Repaired—Replacement Options

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

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

Replastering—Alternative Lath Systems for New Plaster

Replastering old wood lath. When plasterers work with old lath, each lath strip is re-nailed and the chunks of old plaster are cleaned out. Because the old lath is dry, it must be thoroughly soaked before applying the base coats of plaster, or it will warp and buckle; furthermore, because the water is drawn out, the plaster will fail to set properly. As noted earlier, if new metal lath is installed over old wood lath as the base for new plaster,
many of these problems can be avoided and the historic lath can be retained (Fig. 16). The ceiling should still be sprayed unless a vapor barrier is placed behind the metal lath.

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

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

**Painting New Plaster**

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

**A Modern Replacement System**

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

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*Fig. 16. In the restoration of a ca. 1830s house in Maine, split-board lath has been covered with expanded metal lath in preparation for new coats of plaster. This method permits the early lath to be saved while the metal lath, with its superior keying, serves as reinforcement. Photo: National Park Service files.*
The system uses gypsum-core panels that are the same size as drywall (4x8 feet), and specially made for veneer plaster. They can be installed over furring channels to masonry walls or over old wood lath walls and ceilings. Known most commonly as "blueboard," the panels are covered with a special paper compatible with veneer plaster. Joints between the 4-foot wide sheets are taped with fiberglass mesh, which is bedded in the veneer plaster. After the tape is bedded, a thin, 1/16-inch coat of high-strength veneer plaster is applied to the entire wall surface. A second veneer layer can be used as the "finish" coat, or the veneer plaster can be covered with a gauged lime finish-coat—the same coat that covers ordinary plaster (Fig. 17).

Summary

The National Park Service recommends retaining historic plaster if at all possible. Plaster is a significant part of the "fabric" of the building. Much of the building's history is documented in the layers of paint and paper found covering old plaster. For buildings with decorative painting, conservation of historic flat plaster is even more important. Consultation with the National Park Service, with State Historic Preservation Officers, local preservation organizations, historic preservation consultants, or with the Association for Preservation Technology is recommended. Where plaster cannot be repaired or conserved using one of the approaches outlined in this Brief, documentation of the layers of wallpaper and paint should be undertaken before removing the historic plaster. This information may be needed to complete a restoration plan.

Fig. 17. This contemporary plasterer is mixing a lime finish coat in much the same way as America’s earlier artisans. The ring consists of lime putty; the white powder inside is gauging plaster. After the mixture is blended, a steel trowel will be used to apply it. It should be noted that a traditional lime finish coat can be applied over a veneer plaster base coat to approximate the look of historic plaster walls and ceilings. Photo: Marylee MacDonald.

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

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

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

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

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

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

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

### TABLE 1

<table>
<thead>
<tr>
<th>REPLASTERING</th>
<th>Selected Plaster Bases/Compatible Basecoats and Finish Coats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Plaster Bases</td>
<td>Compatible Basecoats</td>
</tr>
<tr>
<td>OLD WOOD LATH</td>
<td>gypsum/sand plaster</td>
</tr>
<tr>
<td></td>
<td>gypsum/perlite plaster</td>
</tr>
<tr>
<td>METAL LATH</td>
<td>gypsum/sand plaster (high strength)</td>
</tr>
<tr>
<td>GYPSUM (ROCK) LATH PANELS</td>
<td>gypsum/perlite plaster</td>
</tr>
<tr>
<td>INGLAZED BRICK/CLAY TILE</td>
<td>gypsum/perlite plaster (masonry type)</td>
</tr>
<tr>
<td>Modern Plaster Base</td>
<td>Compatible Basecoat</td>
</tr>
<tr>
<td>GYPSUM CORE VENEER PANELS (BLUE BOARD)</td>
<td>veneer plaster</td>
</tr>
</tbody>
</table>

Additional bases (wood, metal, and rock lath), the thickness of base coat plaster is one of the most important elements of a good plaster job. Grounds should be set to obtain the following minimum thicknesses: (1) Over rock lath—1/2" (2) Over brick, clay tile, or other masonry—5/8" (3) Over metal lath, measured from face of lath—5/8". In no case should the total thickness be less than 1/2". The allowance for the finish coat is approximately 1/16" which requires the base coat to be 7/16" for 1/2" grounds. This is a minimum base coat thickness on rock lath. The standard for other masonry units and metal lath is 5/8" thick, including the finish. Certain types of construction or fire ratings may require an increase in plaster thickness (and/or an increase in the aggregate ratio) but never a thinner application of plaster than recommended above. Job experience indicates that thin applications of plaster often evidence cracking where normal applications do not. This condition is a direct result of the inability of thin section areas to resist external forces as adequately as thicker, normal applications of plaster.

A lightweight aggregate often used in gypsum plaster is perlite. It performs well in cold weather and has a slightly better insulating value than sand. In a construction with metal lath, perlite is not recommended in the basecoat except under a sand or “float” finish. When gypsum/perlite basecoats are used over any other base (i.e., wood, rock lath, brick) and the finish coat is a “white” finish coat (smooth-troweled gauged lime putty) it is necessary to add fine silica sand or perlite fines to the finish coat. This measure prevents cracking of the “white” finish coat due to normal shrinkage.
Plaster Terms

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

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

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

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

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

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

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

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

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

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

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**Reading List**


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Dangers of Abrasive Cleaning to Historic Buildings
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Preservation Assistance Division Technical Preservation Services

"The surface cleaning of structures shall be undertaken with the gentlest means possible. Sandblasting and other cleaning methods that will damage the historic building materials shall not be undertaken."—The Secretary of the Interior’s “Standards for Historic Preservation Projects.”

Abrasive cleaning methods are responsible for causing a great deal of damage to historic building materials. To prevent indiscriminate use of these potentially harmful techniques, this brief has been prepared to explain abrasive cleaning methods, how they can be physically and aesthetically destructive to historic building materials, and why they generally are not acceptable preservation treatments for historic structures. There are alternative, less harsh means of cleaning and removing paint and stains from historic buildings. However, careful testing should precede general cleaning to assure that the method selected will not have an adverse effect on the building materials. A historic building is irreplaceable, and should be cleaned using only the “gentlest means possible” to best preserve it.

What is Abrasive Cleaning?

Abrasive cleaning methods include all techniques that physically abrade the building surface to remove soils, discolorations or coatings. Such techniques involve the use of certain materials which impact or abrade the surface under pressure, or abrasive tools and equipment. Sand, because it is readily available, is probably the most commonly used type of grit material. However, any of the following materials may be substituted for sand, and all can be classified as abrasive substances: ground slag or volcanic ash, crushed (pulverized) walnut or almond shells, rice husks, ground corn cobs, ground coconut shells, crushed eggshells, silica flour, synthetic particles, glass beads and micro-balloons. Even water under pressure can be an abrasive substance. Tools and equipment that are abrasive to historic building materials include wire brushes, rotary wheels, power sanding disks and belt sanders.

The use of water in combination with grit may also be classified as an abrasive cleaning method. Depending on the manner in which it is applied, water may soften the impact of the grit, but water that is too highly pressurized can be very abrasive. There are basically two different methods which can be referred to as “wet grit,” and it is important to differentiate between the two. One technique involves the addition of a stream of water to a regular sandblasting nozzle. This is done primarily to cut down dust, and has very little, if any, effect on reducing the aggressiveness, or cutting action of the grit particles. With the second technique, a very small amount of grit is added to a pressurized water stream. This method may be controlled by regulating the amount of grit fed into the water stream, as well as the pressure of the water.

Why Are Abrasive Cleaning Methods Used?

Usually, an abrasive cleaning method is selected as an expeditious means of quickly removing years of dirt accumulation, unsightly stains, or deteriorating building fabric or finishes, such as stucco or paint. The fact that sandblasting is one of the best known and most readily available building cleaning treatments is probably the major reason for its frequent use.

Many mid-19th century brick buildings were painted immediately or soon after completion to protect poor quality brick or to imitate another material, such as stone. Sometimes brick buildings were painted in an effort to produce what was considered a more harmonious relationship between a building and its natural surroundings. By the 1870s, brick buildings...

For sale by the Superintendent of Documents, U.S. Government Printing Office
Abrasively Cleaned vs. Untouched Brick. Two brick rowhouses with a common facade provide an excellent point of comparison when only one of the houses has been sandblasted. It is clear that abrasive blasting, by removing the outer surface, has left the brickwork on the left rough and pitted, while that on the right still exhibits an undamaged and relatively smooth surface. Note that the abrasive cleaning has also removed a considerable portion of the mortar from the joints of the brick on the left side, which will require repointing.

were often left unpainted as mechanization in the brick industry brought a cheaper pressed brick and fashion decreed a sudden preference for dark colors. However, it was still customary to paint brick of poorer quality for the additional protection the paint afforded.

It is a common 20th-century misconception that all historic masonry buildings were initially unpainted. If the intent of a modern restoration is to return a building to its original appearance, removal of the paint not only may be historically inaccurate, but also harmful. Many older buildings were painted or stuccoed at some point to correct recurring maintenance problems caused by faulty construction techniques, to hide alterations, or in an attempt to solve moisture problems. If this is the case, removal of paint or stucco may cause these problems to recur.

Another reason for paint removal, particularly in rehabilitation projects, is to give the building a "new image" in response to contemporary design trends and to attract investors or tenants. Thus, it is necessary to consider the purpose of the intended cleaning. While it is clearly important to remove unsightly stains, heavy encrustations of dirt, peeling paint or other surface coatings, it may not be equally desirable to remove paint from a building which originally was painted.

Many historic buildings which show only a slight amount of soil or discoloration are much better left as they are. A thin layer of soil is more often protective of the building fabric than it is harmful, and seldom detracts from the building's architectural and/or historic character. Too thorough cleaning of a historic building may not only sacrifice some of the building's character, but also, misguided cleaning efforts can cause a great deal of damage to historic building fabric. Unless there are stains, graffiti or dirt and pollution deposits which are destroying the building fabric, it is generally preferable to do as little cleaning as possible, or to repaint where necessary. It is important to remember that a historic building does not have to look as if it were newly constructed to be an attractive or successful restoration or rehabilitation project. For a more thorough explanation of the philosophy of cleaning historic buildings see Preservation Briefs: No. 1 "The Cleaning and Waterproof Coating of Masonry Buildings." by Robert C. Mack, AIA.

Problems of Abrasive Cleaning

The crux of the problem is that abrasive cleaning is just that—abrasive. An abrasively cleaned historic structure may be physically as well as aesthetically damaged. Abrasive methods "clean" by eroding dirt or paint, but at the same time they also tend to erode the surface of the building material. In this way, abrasive cleaning is destructive and causes irreversible harm to the historic building fabric. If the fabric is brick, abrasive methods remove the hard, outer protective surface, and therefore make the brick more susceptible to rapid weathering and deterioration. Grit blasting may also increase the water permeability of a brick wall. The impact of the grit particles tends to erode the bond between the mortar and the brick, leaving cracks or enlarging existing cracks where water can enter. Some types of stone develop a protective patina or "quarry crust" parallel to the worked surface (created by the movement of moisture towards the outer edge), which also may be damaged by abrasive cleaning. The rate at which the material subsequently weathers depends on the quality of the inner surface that is exposed.

Abrasive cleaning can destroy, or substantially diminish, decorative detailing on buildings such as a molded brickwork or architectural terra-cotta, ornamental carving on wood or stone, and evidence of historic craft techniques, such as tool marks and other surface textures. In addition, perfectly sound and/or "tooled" mortar joints can be worn away by abrasive techniques. This not only results in the loss of historic craft detailing but also requires repointing, a step involving con-
Considerable time, skill and expense, and which might not have been necessary had a gentler method been chosen. Erosion and pitting of the building material by abrasive cleaning creates a greater surface area on which dirt and pollutants collect. In this sense, the building fabric "attracts" more dirt and will require more frequent cleaning in the future.

In addition to causing physical and aesthetic harm to the historic fabric, there are several adverse environmental effects of dry abrasive cleaning methods. Because of the friction caused by the abrasive medium hitting the building fabric, these techniques usually create a considerable amount of dust, which is unhealthy, particularly to the operators of the abrasive equipment. It further pollutes the environment around the job site, and deposits dust on neighboring buildings, parked vehicles and nearby trees and shrubbery. Some adjacent materials not intended for abrasive treatment such as wood or glass, may also be damaged because the equipment may be difficult to regulate.

Wet grit methods, while eliminating dust, deposit a messy slurry on the ground or other objects surrounding the base of the building. In colder climates where there is the threat of frost, any wet cleaning process applied to historic masonry structures must be done in warm weather, allowing ample time for the wall to dry out thoroughly before cold weather sets in. Water which remains and freezes in cracks and openings of the masonry surface eventually may lead to spalling. High-pressure wet cleaning may force an inordinate amount of water into the walls, affecting interior materials such as plaster or joist ends, as well as metal building components within the walls.

Variable Factors

The greatest problem in developing practical guidelines for cleaning any historic building is the large number of variable and unpredictable factors involved. Because these variables make each cleaning project unique, it is difficult to establish specific standards at this time. This is particularly true of abrasive cleaning methods because their inherent potential for causing damage is multiplied by the following factors:

- the type and condition of the material being cleaned;
- the size and sharpness of the grit particles or the mechanical equipment;
- the pressure with which the abrasive grit or equipment is applied to the building surface;
- the skill and care of the operator; and
- the constancy of the pressure on all surfaces during the cleaning process.

Pressure: The damaging effects of most of the variable factors involved in abrasive cleaning are self-evident. However, the matter of pressure requires further explanation. In cleaning specifications, pressure is generally abbreviated as "psi" (pounds per square inch), which technically refers to the "tip" pressure, or the amount of pressure at the nozzle of the blasting apparatus. Sometimes "psig," or pressure at the gauge (which may be many feet away, at the other end of the hose), is used in place of "psi." These terms are often incorrectly used interchangeably.

Despite the apparent care taken by most architects and building cleaning contractors to prepare specifications for pressure cleaning which will not cause harm to the delicate fabric of a historic building, it is very difficult to ensure that the same amount of pressure is applied to all parts of the building. For example, if the operator of the pressure equipment stands on the ground while cleaning a two-story structure, the amount of force reaching the first story will be greater than that hitting the second story, even if the operator stands on a ladder to reach the higher sections of the wall, it is still almost impossible to have total control over the pressure. The pressure of the sand hitting the lower portion of the wall will still be greater than that above, because of the "line drop" in the distance from the pressure source to the nozzle. (Hugh Miller)

"Line Drop." Even though the operator of the sandblasting equipment is standing on a ladder to reach the higher sections of the wall, it is still almost impossible to have total control over the pressure. The pressure of the sand hitting the lower portion of the wall will still be greater than that above, because of the "line drop" in the distance from the pressure source to the nozzle. (Hugh Miller)
cept building cleaning projects for which they have no experience.

The amount of pressure used in any kind of cleaning treatment which involves pressure, whether it is dry or wet grit, chemicals or just plain water, is crucial to the outcome of the cleaning project. Unfortunately, no standards have been established for determining the correct pressure for cleaning each of the many historic building materials which would not cause harm. The considerable discrepancy between the way the building cleaning industry and architectural conservators define “high” and “low” pressure cleaning plays a significant role in the difficulty of creating standards.

**Nonhistoric/Industrial:** A representative of the building cleaning industry might consider “high” pressure water cleaning to be anything over 5,000 psi, or even as high as 10,000 to 15,000 psi! Water under this much pressure may be necessary to clean industrial structures or machinery, but would destroy most historic building materials. Industrial chemical cleaning commonly utilizes pressures between 1,000 and 2,500 psi.

**Historic:** By contrast, conscientious dry or wet abrasive cleaning of a historic structure would be conducted within the range of 20 to 100 psi at a range of 3 to 12 inches. Cleaning at this low pressure requires the use of a very fine 00 or 0 mesh grit forced through a nozzle with a 1/4 inch opening. A similar, even more delicate method being adopted by architectural conservators uses a micro-abrasive grit on small, hard-to-clean areas of carved, cut or molded ornament on a building façade. Originally developed by museum conservators for cleaning sculpture, this technique may employ glass beads, micro-balloons, or another type of micro-abrasive gently powered at approximately 40 psi by a very small, almost pencil-like pressure instrument. Although a slightly larger pressure instrument may be used on historic buildings, this technique still has limited practical applicability on a large scale building cleaning project because of the cost and the relatively few technicians competent to handle the task. In general, architectural conservators have determined that only through very controlled conditions can most historic building material be abrasively cleaned of soil or paint without measurable damage to the surface or profile of the substrate.

Yet some professional cleaning companies which specialize in cleaning historic masonry buildings use chemicals and water at a pressure of approximately 1,500 psi, while other cleaning firms recommend lower pressures ranging from 200 to 800 psi for a similar project. An architectural conservator might decide, after testing, that some historic structures could be cleaned properly using a moderate pressure (200-600 psi), or even a high pressure (600-1,800 psi) water rinse. However, cleaning historic buildings under such high pressure should be considered an exception rather than the rule, and would require very careful testing and supervision to assure that the historic surface materials could withstand the pressure without gouging, pitting or loosening.

These differences in the amount of pressure used by commercial or industrial building cleaners and architectural conservators point to one of the main problems in using abrasive means to clean historic buildings: misunderstanding of the potentially fragile nature of historic building materials. There is no one cleaning formula or pressure suitable for all situations. Decisions regarding the proper cleaning process for historic structures can be made only after careful analysis of the building fabric, and testing.

### How Building Materials React to Abrasive Cleaning Methods

**Brick and Architectural Terra-Cotta:** Abrasive blasting does not affect all building materials to the same degree. Such techniques quite logically cause greater damage to softer and more porous materials, such as brick or architectural terra-cotta. When these materials are cleaned abrasively, the hard, outer layer (closest to the heat of the kiln) is eroded, leaving the soft, inner core exposed and susceptible to accelerated weathering. Glazed architectural terra-cotta and ceramic veneer have a baked-on glaze which is also easily damaged by abrasive cleaning. Glazed architectural terra-cotta was designed for easy maintenance, and generally can be cleaned using detergent and water; but chemicals or steam may be needed to remove more persistent stains. Large areas of brick or architectural terra-cotta which have been painted are best left painted, or repainted if necessary.

**Plaster and Stucco:** Plaster and stucco are types of masonry finish materials that are softer than brick or terra-cotta: if treated abrasively these materials will simply disintegrate. Indeed, when plaster or stucco is treated abrasively it is usually with the intention of removing the plaster or stucco from whatever base material or substrate it is covering. Obviously, such abrasive techniques should not be applied to clean sound plaster or stuccoed walls, or decorative plaster wall surfaces.

**Building Stones:** Building stones are cut from the three main categories of natural rock: dense, igneous rock such as granite; sandy, sedimentary rock such as limestone or sandstone; and crystalline, metamorphic rock such as marble. As op-
posed to kiln-dried masonry materials such as brick and architectural terra-cotta, building stones are generally homogeneous in character at the time of a building's construction. However, as the stone is exposed to weathering and environmental pollutants, the surface may become friable, or may develop a protective skin or patina. These outer surfaces are very susceptible to damage by abrasive or improper chemical cleaning.

Building stones are frequently cut into ashlar blocks or “dressed” with tool marks that give the building surface a specific texture and contribute to its historic character as much as ornately carved decorative stonework. Such detailing is easily damaged by abrasive cleaning techniques; the pattern of tooling or cutting is erased, and the crisp lines of moldings or carving are worn or pitted.

Occasionally, it may be possible to clean small areas of rough-cut granite, limestone or sandstone having a heavy dirt encrustation by using the “wet grit” method, whereby a small amount of abrasive material is injected into a controlled, pressurized water stream. However, this technique requires very careful supervision in order to prevent damage to the stone. Polished or honed marble or granite should never be treated abrasively, as the abrasion would remove the finish in much the way glass would be etched or “frosted” by such a process. It is generally preferable to underclean, as too strong a cleaning procedure will erode the stone, exposing a new and increased surface area to collect atmospheric moisture and dirt. Removing paint, stains or graffiti from most types of stone may be accomplished by a chemical treatment carefully selected to best handle the removal of the particular type of paint or stain without damaging the stone. (See section on the “Gentlest Means Possible”)

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Abrasive Cleaning of Wood. This wooden windowsill, molding and paneling have been sandblasted to remove layers of paint in the rehabilitation of this commercial building. Not only is some paint still embedded in cracks and crevices of the woodwork, but more importantly, grit blasting has actually eroded the summer wood, in effect raising the grain, and resulting in a rough surface.

Wood: Most types of wood used for buildings are soft, fibrous and porous, and are particularly susceptible to damage by abrasive cleaning. Because the summer wood between the lines of the grain is softer than the grain itself, it will be worn away by abrasive blasting or power tools, leaving an uneven surface with the grain raised and often frayed or “fuzzy.” Once this has occurred, it is almost impossible to achieve a smooth surface again except by extensive hand sanding, which is expensive and will quickly negate any costs saved earlier by sandblasting. Such harsh cleaning treatment also obliterates historic tool marks, fine carving and detailing, which precludes its use on any interior or exterior woodwork which has been hand planed, milled or carved.

Metals: Like stone, metals are another group of building materials which vary considerably in hardness and durability. Softer metals which are used architecturally, such as tin, zinc, lead, copper or aluminum, generally should not be cleaned abrasively as the process deforms and destroys the original surface texture and appearance, as well as the acquired patina. Much applied architectural metal work used on historic buildings—tin, zinc, lead and copper—is often quite thin and soft, and therefore susceptible to denting and pitting. Galvanized sheet metal is especially vulnerable, as abrasive treatment would wear away the protective galvanized layer.

In the late 19th and early 20th centuries, these metals were often cut, pressed or otherwise shaped from sheets of metal into a wide variety of practical uses such as roofs, gutters and flashing, and façade ornamentation such as cornices, friezes, dormers, panels, cupolas, oriel windows, etc. The architecture of the 1920s and 1930s made use of metals such as chrome, nickel alloys, aluminum and stainless steel in decorative exterior panels, window frames, and doorways. Harsh abrasive blasting would destroy the original surface finish of most of these metals, and would increase the possibility of corrosion.

However, conservation specialists are now employing a sensitive technique of glass bead peening to clean some of the harder metals, in particular large bronze outdoor sculpture. Very fine (75-125 micron) glass beads are used at a low pressure of 60 to 80 psi. Because these glass beads are completely spherical, there are no sharp edges to cut the surface of the metal. After cleaning, these statues undergo a lengthy process of polishing. Coatings are applied which protect the surface from corrosion, but they must be renewed every 3 to 5 years. A similarly delicate cleaning technique employing glass beads has been used in Europe to clean historic masonry structures without causing damage. But at this time the process has not been tested sufficiently in the United States to recommend it as a building conservation measure.

Sometimes a very fine smooth sand is used at a low pressure to clean or remove paint and corrosion from copper flashing and other metal building components. Restoration architects recently found that a mixture of crushed walnut shells and copper slag at a pressure of approximately 200 psi was the only way to remove corrosion successfully from a mid-19th century terne-coated iron roof. Metal cleaned in this manner must be painted immediately to prevent rapid recurrence of corrosion. It is thought that these methods “work harden” the surface by compressing the outer layer, and actually may be good for the surface of the metal. But the extremely complex nature and the time required by such processes make it very expensive and impractical for large-scale use at this time.

Cast and wrought iron architectural elements may be gently sandblasted or abrasively cleaned using a wire brush to remove layers of paint, rust and corrosion. Sandblasting was, in fact, developed originally as an efficient maintenance procedure for engineering and industrial structures and heavy machinery—iron and steel bridges, machine tool frames, engine frames, and railroad rolling stock—in order to clean and prepare them for repainting. Because iron is hard, its surface...
which is naturally somewhat uneven, will not be noticeably damaged by controlled abrasion. Such treatment will, however, result in a small amount of pitting. But this slight abrasion creates a good surface for paint, since the iron must be repainted immediately to prevent corrosion. Any abrasive cleaning of metal building components will also remove the caulkings from joints and around other openings. Such areas must be recaulked quickly to prevent moisture from entering and rusting the metal, or causing deterioration of other building fabric inside the structure.

When is Abrasive Cleaning Permissible?

For the most part, abrasive cleaning is destructive to historic building materials. A limited number of special cases have been explained when it may be appropriate, if supervised by a skilled conservator, to use a delicate abrasive technique on some historic building materials. The type of "wet grit" cleaning which involves a small amount of grit injected into a stream of low pressure water may be used on small areas of stone masonry (i.e., rough cut limestone, sandstone or unpolished granite). With these methods, the force of the abrasive blasting may cause grit particles to lodge in cracks of wooden elements, which will be impossible to remove. Abrasive cleaning is also impractical. Rough surfaces of abradively cleaned wooden elements are hard to keep clean. It is also difficult to seal, paint or maintain these surfaces which can be splinter and a problem to the building's occupants. The force of abrasive blasting may cause grit particles to lodge in cracks of wooden elements, which will be a nuisance as the grit is loosened by vibrations and gradually sifts out. Removal of plaster will reduce the thermal and insulating value of the walls. Interior brick is usually softer than exterior brick, and generally of a poorer quality. Removing surface plaster from such brick by abrasive means often exposes gaping mortar joints and mismatched or repaired brickwork which was never intended to show. The resulting bare brick wall may require repointing, often difficult to match. It is also necessary to apply a transparent surface coating (or sealer) in order to prevent the mortar and brick from "dusting." However, a sealer may not only change the color of the brick, but may also compound any existing moisture problems by restricting the normal evaporation of water vapor from the masonry surface.

Historic Interiors that Should Not Be Cleaned Abrasively

Those instances (generally industrial and some commercial properties), when it may be acceptable to use an abrasive treatment on the interior of historic structures have been described. But for the majority of historic buildings, the Secretary of the Interior's Guidelines for Rehabilitation do not recommend "changing the texture of exposed wooden architectural features (including structural members) and masonry surfaces through sandblasting or use of other abrasive techniques to remove paint, discolorations and plaster."

Thus, it is not acceptable to clean abrasively interiors of historic residential and commercial properties which have finished interior spaces featuring milled woodwork such as doors, window and door moldings, wainscoting, stair halustrades and mantelpieces. Even the most modest historic house interior, although it may not feature elaborate detailing, contains plaster and woodwork that is architecturally significant to the original design and function of the house. Abrasive cleaning of such an interior would be destructive to the historic integrity of the building.

Abrasive cleaning is not acceptable either. Rough surfaces of abradively cleaned wooden elements are hard to keep clean. It is also difficult to seal, paint or maintain these surfaces which can be splinter and a problem to the building's occupants. The force of abrasive blasting may cause grit particles to lodge in cracks of wooden elements, which will be a nuisance as the grit is loosened by vibrations and gradually sifts out. Removal of plaster will reduce the thermal and insulating value of the walls. Interior brick is usually softer than exterior brick, and generally of a poorer quality. Removing surface plaster from such brick by abrasive means often exposes gaping mortar joints and mismatched or repaired brickwork which was never intended to show. The resulting bare brick wall may require repointing, often difficult to match. It is also necessary to apply a transparent surface coating (or sealer) in order to prevent the mortar and brick from "dusting." However, a sealer may not only change the color of the brick, but may also compound any existing moisture problems by restricting the normal evaporation of water vapor from the masonry surface.

"Gentlest Means Possible"

There are alternative means of removing dirt, stains and paint from historic building surfaces that can be recommended as more efficient and less destructive than abrasive techniques. The "gentlest means possible" of removing dirt from a building surface can be achieved by using a low-pressure water wash, scrubbing areas of more persistent grime with a natural bristle (never metal) brush. Steam cleaning can also be used effectively to clean some historic building fabric. Low-pressure water or steam will soften the dirt and cause the deposits to rise to the surface, where they can be washed away.

A third cleaning technique which may be recommended to remove dirt, as well as stains, graffiti or paint. involves the use of commercially available chemical cleaners or paint removers, which. when applied to masonry, loosen or dissolve the dirt or stains. These cleaning agents may be used in combination with water or steam, followed by a clear water wash to remove the residue of dirt and the chemical cleaners from the masonry. A natural bristle brush may also facilitate this type of chemically assisted cleaning, particularly in areas of heavy dirt deposits or stains, and a wooden scraper can be

Permissible Abrasive Cleaning. In accordance with the Secretary of the Interior's Guidelines for Rehabilitation Projects, it may be acceptable to use abrasive techniques to clean an industrial interior space such as that illustrated here, because the masonry surfaces do not have significant design, detailing, tooling or finish, and the wooden architectural features are not finished, molded, beaded or worked by hand. with raised wood grain. These nonsignificant surfaces will be damaged and have a roughened texture, but because they are interior elements, they will not be subject to further deterioration caused by weathering.
Mitigating the Effects of Abrasive Cleaning

There are certain restoration measures which can be adopted to help preserve a historic building exterior which has been damaged by abrasive methods. Wood that has been sand-blasted will exhibit a frayed or "fuzzed" surface, or a harder wood will have an exaggerated raised grain. The only way to remove this rough surface or to smooth the grain is by laborious sanding. Sandblasted wood, unless it has been extensively sanded, serves as a dustcatcher, will weather faster, and will present a continuing and ever worsening maintenance problem. Such wood, after sanding, should be painted or given a clear surface coating to protect the wood, and allow for somewhat easier maintenance.

There are few successful preservative treatments that may be applied to grit-blasted exterior masonry. Harder, denser stone may have suffered only a loss of crisp edges or tool marks, or other indications of craft technique. If the stone has a compact and uniform composition, it should continue to weather with little additional deterioration. But some types of sandstone, marble and limestone will weather at an accelerated rate once their protective "quarry crust" or patina has been removed.

Softer types of masonry, particularly brick and architectural terra-cotta, are the most likely to require some remedial treatment if they have been abrassively cleaned. Old brick, being essentially a soft, baked clay product, is greatly susceptible to increased deterioration when its hard, outer skin is removed through abrasive techniques. This problem can be minimized by painting the brick. An alternative is to treat it with a clear sealer or surface coating but this will give the masonry a glossy or shiny look. It is usually preferable to paint the brick rather than to apply a transparent sealer since...
Hazes of Sandblasting and Surface Coating. In order to "protect" this heavily sandblasted brick, a clear surface coating or sealer was applied. Because the air temperature was too cold at the time of application, the sealer failed to dry properly. dripping in places, and giving the brick surface a cloudy appearance.

Sealers reduce the transpiration of moisture, allowing salts to crystallize as subflorescence that eventually spalls the brick. If a brick surface has been so extensively damaged by abrasive cleaning and weathering that spalling has already begun, it may be necessary to cover the walls with stucco, if it will adhere.

Of course, the application of paint, a clear surface coating (sealer), or stucco to deteriorating masonry means that the historical appearance will be sacrificed in an attempt to conserve the historic building materials. However, the original color and texture will have been changed already by the abrasive treatment. At this point it is more important to try to preserve the brick, and there is little choice but to protect it from "dusting" or spalling too rapidly. As a last resort, in the case of severely spalling brick, there may be no option but to replace the brick—a difficult, expensive (particularly if custom-made reproduction brick is used), and lengthy process. As described earlier, sandblasted interior brick work, while not subject to change of weather, may require the application of a transparent surface coating or painting as a maintenance procedure to contain loose mortar and brick dust. (See Preservation Briefs: No. 1 for a more thorough discussion of coatings.)

Metals, other than cast or wrought iron, that have been pitted and dented by harsh abrasive blasting usually cannot be smoothed out. Although fillers may be satisfactory for smoothing a painted surface, exposed metal that has been damaged usually will have to be replaced.

**Summary**

Sandblasting or other abrasive methods of cleaning or paint removal are by their nature destructive to historic building materials and should not be used on historic buildings except in a few well-monitored instances. There are exceptions when certain types of abrasive cleaning may be permissible, but only if conducted by a trained conservator, and if cleaning is necessary for the preservation of the historic structure.

There is no one formula that will be suitable for cleaning all historic building surfaces. Although there are many commercial cleaning products and methods available, it is impossible to state definitively which of these will be the most effective without causing harm to the building fabric. It is often difficult to identify ingredients or their proportions contained in cleaning products, consequently it is hard to predict how a product will react to the building materials to be cleaned. Similar uncertainties affect the outcome of other cleaning methods as they are applied to historic building materials. Further advances in understanding the complex nature of the many variables of the cleaning techniques may someday provide a better and simpler solution to the problem. But until that time, the process of cleaning historic buildings must be approached with caution through trial and error.

It is important to remember that historic building materials are neither indestructible, nor are they renewable. They must be treated in a responsible manner, which may mean little or no cleaning at all if they are to be preserved for future generations to enjoy. If it is in the best interest of the building to clean it, then it should be done "using the gentlest means possible."

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**Selected Reading List**


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This Preservation Brief was written by Anne E. Grimmer, Architectural Historian, Technical Preservation Services Division. Valuable suggestions and comments were made by Hugh C. Miller, AIA, Washington, D.C.; Martin E. Weaver, Ottawa, Ontario, Canada; Terry Bryant, Downers Grove, Illinois; Daniel C. Cammer, McLean, Virginia; and the professional staff of Technical Preservation Services Division. Deborah Conley edited the final manuscript.

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**PRESERVATION BRIEFS**

The Cleaning and Waterproof Coating of Masonry Buildings

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**Technical Preservation Services Division**

Office of Archaeology and Historic Preservation/Heritage Conservation and Recreation Service

The inappropriate cleaning and waterproofing of masonry buildings is a major cause of deterioration of the Nation's historic resources. While both treatments may be appropriate in some cases, they may cause serious deterioration in others. The purpose of this leaflet is to provide guidance on the techniques of cleaning and waterproofing, and to explain the consequences of their inappropriate use.

**Why Clean?**

The reasons for cleaning any building must be considered carefully before arriving at a decision to clean.

- Is the cleaning being done to improve the appearance of the building or to make it look new? The so-called "dirt" actually may be weathered masonry, not accumulated deposits; a portion of the masonry itself thus will be removed if a "clean" appearance is desired.

- Is there any evidence that dirt and pollutants are having a harmful effect on the masonry? Improper cleaning can accelerate the deteriorating effect of pollutants.

- Is the cleaning an effort to "get your project started" and improve public relations? Cleaning may help local groups with short term fund raising, yet cause long term damage to the building.

These concerns may lead to the conclusion that cleaning is not desirable—at least not until further study is made of the building, its environment and possible cleaning methods.

**What Is The Dirt?**

The general nature and source of dirt on a building must be determined in order to remove it in the most effective, yet least harmful, manner. Soot and smoke, for example, may require a different method of cleaning than oil stains or bird droppings. The "dirt" also may be a weathered or discolored portion of the masonry itself rather than extraneous materials. Removal of part of the masonry thus would be required to obtain a "clean" appearance, leading to loss of detail and gradual erosion of the masonry. Other common cleaning problems include metal stains such as rust or copper stains, and organic matter such as the tendrils left on the masonry after removal of ivy. The source of dirt, such as coal soot, may no longer be a factor in planning for longer term maintenance, or it may be a continuing source of problems. Full evaluation of dirt and its effect on the building may require one or several kinds of expertise: consultants may include building conservators, geologists, chemists, and preservation architects. Other sources of local experience or information may include building owners in the area, local universities, the State Historic Preservation Officer, and the AIA State Preservation Coordinator.

If the proposed cleaning is to remove paint, it is important in each case to learn whether or not exposed brick is historically appropriate. Many buildings were painted at the time of construction or shortly thereafter; retention of the paint, therefore, may be more appropriate historically than exposing the brick, in spite of current attitudes about "natural" brick. Even in cases 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 prior to repainting. It is essential, however, that research on the paint type, color, and layering be completed on the entire building before removal.

**What Is The Construction Of The Building?**

The construction of the building must be considered in developing a cleaning program because inappropriate cleaning can have a corrosive effect on both the masonry and the other building materials.

Incorrectly chosen cleaning products can cause damaging chemical reactions with the masonry itself. For example, the effect of acidic cleaners on marble and limestone generally is recognized. Other masonry products also are subject to adverse chemical reactions with incompatible cleaning products. Thorough understanding of the physical and chemical properties of the masonry can help you avoid the inadvertent selection of damaging cleaning materials.

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 (Fig. 1). 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.

Previous treatments of the building and its surroundings also should be evaluated, if known. Earlier waterproofing applications may make cleaning difficult. Repairs may have been stained to match the building, and cleaning may make...
these differences apparent. Salts or other snow removal chemicals used near the building may have dissolved and been absorbed into the masonry, causing potentially serious problems of spalling or efflorescence. Techniques for overcoming each of these problems should be considered prior to the selection of a cleaning method.

Types Of Cleaning
Cleaning methods generally are divided into three major groups: water, chemical, and mechanical (abrasive). Water methods soften the dirt and rinse the deposits from the surface. Chemical cleaners react with the dirt and/or masonry to hasten the removal process; the deposits, reaction products and excess chemicals then are rinsed away with water. Mechanical methods include grit blasting (usually sand blasting), grinders, and sanding discs, which remove the dirt by abrasion and usually are followed by a water rinse. Problems related to each of these cleaning methods will be discussed later in this leaflet.

Planning A Cleaning Project
Once the existing conditions have been evaluated, including the type of dirt and the building materials, planning for the cleaning project can begin.

Environmental concerns: The potential effect of each proposed method of cleaning should be evaluated carefully. Chemical cleaners, even though dilute, may damage trees, shrubs, grass, and plants. Animal life, ranging from domestic pets to song birds to earth worms, also may be affected by the run-off. In addition, mechanical methods can produce hazards through the creation of airborne dust.

The proposed cleaning project also may cause property damage. Wind drift, for example, may carry cleaning chemicals onto nearby automobiles, causing 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.

Personal safety: The potential health dangers of each method proposed for the cleaning project must be considered, and the dangers must be avoided. Both acidic and alkaline chemical cleaners can cause serious injury to cleaning operators and passers-by; injuries can be caused by chemicals in both liquid and vapor forms. Mechanical methods cause dust which can pose a serious health hazard, particularly if the abrasive or the masonry contain silica. Steam cleaning has serious hazards because of high temperatures.

Testing cleaning methods: Several potentially useful cleaning methods should be tested prior to selecting the one for use on the building. The simplest and least dangerous methods should be included—as well as those more complicated. All too often simple methods, such as a low pressure water wash, are not even considered, yet they frequently are effective, safe, and least expensive. Water of slightly higher pressure or with a mild non-ionic detergent additive also may be effective. It is worth repeating that these methods should be tested prior to considering harsher methods; they are safer for the building, safer for the environment, and less expensive.

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. A "brand new" appearance, however, may be inappropriate for an older building, and may require an overly harsh cleaning method. It may be wise, therefore, to determine a lower level of acceptable cleaning. The precise amount of residual dirt considered acceptable would depend upon the type of masonry and local conditions.

Cleaning tests, whether using simple or complex methods, should be applied to an area of sufficient size to give a true indication of effectiveness. The test patch should include at least a square yard, and, with large stones, should include several stones and mortar joints. It should be remembered that a single building may have several types of masonry materials and similar materials may have different surface finishes; each of these differing areas should be tested separately. The results of the tests may well indicate that several methods of cleaning should be used on a single building.
The cleaning budget should include money to pay for these tests. Usually contractors are more willing to conduct a variety of tests if they are reimbursed for their time and materials, particularly if the tests include methods with which the contractor is not familiar.

When feasible, test areas should be allowed to weather for an extended period prior to evaluation. A waiting period of a full year is not unreasonable in order to expose the masonry to a full range of seasons. For any building which is considered historically important, the delay is insignificant compared to the potential damage and disfigurement which may arise from use of an incompletely tested method (Figs. 2-5).

**Potential Problems Of Cleaning**

**Water Cleaning:** Water cleaning methods include: (1) low pressure wash over an extended period, (2) moderate to high pressure wash, and (3) steam. Bristle brushes frequently are used to supplement the water wash. All joints, including mortar and sealants, must be sound in order to minimize water penetration to the interior.

Porous masonry may absorb excess amounts of water during the cleaning process and cause damage within the wall or on interior surfaces. Normally, however, water penetrates only part way through even moderately absorbent masonry materials.

Excess water also can bring soluble salts from within the masonry to the surface, forming efflorescences (Fig. 2); in dry climates, the water may evaporate inside the masonry, leaving the salts slightly in back of the surface. The damage which can be caused by soluble salts is explained in more detail later in this leaflet. Efflorescence usually can be traced to a source other than a single water wash.

Another source of surface disfigurement is chemicals such as iron and copper in the water supply; even "soft" water may contain deleterious amounts of these chemicals. Water methods cannot be used during periods of cold weather because water within the masonry can freeze, causing spalling and cracking. Since a 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.

In spite of these potential problems, water methods generally are the simplest to carry out, the safest for the building and the environment, and the least expensive.

**Chemical cleaning:** Since most chemical cleaners are water based, they have many of the potential problems of plain water. Additional problems of chemical cleaning agents have been mentioned in the discussion of environmental concerns.

Chemical cleaners have other problems as well. Some types of masonry are subject to direct attack by cleaning chemicals. Marble and limestone, for example, are dissolved easily by acidic cleaners, even in dilute forms. Another problem may be a change in the color of the masonry caused by the chemicals, not by removal of dirt; the cleaner also may leave a hazy residue in spite of heavy rinsing (Fig. 3). In addition, chemicals can react with components of mortar, stone, or brick to create soluble salts which can form efflorescences, as mentioned earlier. Historic brick buildings are particularly susceptible to damage from hydrochloric (muriatic) acid, although it is, unfortunately, widely used on these structures.

**Mechanical cleaning:** Grit blasting, grinders, and sanding discs all operate by abrading the dirt off the surface of the masonry, rather than reacting with the dirt and masonry as in water and chemical methods. Since the abrasives do not differentiate between the dirt and the masonry, some erosion of the masonry surface is inevitable with mechanical methods, especially blasting. Although a skilled operator can minimize this erosion, some erosion will still take place. In the case of brick, soft stone, detailed carvings, or polished surfaces, even minimal erosion is unacceptable (Figs. 4 and 5). Brick, a fired product, is hardest on the outside where the temperatures were highest; the loss of this "skin" of the brick exposes the softer inner portion to more rapid deterioration. Abrasion of intricate details causes a rounding of sharp corners and other loss of delicate features, while abrasion of polished surfaces removes the polished quality of stone. Mechanical methods, therefore, should never be used on these surfaces and should be used with extreme caution on others.

Grit blasting, unfortunately, still is widely used in spite of these serious effects. In most cases, blasting will leave
vapor: they usually are opaque, such as bituminous coatings and some paints. Water repellents keep liquid water from penetrating the surface but allow water vapor to enter and leave through the "pores" of the masonry. They are transparent, such as the silicone coatings, although they may change the reflective property of the masonry, thus changing the appearance.

Waterproof coatings: These coatings usually do not cause problems as long as they exclude all water from the masonry. If water does enter the wall, however, 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 exterior cracks in the coating, it can lead to damage from the build-up of salts as described below.

Water repellent coatings: These coatings also can cause serious damage, but by a somewhat different mechanism. As water repellent coatings do not seal the surface to water vapor, it can enter the wall as well as leave the wall. Once inside the wall, the vapor can condense at cold spots, producing liquid water. Water within the wall, whether from condensation, leaking gutters, or other sources, can do damage, as explained earlier.

Further damage can be done by soluble salts. Salts frequently are present in the masonry, either from the mortar or from the masonry units themselves. Liquid water can dissolve these salts and carry them toward the surface. If the water is permitted to come to the surface, efflorescences appear upon evaporation. These are unsightly but usually are easily removed; they often are washed away by the simple action of the rain.

The presence of a water repellent coating, however, prevents the water and dissolved salts from coming completely to the surface. The salts then are deposited slightly behind the surface of the masonry as the water evaporates through the pores. Over time, the salt crystals will grow and will develop substantial pressures which will spill the masonry, detaching it at the depth of crystal growth. This build-up may take several years to cause problems.

Test patches for coatings generally do not allow an adequate evaluation of the treatment, because water may enter and leave through the surrounding untreated areas, thus flushing away the salt build-up. In addition, salt deposits may not cause visible damage for several years, well after the patch has been evaluated.

This is not to suggest that there is never a use for water repellents or waterproofings. Sandblasted brick, for example, may have become so porous that paint or some type of coating is essential. In other cases, the damage being caused by local pollution may be greater than the potential damage from the coatings. Generally, coatings are not necessary, however, unless there is a specific problem which they will help to solve. If the problem occurs on only a portion of the masonry, it probably is best to treat only the problem area rather than the entire building. Extreme exposures such as parapets, for example, or portions of the building subject to driving rains can be treated more effectively and less expensively than the entire building.

This publication has been prepared in response to Executive Order 11593, "Protection and Enhancement of the Cultural Environment," which directs the Secretary of the Interior to "... develop and make available to Federal agencies and State and local governments information concerning professional methods and techniques for preserving, improving, restoring and maintaining historic properties." It has been written by Robert C. Mack, AIA, Architect, Technical Preservation Services Division, Office of Archeology and Historic Preservation, Heritage Conservation and Recreation Service, U.S. Department of the Interior, Washington, D.C. 20240. November 1975.
Exterior Paint Problems on Historic Woodwork
Kay D. Weeks and David W. Look, AIA

Technical Preservation Services  Preservation Assistance Division
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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 this 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

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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 alligating to bare wood. See descriptions of these and other paint surface conditions as well as recommended treatments on pp. 5-10.
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.\[9\]

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 porch balusters and window sills cracking and alligatoring. 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.

\[9\] 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 ½ 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

Fig. 4 Paint films wear unevenly depending on exposure and location. Exterior locations which are susceptible to accelerated deterioration are horizontal surfaces such as window sills. These and similar areas will require repainting more often than less vulnerable surfaces. In the case of this window sill where paint has peeled off and adjacent areas have cracked and alligatored, the paint should be totally removed. Prior to repainting, any weathered wood should be rejuvenated using a solution of 3 cups exterior varnish, 1 oz. paraffin wax, and mineral spirits/paint thinner/or turpentine to make 1 gallon. Liberal brush application should be made. This formula was tested over a 20-year period by th. U.S. Department of Agriculture’s Forest Products Laboratory and proved to be just as effective as water-repellent preservatives containing pentachlorophenol. After the surface has thoroughly dried (2-3 days of warm weather), the treated surface can be painted. A high quality oil-base primer followed by two top coats of a semi-gloss oil-enamel or latex-enamel paint is recommended. Photo: Baird M. Smith, AIA.
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, 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. Oehriein, 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.

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**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
I paint removal method is without its drawbacks and all removal. By applying these criteria, it will be seen that no land safety of those individuals performing the paint of the sequence of historic paint layers; and (3) the health (consideration (1) the continued protection and preserva­tion of the historic exterior woodwork; (2) the retention (of which take three over-riding issues into grant-in-aid and certification of rehabilitation projects— as well as onsite monitoring of Department of Interior (tion of the historic exterior woodwork; (2) the retention (ation 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:

**Abrasive**—“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**—Softening and raising the paint layers by applying heat followed by scraping and sanding. Generally used for total paint removal.

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

- **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:** Scoring 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 as smooth a transition as possible is made between damaged and undamaged areas (see figure 10).

Paint scrapers are commonly available in 1½, 2½, and 3½ 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.

**Sandpaper/Sanding Block/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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**Abrasives 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 X 7 inches to 4 X 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, 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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**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.
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”.)

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.

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 profile scraper. Photo: Charles E. Fisher, III.

**Recommended Chemical Methods**

**Recommended Chemical Methods**

**Blow Torch:** Blow torches, such as hand-held propane or butane torches, were widely used in the past for paint removal because other thermal devices were not available. With this technique, the flame is directed toward the paint until it begins to bubble and loosen from the surface. Then the paint is scraped off with a putty knife. Although this is a relatively fast process, at temperatures between 3200 and 3800 degrees Fahrenheit the open flame is not only capable of burning a careless operator and causing severe damage to eyes or skin, it can easily scorch or ignite the wood. The other fire hazard is more insidious. Most frame buildings have an air space between the exterior sheathing and siding and interior lath and plaster. This cavity usually has an accumulation of dust which is also easily ignited by the open flame of a blow torch. Finally, lead-base paints will vaporize at high temperatures, releasing toxic fumes that can be unknowingly inhaled. Therefore, because both the heat plate and the heat gun are generally safer to use—that is, the risks are much more controllable—the blow torch should definitely be avoided!

**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, toluol, 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 cavities 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.

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**Reading List**


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Special thanks go to Baird M. Smith, AIA (formerly Chief, Preservation Technology Branch, TPS) for providing general direction in the development of the manuscript. In addition, the following individuals are to be thanked for their contributions as technical experts in the field: Royal T. Brown, National Paint and Coatings Association, Washington, D.C.; Dr. Judith E. Selwyn, Preservation Technology Associates, Boston, Massachusetts; and Dennis R. Vacca, Pratt & Lambert Co., Carlstadt, New Jersey. Finally, thanks go to several National Park Service staff members whose valuable comments were incorporated into the text and who contributed to the production of the brief: James A. Caufield, Anne E. Grimmer, Jean E. Travers, David C. Battle, Sharon C. Park, AIA, Charles E. Fisher III, Sara K. Blumenthal, and Martha A. Gutrick.

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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September 1982

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Washington, D.C. 20402
Appendix F -- List of Consultants

Consultants in Georgia for Historic Resource Surveys
and National Register Nominations

These consultants have expressed interest in working within Georgia. The Historic Preservation
Georgia Department of Natural Resources, however, endorses and recommends consultants. This list is
provided to local sponsors of surveys for their convenience in obtaining the professional services required
to complete work in Georgia. Local project sponsors are encouraged to discuss their project with more than
one consultant.

Robert A. Cleaves
619 East 48th Street
Savannah, GA 31405
912-233-8655

Community Preservation Partners
Robin Hubbell, MUP, CMSM
2625 Piedmont Road, Suite 56213
Atlanta, GA 30305
404-572-1212

Heitage Works, Inc.
Sarah Brown
307 Kentucky Avenue
Savannah, GA 31404
912-238-5973

Historic Resource Assessments
Kip Wright
1920 Park Hill Circle South
Ft. Worth, TX 76110
817-924-8361

Charlton Hudson
127 Cascade Road
Columbus, GA 31904
706-329-3620

Hudson Preservation Consulting
Helen Hudson
218 East 52nd Street
Savannah, GA 31402
912-236-1994

The Jaeger Company
Dale Jaeger
119 Washington Street
Gainesville, GA 30501
770-533-7024

Community Preservation Partners
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Atlanta, GA 30305
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The Preservation Consultant
682 Ridgewood Avenue
Gainesville, GA 30501
770-533-4430

New South Associates
Denise Meclellan
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Stone Mountain, GA 30083

Bamby Ray
Ray and Associates
328 Sewall Street, NE
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404-607-7705
Consultants in Georgia for Historic Resource Surveys and National Register Nominations

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912-233-8655

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Community Preservation Partners
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John Kissane
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706-322-8620

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404-607-7703

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218 East 52nd Street
Savannah, GA 31402
912-236-1994

Bethel A.M.E. Church – Acworth, Georgia
6 Bibliography


[Website Link] www.ame-church.org/amehist.htm
RESCUING THOSE "HOPELESS" WINDOWS

Sills like this can be rehabilitated. Those in worse condition can be replaced without replacing the entire window unit.

Low-Tech Repairs
By Clem Labine

AT THE SIGHT of peeling paint on a window sill, the typical home improvement contractor will shake his head sadly and pronounce the window "hopeless." The only solution, he will announce gravely, is to replace the old window with a modern unit. But beware: Not only may the replacement look bad, but it may also be an unnecessarily costly solution.

THE WINDOWS in my 1883 brownstone were pronounced hopeless 15 years ago. Yet, with some relatively simple repairs, these windows have served me well for 15 years. Moreover, they should be serviceable well into the next century. And since it was all do-it-yourself work, the cost of repair was only a few dollars. Even on some standard commercial jobs, those contractors who take the trouble to cost out the alternatives are finding that in some cases it is cheaper to rejuvenate the old windows than to buy replacements.

THE TRADITIONAL wooden double-hung window has some outstanding advantages: (1) The wood is a relatively good insulator; (2) The simple construction makes it forever "fixable"; (3) The wood will last indefinitely if it's properly maintained. If the wood does rot out, new wood can be spliced in using simple carpentry techniques. Try to imagine locating replacement vinyl gasketing 10 years from now, or the problem of replacing a bent aluminum channel.

THE MORAL IS CLEAR: It makes sense to rehabilitate your current wood windows if at all possible.

Dealing With Rot

MORE THAN ANY other factor, rotted and checked wood in the sill and lower sash rail leads to the verdict of "hopeless." So this article is going to focus on the rejuvenation of partially rotted window elements. A directory of how-to information for the other common window repairs will be found on the opposite page.

BEFORE PLUNGING IN to repair and consolidate wooden window elements, try to determine whether the failure is caused by normal weathering, or whether there is an unusual condition that is causing water to collect on or behind the window. Among these conditions would be defective gutters, cracks in window framing that permit water to enter, sills that aren't tipped so as to shed water, and defective storm windows.

TRIPLE-TRACK STORM WINDOWS can trap water on window sills. The installers are supposed to leave two gaps ("weep holes") in the caulking at the bottom edge of the storm window. Then, during summer when the screen section is down, rainwater that gets on the sill can drain out. But if the storms weren't properly installed, or if the weep holes have gotten plugged, you have an ideal holding tank for rainwater.
EELING PAINT is a good indicator of where water is entering wood. Usually you'll find paint failure on the top of the sill and areas where the end-grain of the wood is exposed to moisture. Wood that is badly deteriorated is a candidate for replacement or epoxy consolidation (see section following). Wood that has only minor decay (such as the sill in the photo opposite) can be rehabilitated with low-tech repairs.

FIRST STEP is to seal the wood to retard moisture absorption. Make sure the wood is thoroughly dry. Then scrape and wire-brush all loose paint. Better still, remove all the old paint with a heat gun or by hand scraping. Complete removal enhances absorption of the water repellant and subsequent adhesion of the new coat of paint. Flow on generous amounts of water repellant—as much as the wood will absorb. Pay special attention to joints and other places where water can reach the end-grain.

FOR THE WATER REPELLENT, you can use a commercial product (e.g., Thompson's Water Seal) or you can make your own (OHJ Oct. 1981 p. 223). Some old-timers prefer a 50-50 solution of boiled linseed oil and turpentine. Take your choice.

### Where To Find Window Fix-It Information

A directory of how-to information from two basic sources: the back issues of The Old-House Journal and the Reader’s Digest Complete Do-It-Yourself Manual—a good, basic book available at most bookstores.

<table>
<thead>
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<th>WHAT TO DO</th>
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<tbody>
<tr>
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<td>Remove accumulated paint; lubricate with soap or paraffin; plane wood only if absolutely necessary.</td>
<td>Reader’s Digest Manual p. 119</td>
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<tr>
<td>Excessive air infiltration</td>
<td>Caulk and weatherstrip</td>
<td>This issue p. 77</td>
</tr>
<tr>
<td>Broken sash cord</td>
<td>Replace cord or chain</td>
<td>OHJ Sept. 1980 p. 128</td>
</tr>
<tr>
<td>Broken glass</td>
<td>Re-glaze; while sash is out, do other reconditioning.</td>
<td>OHJ Aug. 1976 p. 1</td>
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<tr>
<td>Loose and/or missing putty</td>
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<td>Reader’s Digest Manual p. 123</td>
</tr>
<tr>
<td>Peeling paint on frame</td>
<td>Eliminate unusual sources of moisture; strip or scrape loose paint; caulk; prime and paint.</td>
<td>OHJ Sept. 1980 p. 113</td>
</tr>
<tr>
<td>Loose or rotten bottom rail on lower sash</td>
<td>1. Brace existing rail connection with flat angle; or 2. Splice in new bottom rail</td>
<td>OHJ Apr. 1981 p. 89</td>
</tr>
<tr>
<td>Broken or missing muntins</td>
<td>1. Repair with epoxy if possible; or 2. Make or buy new muntin</td>
<td>OHJ May 1981 p. 103</td>
</tr>
<tr>
<td>Rotted sash</td>
<td>1. Consolidate existing sash; or 2. Replace sash</td>
<td>1. This article</td>
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**DECAY-PRONE AREAS**

Window elements start rotting at points where end-grain can absorb moisture, such as ends of sill, bottom of jambs, and joints in sash. Treatment starts by thoroughly waterproofing these vulnerable areas.

**Where To Find Window Fix-It Information**

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FOR BEST RESULTS, let the waterproofer dry for 24 hours, then repeat the process. After another 24 hours, fill all holes with linseed oil putty or glazing compound. Long cracks can be filled with a high-quality caulk, such as polyurethane. Also seal all joints in the window frame with caulk, especially the joint between jamb and sill. Wait at least 24 hours for a skin to form on the putty and caulk. Then prime with an alkyd primer. Finish coat can be either an alkyd or latex paint.

Epoxy Consolidation

By Larry Jones

ROTTED WOOD can be detected with the "ice-pick test": Probe suspected areas with an ice pick. Those areas that break across the grain—rather than splintering—are weakened by rot and are candidates for epoxy consolidation. This is an amazingly simple technique for strengthening and solidifying decayed wood. The trick is to use the right epoxy, and knowing when it is cheaper to replace an element rather than consolidating it.

I HAVE FOUND that it is often cheaper to repair items such as deteriorated window sills than it is to pull the frame apart to replace the sill. Epoxy consolidants are not cheap—but splicing in new wood is a labor intensive (and thus expensive) process.

I SHOULD ALSO MENTION products that have NOT worked in consolidating exterior woodwork such as window sills. A spackling compound called Tuff Kote proved to be a total disaster, both when used by itself and in conjunction with fiberglass mesh. Auto body fillers, such as Bondo, and fiberglass boat repair products have not proved successful. If moisture gets behind these patches (which it has in our experience) it leads to further wood deterioration.

One That Works

I FOUND ONE FIRM, through The Old-House Journal Catalog, whose products do work successfully on wood repair: Abatron, Inc. (see p. 94). The President, John Caporaso, has been very helpful in helping us find the right epoxy (they make dozens) for our application.

EPOXY CONSOLIDATION is usually a two-step process. First, an epoxy of thin viscosity (about the consistency of motor oil) is allowed to penetrate deep into the wood. When cured, the epoxy renders the treated wood fibers impermeable to moisture—and thus relatively immune to further decay. The second step is to use a thicker epoxy to fill any cracks and voids, and to build up a smooth surface for painting.

THE PENETRATING EPOXY we used for the first step was a two-part system: Abocast #8101-4 resin and Abocure #8101-4 catalyst. It has a pot life of about 30 minutes when mixed for use. (The factory can adjust set-up times to suit needs.) Resin and catalyst are mixed at a 2 to 1 ratio for best moisture resistance, or a 1 to 1 ratio for greatest flexibility.

THE PENETRATING EPOXY can be applied with a brush, making sure to get it into all cracks and voids. It is best applied to horizontal surfaces since it is fairly thin, although sloping window sills seem to pose no problem. Lay window sashes on their sides to apply.

COST is about $20 per quart (for a 2 to 1 mix, 3 quarts are required) or $50 per gallon (for a 2 to 1 mix, 3 gallons required). The material seems to go a long way, so try out the quart size first.

DIPPING OR SOAKING wood elements for at least three minutes is the best way to ensure deep penetration of the water repellent solution. One of the simplest ways to dip-treat wood elements, such as window sash, is to take an old piece of aluminum gutter that is long enough to hold the longest side of the sash. Cap each end of the gutter, sealing the seams with silicone caulk. Fill the gutter with waterproofer and soak each side of the sash in the trough, then set aside to dry.

TO USE THIS TECHNIQUE, the sash must be free of paint. Best results are achieved if the glass and glazing putty are removed from the sash. However, you can leave the glass in place with good results. Obviously, such areas as sills and jambs will have to be brush-treated. Allow the bare wood to soak up all the waterproofer it will hold in two successive brush applications. After 24 hours of drying, prime and paint as usual.

COMING NEXT MONTH: Photos and text showing step-by-step procedures for epoxy consolidation of deteriorated wood.
Anatomy of a Double-Hung Window

Restoration Design File #10

April 1982

The Old-House Journal
Fixing Double-Hung Windows

By James McConkey, Washington, D.C.

IT'S TOO BAD window manufacturers abandoned the counterweighted design. Spring-loaded and friction-fit windows are easier for manufacturers to assemble, but that's about their only advantage. Springs and friction must constantly resist the force of gravity, while counterweights work in unison with it. And repairs in new windows mean replacement of costly manufactured components which may become obsolete and unavailable due to further "improvements" in design.

CONTRAST THIS to the simple sash cord needed to repair a counterweighted window. Unlike modern replacement parts, its cost is minimal, it's not difficult to replace, and it's in no danger of obsolescence. Properly kept, counterweighted windows were designed to last the life of the house.

Anatomy Of A Window

A QUICK DESCRIPTION of window anatomy shows there's nothing mysterious about them: A window is simply an open-ended box set through a wall. The bottom of the box, the SILL, is of heavier stock and slopes to shed water outward. The STOOL caps the sill on the inside. The other three sides are called the JAMB. The two vertical sides are sub-classified as STILES. The SASH is the wooden frame that holds the glass, and is housed within the jamb. The bottom horizontal member of the outer (upper) sash, and the top member of the inner (lower) sash are called MEETING RAILS.

DOUBLE-HUNG WINDOWS, which we're dealing with here, are so named because there are two sashes hung in place on SASH CORDS or CHAINS. The sashes slide up and down in runways called SASH RUNS, formed by mouldings affixed to the stiles. The first moulding is the STOP, and the one behind it is the PARTING BEAD, which parts the inner sash from the outer. Removing both sashes means removing both mouldings.

NEAR THE TOP of each sash run is a PULLEY. The cords pass over the pulleys into the WEIGHT POCKETS, and there are tied to SASH WEIGHTS. The weighted mechanism acts as a counterbalance so the window stays put.

(Continued on page 138)
Disassembly

IT'S POSSIBLE to do all the work from inside. Keep three things in mind while working:

1. When scarring wood is unavoidable, do it where it won't be seen.
2. When you pry against or hammer on visible parts of the window frame, use a block of wood to protect the surface.
3. Never leave a loose sash sitting on a frame, use a block of wood to protect the surface.

FIRST REMOVE ONE STOP to take out the inner sash. Before prying it loose, use the utility knife to score the paint along the seam between the stop and the jamb. Work the pry bar under from behind the stop bead to keep any initial scarring concealed. Work up and down the strip, prying a little at a time. Remember: Old wood is brittle, so you can't just yank it off. You can pry from the front once the stop is loose.

IF THE STOP BREAKS, similar lumberyard stock is available. However, even if it's the right shape, it may be smaller than the original... so you'd need enough to replace it on the entire window.

IF THE WINDOW WON'T OPEN due to paint build-up, take the Windo-Zipper to the seam between the window sash and the stop moulding. Don't force the tool into the crack; cut the paint film in long, moderate strokes. If the window still won't open, it's probably painted shut on the outside too, and in this case going outdoors will help. If this is impractical, try at least to loosen the stop from behind, above the sash. With the utmost care, proceed prying from the front. When the stop is off, pull or pry the sash toward you to break the grip of the outside paint. Absolutely do not pry upward from below on the stop--this always results in obvious gouges. (Of course, you can pry up from the outside.)

IF THE SASH STILL doesn't come out, see if the problem is attached weatherstripping.

IF YOU WANT to remove the sash, but don't need access to the weights, SECURE THE ROPE OR CHAIN and DON'T let it fall with the weights down behind the jamb. Otherwise, cut the sash cords and let the weights fall into the pockets. Put the sash in a safe place.

JUST AS YOU removed the stop to take out the inner sash, now you remove the parting bead to get to the outer sash. Because it's thinner, the parting bead is even more likely to break than the stop moulding, but it too is commercially available.

THE PARTING BEAD is in a groove in the stile, so you can't get the pry bar under it at first. Score the paint seams and pry carefully again.

TO GET THE SASH MOVING, reach outside with the Windo-Zipper and rip the seam between the sash and the BLIND-STOP (so named because the exterior shutters--called "blinds"--stopped against it when closed.) If it won't yield to pulling, pry downward at the top from the outside (where it's inconspicuous) and tap gently downward on the meeting rail. Too much pressure or hammering can break the meeting rail and pull it loose at the ends--so take it easy. When there is space for your fingers at the top, pull down on the sash from there. If nothing makes it yield, see if it is nailed shut. (This is a common way of keeping the sash up after the cords break. Also, some people do it to keep burglars out.) If finish nails were used, just drive them on through. If common nails were used, get under the heads and pull them out. Here, a bit of scarring could be the price of somebody's earlier incompetence.

NOW, EXAMINE the inner sash runs. You'll see a screw, probably encrusted with paint, about a foot or eighteen inches up from the sill. A section of the stile is removable here, to give access to the weight pockets... and that screw holds the section in place. It may take awhile to find and remove the access plate. If there is no screw, a previous workman may have discarded it and undoubtedly nailed the section back in. It's usually rabetted to run under the parting bead, and if so you must remove the parting bead on both sides. Reach inside the pockets and pull out the weights.

(NOTE: Some windows, particularly in pre-1860 and rural houses, don't have access holes. To get to the weight pocket, it's necessary to remove the casement moulding.)

Repair & Replacement

WITH THE WINDOW THUS DISMANTLED, you're ready for any maintenance tasks. Ridges of paint build up on the sashes where they encounter the stop moulding and parting bead. These ridges should be scraped, as should any other areas of excess or loose or flaking paint. I recommend using the sharpened paint scraper because it neatly makes fast work of thick paint. Don't try baring the wood with the scraper, no matter how sharp. If you want bare wood, use paint remover. File the scraper often.

THIS IS THE TIME to repair broken glass, and to replace loose, dry putty. May as well wash the windows too.

YOUR LAST STEP is replacing the sash cords. Cotton rope with a nylon center is sold in hanks, specifically labelled "sash cord." How-
ever, since the same weights and pulleys are used with chain or rope, consider switching to sash chain: It can't rot or stretch or get stiff. This flat steel chain, too, can be purchased in pre-packaged lengths.

GAUGE THE LENGTH of new cord according to the old. To adjust the rope length: Hold the sash against the parting bead as you raise it to the top. Look at the weight in the access hole— with the sash up, it should be three inches above the sill. If not, adjust the rope at the sash.

THE SASH CORDS are housed in slots in the vertical sash pieces—called STILES like the vertical jamb members. Put the cord into the slot, and thread it through the hole beneath. Tie a knot in the end and push the knot back into the hole, where it will support the sash. (If you're using metal chain, attach the end of the chain to the sash with wood screws.)

Smooth Sliding

PUTTING THE WINDOW back together is just the reverse of taking it apart. Take the block of paraffin and wax both the edges of the sash and the insides of the sash runs; this helps the sash slide smoothly.

THE ONE CRITICAL STEP is renailing the stop moulding. It shouldn’t be so tight that the sash is hard to move, nor so loose that the window rattles. About five 4- or 6-penny finish nails hold the stop on each side. Drive one part-way in, check the movement of the sash, drive another and recheck, and so on till all the nails are in place. Drive them down and set them.

AFTER SOME MINOR spackling and paint touch-up, that obdurate old window is ready for another fifty years of service!