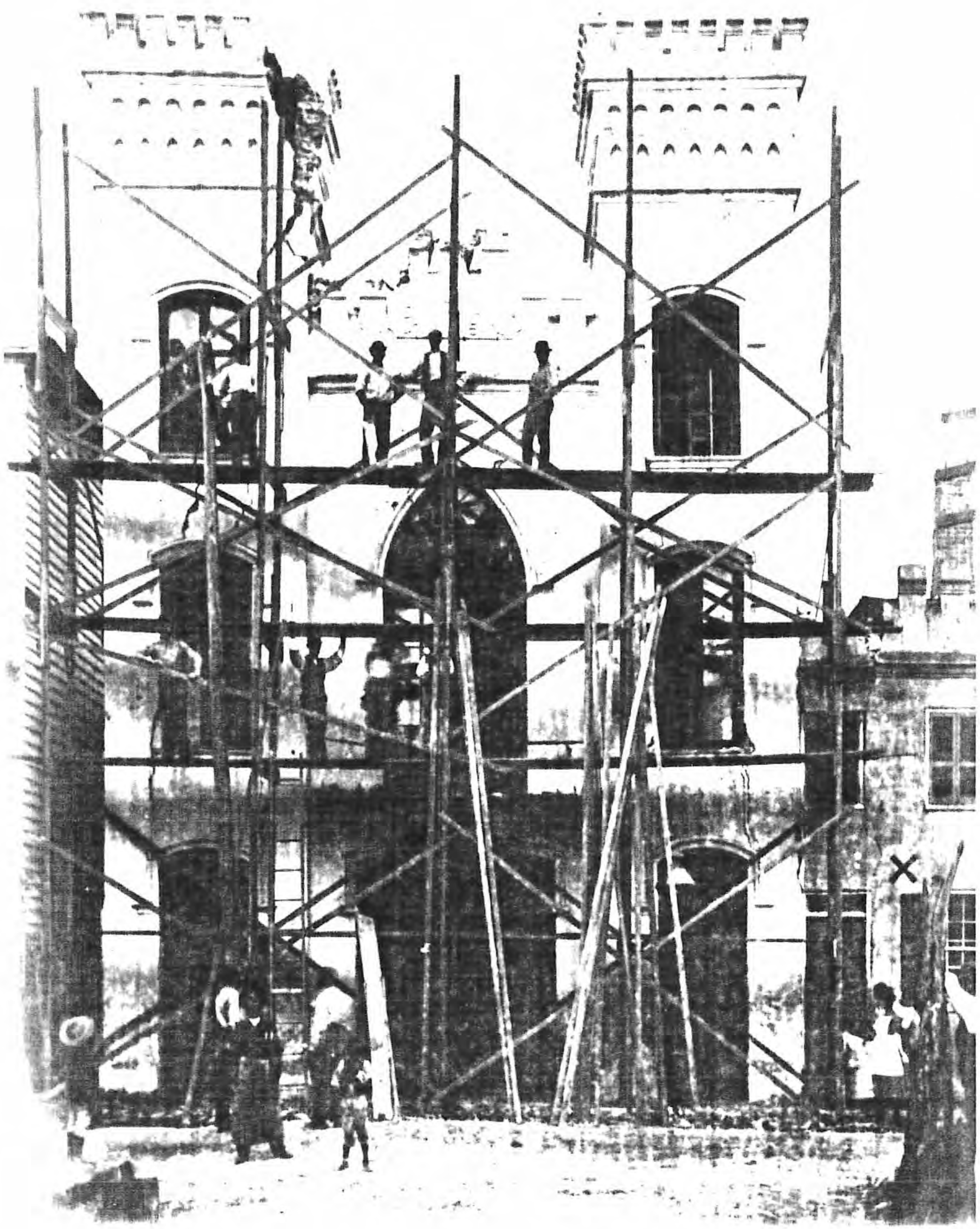

An Introductory Guide to the Repair of Charleston's Historic Masonry and Wood Buildings

By George Fore

HISTORIC CHARLESTON FOUNDATION
CHARLESTON S.C.

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Forward

For many years, preservationists, building conservationists, and architects, especially from other areas have noted that Charleston's approach to the repair of historic masonry and wood buildings is lacking in craftsmanship and proper approach. In the early 1980s, some influence was exerted by the National Park Service and its Atlanta Regional Office over bad quality work that was under consideration for investment tax credit incentives. The city's Board of Architectural Review went to the site of the Lodge Alley project on June 23, 1983, and criticized the poor masonry repointing then in progress. Unfortunately, city guidelines or enforcement of Architectural Review codes have not been utilized until recently and such work has continued on other sites.

The problem of a lack of craftsmanship is of recent vintage. Before World War II, Charleston was considered a bastion of some of the best traditional building craftsmen in North America. Carpenters and some masons were some of the earliest settlers of Carolina. Carpenters and joiners such as Dudley Inman, John Wood, and Samuel Cardy were sophisticated enough to be architects of some of Charleston's great colonial buildings. Brick masons used finely honed techniques in laying and pointing bricks in the city's earliest structures. Although, a volume on the brick made and imported to Carolina from England, New England, and Holland is a future necessity, drawing on the earlier research by the late Ben Moise and Henry P. Staats, we can now determine the historic mortar compositions and techniques. The shift from the tooled joints of the colonial period to the finely chiselled lime putty joints of the federal style exhibits the change in tastes and the growth of the local craft. This craftsmanship may have virtually peaked early in the twentieth century with master masons such as the late Pinckney Ezekiel.

In 1987, Historic Charleston Foundation realized that a set of guidelines for building repair in Charleston would be an important first step in waging war upon bad craftsmanship and the resulting damage to Charleston's (and in the surrounding Lowcountry's) internationally significant inventory of buildings. A grant project initiated by the Foundation to study the problems in detail was funded by a Survey and Planing Grant from federal funds from the National Park Service, United States Department of the Interior, and administered by the South Carolina Department of Archives and History* and by the Marquette Foundation. The consultant selected to conduct this grant project was George Fore, an architectural conservator. Mr. Fore, the author of this study, based on his findings, has amassed substantial expertise in the analysis and conservation of Charleston's historic structures. This study was augmented by a later, more detailed examination of the range of composition of Charleston's historic mortars in 1989, also conducted by Mr. Fore and similarly funded by a grant from the South Carolina Department of Archives and History.

Much of the findings of the latter study will be published at a later date.

This book is intended to provide contractors, homeowners, architects, government officials, and the general public with a simple explanation of the repair problems associated with exterior brick, stucco, and wood building elements and recommended conservation approaches to insure long-term stabilization and to prevent the introduction of those modern materials and methods which would permanently damage historic fabric. It also serves in an official way for elucidating Historic Charleston Foundation's Exterior Preservation Guidelines for dealing with issues pertaining to the numerous properties protected by its covenants and easements. This study is also the first in a series to be produced in the next few years on issues pertaining to historic preservation in Charleston and the South Carolina Lowcountry.

For their help we would like to thank the staff of the South Carolina Department of Archives and History, especially Susan McGahee and Nancy Pittenger; the City of Charleston, especially Charles Chase and Deborah Rhoad; and the staff of Historic Charleston Foundation, especially Lawrence A. Walker, executive director of HCF and M. E. Van Dyke, HCF Conservation Projects Coordinator, who assists countless homeowners with mortar and wood conservation problems.

Jonathan H. Poston
Historic Charleston Foundation
October 1990

Introduction

The challenge of maintaining and preserving our architectural heritage includes the control of the effects of natural and man induced deterioration. The long term preservation of historic structures requires the careful study of the many components of each building. An understanding of the historic materials and construction techniques, the deterioration processes that affect the materials and the effects of repair techniques is critical. Successful repair and maintenance programs can ensure the preservation of the masonry and wood elements of historic buildings.

The technology and methods of masonry and wood construction have changed significantly since the early eighteenth century. The development of new mortars, the introduction of brick manufacturing processes and the development of new coating systems has altered the manner of construction and design details. The construction practices of the late twentieth century differ from those of the eighteenth and nineteenth centuries by more than just the appearance of the materials. The mechanical, physical and structural differences between the materials are so great that the materials are seldom interchangeable.

Several of the techniques currently used in the repair of Charleston's historic structures can cause irreversible damage. The character and details of masonry can be altered by improper repairs. When the "best" modern masonry practices, materials and techniques are applied to an historic building the results are often frustrating, producing significant changes in the building's appearance, the more rapid deterioration of the original masonry and the spreading of the deterioration to other areas of the structure. The alteration of wood surfaces in the preparation for repainting is of considerable concern. In several cases the aggressiveness of the repair techniques is of greater concern than the effects of the deterioration processes.

This handbook addresses several of the more common maintenance problems of historic buildings. A guideline is provided for the evaluation of repair materials and techniques. The materials and techniques of masonry and wood construction are discussed along with suggested approaches to their repair. The details of approved techniques are described in outline specifications. While these recommendations cannot address the more involved problems of reinforcement and material conservation they can serve as a basis for most of the repair programs in Charleston's historic district.

Procedural Recommendations

The following principles should be applied before and during the planning phase for each construction project.

All historic elements and materials are subject to varying rates of deterioration. No repair processes, techniques, or materials should be viewed as permanent, for they also are subject to reduction and erosion processes that tend to return combined materials to their basic constituents.

All repairs, treatments, and alterations should be removable or reversible without causing injurious effects to historic materials.

All processes and techniques used in the repair or restoration of historic buildings should be fully documented as to the long-term effects that each process or technique will produce on the whole of the historic structure.

The following procedural recommendations apply to all masonry and wood conservation projects.

1. The most important step in assessing a problem which has been noticed by its visual effect is to identify the cause of the deterioration. The failure of most repair projects has been due to treating the effects and not the cause of a problem.

2. Estimate the severity of the deterioration by determining the rate of material loss as evidenced by the scope of the affect and as compared to similar unaffected elements.

3. Distinguish between effects which are results of unacceptable accelerated deterioration processes and effects which are cosmetic responses to acceptable local conditions. Distinguish between conservation concerns for the preservation of materials and the cosmetic concerns for presentation.

4. Employ only processes and techniques which have been demonstrated to be acceptable conservation practices.

5. Never use an historic structure to test new products or techniques.

6. Never use processes or techniques which cause the loss of <u>any</u> amount of historic material in the preparation or application of a product or procedure.

7. Clearly identify and describe all procedures and products in writing that are to be employed in a project. Identify all areas or elements to be treated or excluded in the project.

8. When evaluating the skills and understanding of a tradesman, review all processes and procedures with each person who may execute the work. Review completed examples of tradesmen's work which demonstrate skill levels and understanding of preservation practices.

Masonry

Masonry Construction Techniques

Charleston's historic brick buildings are either of exposed brick or brick finished with stucco. Many of Charleston's stuccoed buildings were originally of exposed brick, but were later stuccoed to unify the appearance of the structure following repairs to the masonry or the construction of additions. The technique of historic masonry construction is quite simple. The formulations of the mortars and stuccoes are quite similar and are produced from the same group of materials (*Illustration 2*). The use of mortar in the coursing of the masonry and the application of stucco to the brick surfaces is similar for all of the architectural periods. Yet, the many variations within the masonry construction requires a careful study of the many details.

The appearance of the brickwork among Charleston's many periods of construction is quite diverse. There are many variations in the size and types of bricks, the types of mortar joints and the patterns of the brick coursing. There are also variations in the color contrast between the brick and mortar, the depth of the shadow lines created by the joints, the emphasis on the geometry of the construction and the texture of the finished surfaces. The successful repair of historic brickwork will reproduce each of these visual qualities.

Charleston's masonry construction from the early eighteenth century to the mid-nineteenth century includes some of the finest examples of American brickwork. During this one-and-one-half century period can be found the work of the most highly skilled craftsmen. The concern for the appearance of the brickwork led to the development of several construction techniques. The characteristic irregularities of the handmade bricks produced uneven coursing. The desire for a strict geometry in the appearance of the finished work required the mortar joints to accommodate the irregularities of the bricks and produce the effect of regular horizontal and vertical lines (*Illustration 1*).

The principal masonry bonding patterns found in Charleston are Flemish bond, English bond and American bond. *Drawing 1* illustrates the patterns of these designs. The Flemish bond alternates stretchers and headers within each course. English bond alternates courses of stretchers and headers. The American bonding pattern uses a course of headers every five courses of stretchers, although this is sometimes increased to seven courses or more.

The different mortar joint profiles are illustrated in *Drawing 2* and *Illustrations 3, 4, 5, 6 and 7*. The most popular tooled profile in the early eighteenth century was the ruled, or scored, joint. Starting in the late eighteenth century and continuing for the next seventy-five years, a variety of other

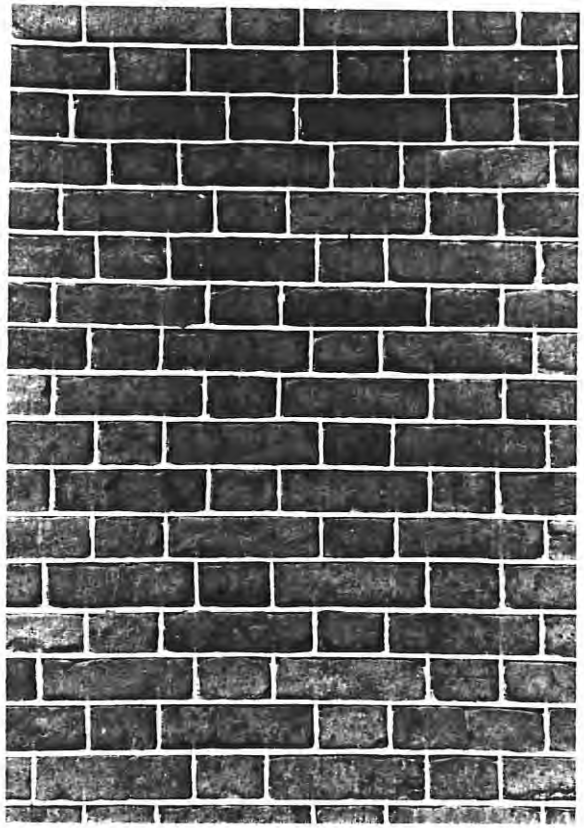


Illustration 1. Early nineteenth century masonry composed of hand made bricks and lime mortar ribbon joints. The irregular shapes of the bricks are hidden by the regular geometry of the finely tooled mortar joints.

joint profiles were developed: "V" joints, ribbon joints, struck joints, flush joints and tuck pointed joints. All of these profilewere produced with lime based mortars that were tooled using guides and molding implements.

The production of the tuck pointed joint and its variations was somewhat more involved than the other profiles. This technique addressed the unevenness of the bricks. The irregularities of the brick joints were fully filled, in the same manner as a flush joint, using a mortar pigmented to match the color of the brick. The surface of the mortar was scored using a guide. The score lines were then filled with a near perfect ribbon of white lime putty formed with a stencil. A variation of the tuck pointing technique filled the irregularities of ribbon tooled joints. The irregularities of the bricks and the shoulders of the pointing were rubbed with a brick colored mortar, leaving the outermost face of the ribbon pointing exposed. All of these joint finishing techniques reflect, on a smaller scale, the design of regularity found throughout the architecture of Charleston's early buildings.

There are many variations of the joint profile types. On some buildings the bedding, or horizontal, joints were tooled with a "V" profile; the head, or vertical, joints were finished with a ribbon profile. On most buildings the major street and gallery elevations were tooled with the finest profiles, such as scored, ribbon or tuck pointing, and the minor elevations, such as at the side, were tooled with "V" or struck joints. The finer joint tooling, though recognized for its desired effect, was seldom presented to the neighbor's garden.

Beginning in the mid-nineteenth century, and proceeding rapidly, many new manufacturing techniques and masonry materials were developed that allowed the construction of masonry without the dependence on the mortar joints for regularity. Indeed, the joints would soon lose most of the decorative qualities which required such a high skill level of the mason.

The application and finish of stucco did not parallel the changes in tooling techniques described for exposed brickwork. Stucco, being a quite plastic material, was easily shaped and tooled to form the appearance of natural stone. The stucco could be scored to imitate ashlar blocks, shaped to imitate stone moldings, and even cast to imitate carved stone blocks (*Illustration 10*). The ingredients used in the formulations of stuccoes closely followed those used in mortar mixes. Often,combinations of masonry elements were used: quoin blocks formed in stucco, molded stucco architraves and finely tooled brick joints. One of the highest developed uses of stucco in Charleston is the City Market Hall, exhibiting cast ornament in stucco and iron, run-in-place stucco moldings, details carved from sandstone, and the imitation of sandstone ashlar blocks scored in stone-pigmented stucco (*Illustrations 8 and 9*).

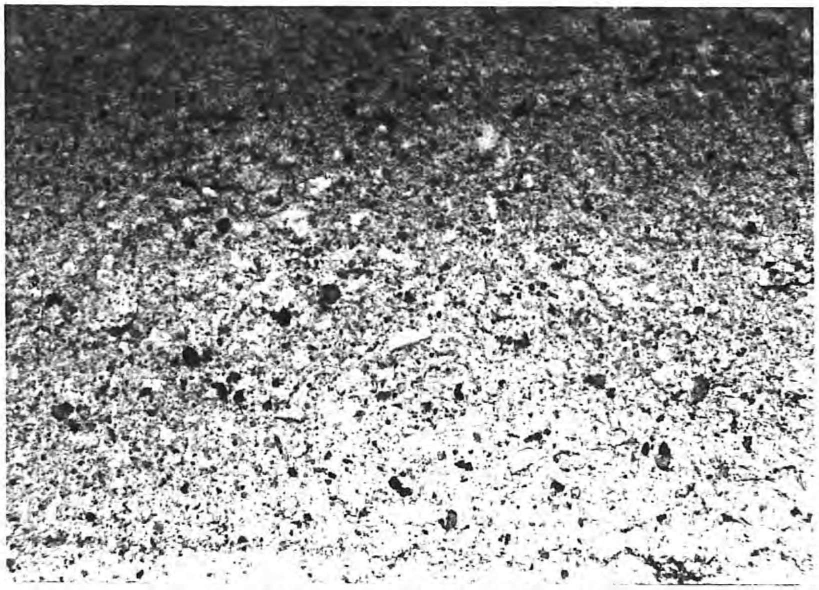


Illustration 2. Eighteenth and nineteenth century lime stucco typically consists of lime, crushed brick, sand and crushed oyster shell.

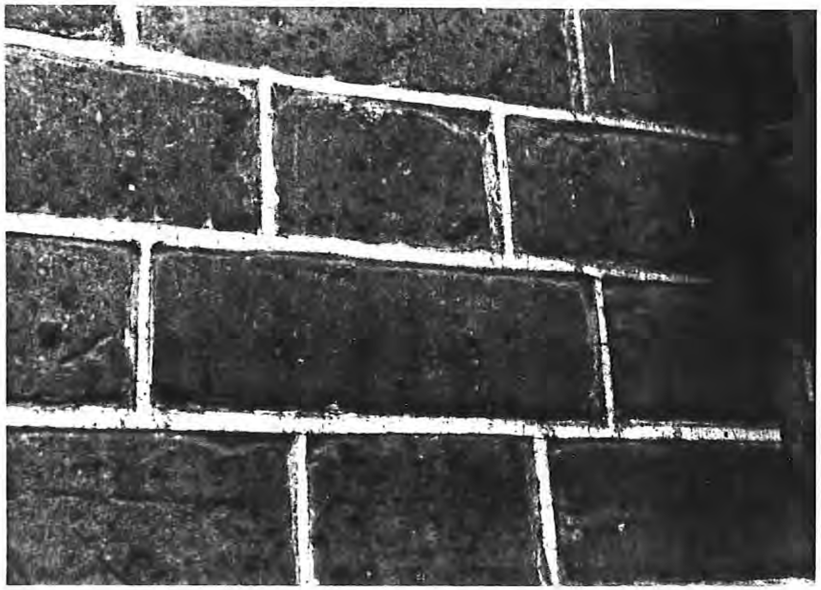


Illustration 3. The formation of the ribbon joint produces a three sided, molded profile.

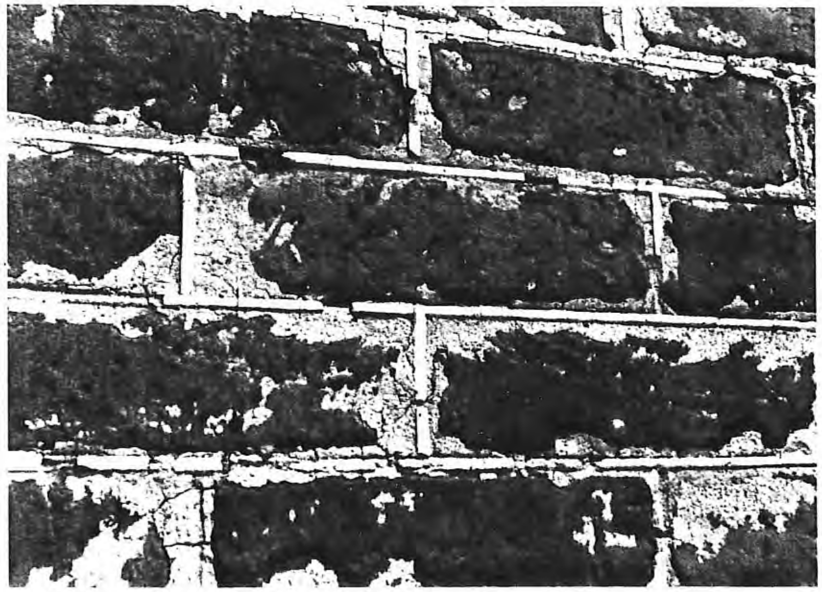


Illustration 4. The tuck pointed joint is produced with two mortars. The irregularities of the bricks are hidden by a brick colored, pigmented mortar that fully fills the joints. A fine bead of white of white mortar is then set into a scored line in the pigmented mortar, producing the effect of a regular geometry. The pigmented mortar in this example has faded to a lighter color.

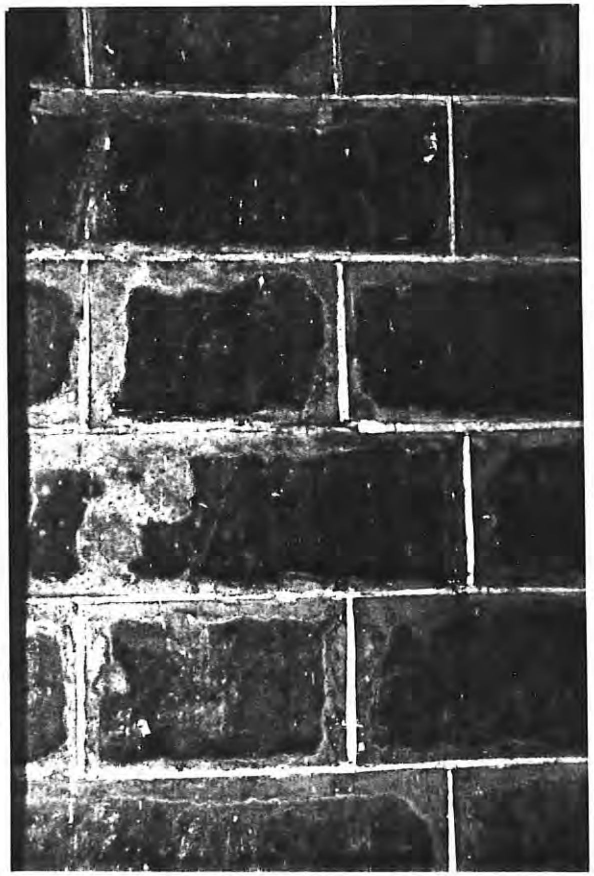
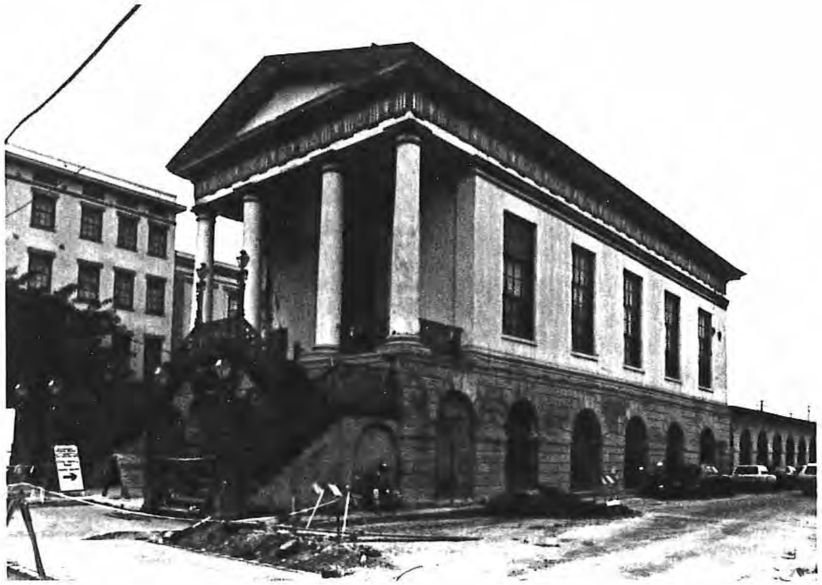


Illustration 5. This variation of the ribbon joint is similar to tuck pointing. A brick colored mortar has been rubbed into the spaces between the brick edges and the ribbon joints.

Illustration 6. The appearance of regularity in this example was produced by thin white lines painted onto the surface of flush tooled mortar joints. The mortar was originally the same color as the bricks.

Illustration 7. The development of machine pressed bricks produced masonry products of very close uniformity. The tooling of the mortar joints was no longer necessary for the appearance of regularity. In this example the narrow, dark joints were intended to be hidden.



Illustrations 8 and 9. The Market Hall is one of the finest examples of the use of stucco to imitate stone. The details of the 1841 structure include walls scored to imitate ashlar blocks, run-in-place moldings and cast elements. The Market originally appeared as a brownstone building. The column capitals and bases, the projecting cornice and the step construction are of natural brownstone.

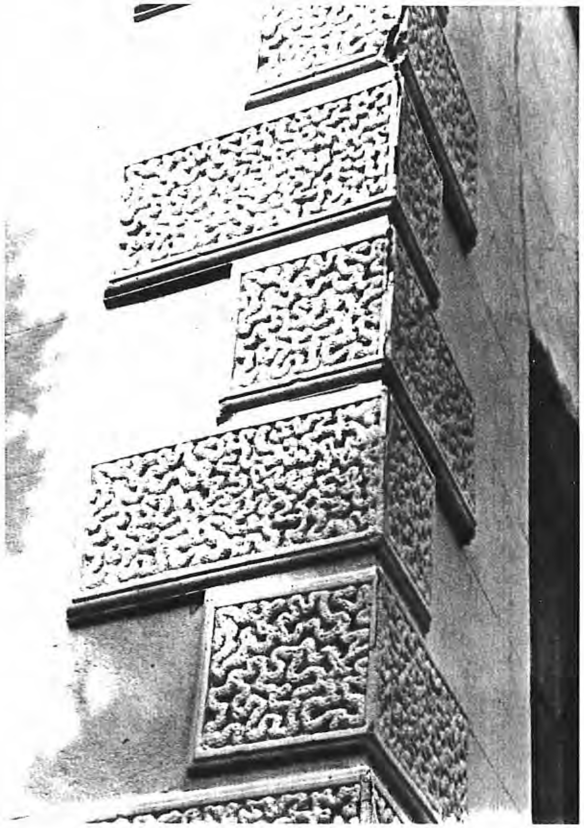
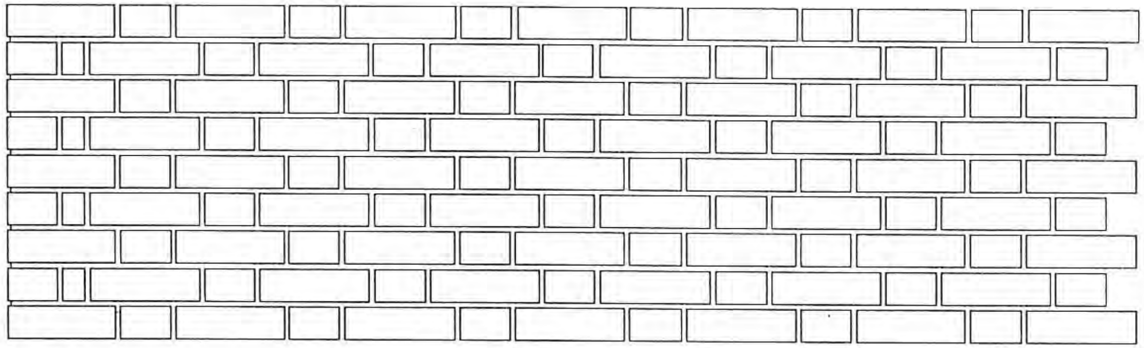
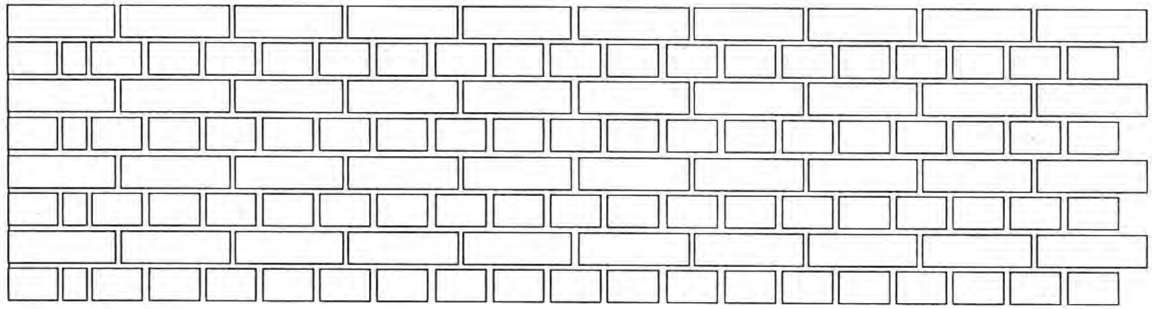


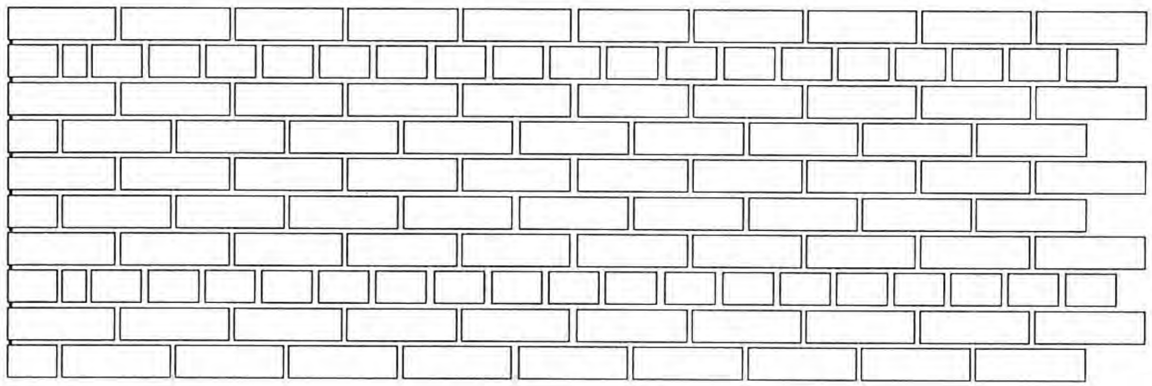
Illustration 10. Many of the eighteenth and nineteenth century exterior decorative details are of cast and molded stucco. Here, stucco has been cast in imitation of stone corner quoins.



Flemish Bond.

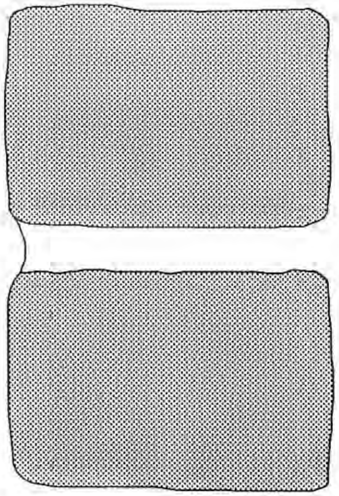


English Bond

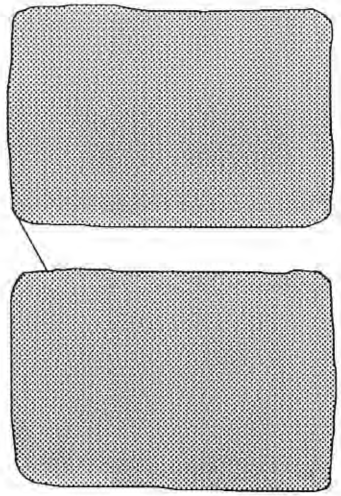


American Bond

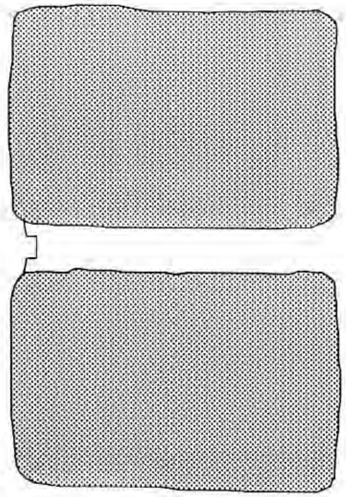
Drawing 1. Brick bonding patterns.



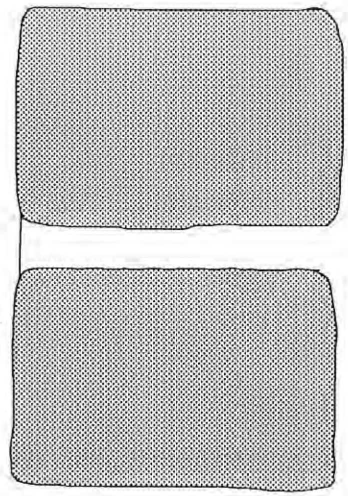
Tooled joint.



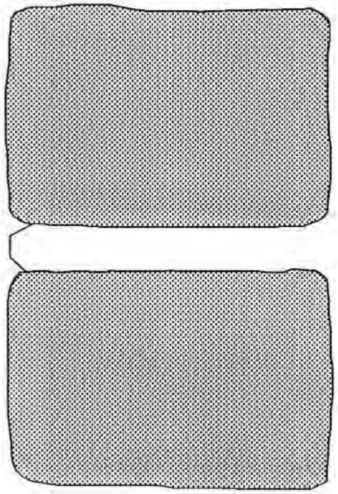
Struck joint.



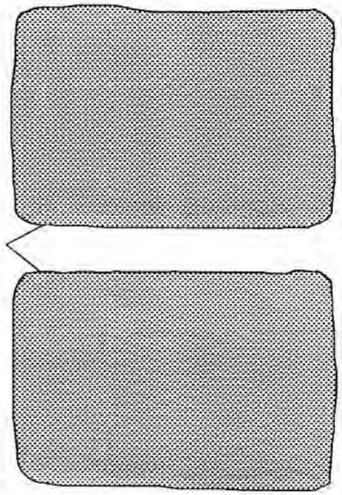
Scored joint.



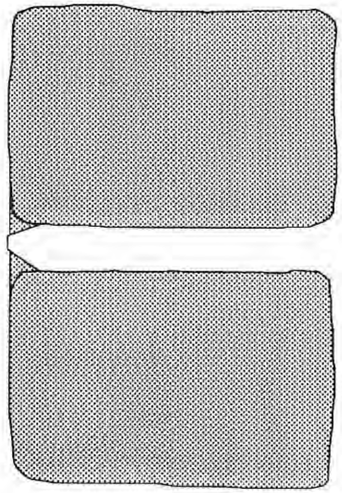
Flush joint. This joint is sometimes pencilled with white paint in imitation of tuck pointing.



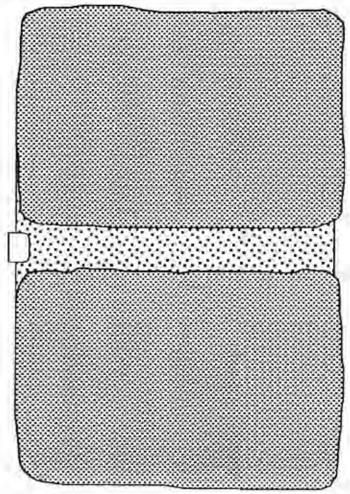
Ribbon joint. The joint is molded in white mortar in a very regular geometry.



'V' joint.



Ribbon joint with pigmented mortar. Brick- colored mortar is rubbed into the irregularities of the brick arris. This technique achieves a similar effect as the tuck pointed joint.



Tuck pointed joint. A ribbon of white mortar is set into the surface of a pigmented mortar the color of the brick.

Drawing 1. Mortar joint profiles.

Masonry Materials

BRICKS manufactured in the eighteenth and nineteenth centuries are of three types. The earliest bricks were handmade, produced from a clay-sand packed in wood molds. This process produced bricks with layers of varying densities and many air pockets. When fired, in either a kiln or clamp, the bricks were vitrified to varying degrees depending upon their location within the stack. Because of their nonuniform density, considerable warping and cracking occurred, producing brick units with considerable variations in geometry. Because of these variations, masonry construction of hand made bricks was dependent upon the straight tooling of the mortar joints to produce the effect of regularity.

The firing process of the hand packed bricks produced three grades of bricks: salmon bricks that were under burned, light in color and used in areas that were protected from the weather; face bricks that were hard burned, darker red and used on the exposed exterior face of buildings; and clinkers that were over burned, quite warped, dark red to black and not generally used in exposed areas. The hand made bricks produced in the Charleston area were medium in color, somewhat of a grey-red to tan color, and characterized by dark spots. The dark-red bricks of Charleston's buildings were produced in areas of red clay, most likely the Philadelphia-Baltimore area, where brick production was a well developed industry in the seventeenth century. This latter area became such a major exporter of brick that all red face brick throughout the country became commonly known as Philadelphia brick.

The first major development in brick manufacture came at the mid-nineteenth century. Machines were developed that pressed a clay-sand mixture into iron molds, producing a more uniform brick with fewer laminations. The pressed bricks were denser than the hand molded bricks and when fired, warped considerably less. The production of somewhat more uniform bricks meant that the geometry of masonry construction could depend less upon the mortar joint tooling for the effect of regularity. The need for the more decorative, and expensive, molded joint profiles was lessened.

The third brick type began to appear in the last quarter of the nineteenth century. Brick making machines, quite similar to modern machines, were developed that could extrude a continuous, very dense line of clay-sand that could then be cut into bricks. These were fired in new brick kilns that were uniformly heated. The uniform geometry of the extruded bricks allowed masonry construction to reduce both the size and emphasis of the mortar joint. Brick buildings began to be engineered structures, requiring denser mortars to increase the strength of the brick mass. By the third quarter of the nineteenth century the use of ribbon joints, tuck pointing and the other molded joint profiles was no longer in practice.

The MORTARS and STUCCOES of the eighteenth and nineteenth centuries are quite varied. The assorted binders and aggregates that are found in Charleston's historic mortars and stuccoes reflect the developments in brick manufacture and the continuing search by the early builders to develop a more durable masonry construction. A proportional analysis of the mortar and stucco ingredients has been conducted on representative Charleston buildings. The study of the samples identified the groups of materials that were commonly employed. *Chart 1* lists the range of materials identified for the stucco and mortar types for each period. Within each grouping there are many possible combinations, it being unlikely that any one mortar or stucco would contain all of the listed ingredients.

As one can see, the great range of binders and additives produced dozens of possible formulations, each with its own characteristic setting time, workability, porosity, strength, adhesive qualities, and, of course, durability. The materials which influenced all of these qualities were those which resisted weathering by imparting a hydraulic quality to the mortar or stucco. These materials included the hydraulic limes, natural cements, mineral containing clays, ground brick, and fine silicates. All of these materials could impart hydraulic qualities to the mortar or stucco mix, making them resistent to dissolution in water.

The limes used in mortars and stuccoes was produced by burning calcium carbonate, either limestone or shells, in a kiln. The burnt carbonate was known as quicklime, and required hydration with water to produce a usable binder. The Some of the limes possessed hydraulic properties. These were produced by the burning of naturally occurring, or intentionally added, amounts of magnesium, silicon, alumina, or iron. Many of the limestones used in the production of lime contained fine clays that were composed of these minerals. Limestones containing a large amount of these minerals produced binders that were very hydraulic and known as natural cements. Hydraulic mortar and stucco mixtures could also be produced by adding fine clays or ground brick which contained these minerals, and which had also been burnt.

The degree of the hydraulic quality of the mix varied widely. The hydraulic limes contained 10-30% clay and were somewhat hydraulic. Natural cements contained 30-60% clay and were almost completely hydraulic. Common lime mixtures modified by the addition of vitrified, or burned, materials were moderately hydraulic. Fully hydraulic limes and cements were often modified with non-hydraulic lime to control density and hardness, and to impart some of the plastic qualities of pure lime to the mix.

The hydraulic qualities of Charleston's early mortars and stuccoes were due to the addition of ground brick and fine clays to the mix. For the most part the lime used in the construction of Charleston's buildings before 1825 was produced from oyster shells and did not possess any hydraulic quality. Occasionally the use of "stone" lime, that produced from the burning of limestone, was used, but, because of its expense, this was generally reserved for large projects and residences. The use of the hydraulic natural cements began in the 1810s and gained considerable favor by mid-century. The most notable examples of the use of natural cement stucco in Charleston are St. Philip's Episcopal Church, the Charleston City Market and St. Michael's Episcopal Church. The latter edifice has long been painted white, but was, in the mid-nineteenth century, restuccoed in imitation of dark stone. Because of their dark color the natural cements were quite successful in their imitation of sandstone.

The lime used in modern reproduction mortars and stuccoes is Type S mason's lime. This lime is quite pure and imparts no hydraulic properties to the restoration formulations. Small amounts of white portland cement and brick dust are added to the mixes to give a degree of hydraulic set. The associated increase in hardness of the mixes and the formation of soluble salts makes the use of portland cement a less satisfactory substitute for the historic materials. The use of crushed brick as an aggregate and the addition of fly ash can impart some of the qualities of the moderately hydraulic historic mixes. Unfortunately, there are, at present, no sources for either hydraulic lime or natural cement.

Category	Ingredients
"White lime" pointing mortars of the early eighteenth century to the 1870s	Hydraulic lime Lime putty Fine sands Ground brick aggregate Ground brick fines Clay Calcium carbonate aggregate in form of shell
"White lime" stucco of the early eighteenth century to late nineteenth century	Hydraulic lime Lime putty Fine to coarse sand Ground brick aggregate, medium to coarse Ground brick fines Clay Calcium carbonate aggregate, fine to medium, in form of shells
Bedding mortars of the early eighteenth to mid-nineteenth century	Hydraulic lime Lime putty Fine to coarse sand Clay Calcium carbonate aggregate; medium, coarse, and whole shells
Natural cement stuccoes of the 1810s to the late nineteenth century	Hydraulic lime Natural cements (various) Lime putty Fine to coarse sands Ground natural stone
Late nineteenth century portland mortar and stucco	Portland cement Lime putty Fine to medium sands

Chart 1. The range of ingredients in Charleston's eighteenth and nineteenth century mortars and stuccoes.

Repair of Historic Masonry

The masonry construction of the eighteenth and nineteenth centuries should be considered fairly organic. The durability of the masonry as a whole is determined by its response to water movement. The masonry is subject to the free movement of both liquid water and water vapor due to capillary action, differential vapor and air pressures, and condensation. Nearly all of the deterioration processes which affect Charleston's historic masonry are driven by moisture.

Historically, well designed masonry construction used the mortar as a sacrificial material. The mortar was subject to cycles of wetting and drying and the penetration of moisture due to rising damp and surface pressures. The mortar was designed to be substantially more porous and more plastic than the brick units. All of the induced stresses of the masonry walls, such as thermal stresses which occur on a daily basis, were compensated for by the mortar joints. In over stressed areas, this compensation often resulted in the loss of the mortar joint. It is easy to see, though, that the periodic replacement in high stress areas of the mortar joints is preferable to the replacement of areas of brick and mortar.

The damage induced by moisture movement is greatly exaggerated by the presence of water soluble salts. The crystalline structure of the naturally occurring salts, usually sulfates, carbonates, and chlorides, is somewhat larger than the pore structure of the bricks and mortar. Repeated wetting and drying of the masonry also produces cycles of dissolution and recrystallization of the salts just beneath the surface, exerting large local forces that push off the surface. Although this occurs on a small scale, the long term repetition of these cycles can cause the complete loss of the stucco and brick

Illustration 11. This illustration of stucco deterioration shows the affects of using dense cement stucco in the repair of porous masonry. The lower wall has been previously repaired with portland cement. The moisture within the masonry has been driven higher in the construction, beyond the original area of deterioration.

surfaces (*Illustrations 11 and 12*).

Any change in the relationship between the porosity of the bricks and the porosity of the mortar or stucco can reverse the role of the mortar as the sacrificial material. This is commonly seen in the masonry repairs of the twentieth century where dense, portland cement mortars have been substituted for the lime or natural cement binders. Portland cement is a dense, hydraulic, manufactured cement that began to be produced in the United States in the late nineteenth century. Portland cement is an excellent material when used for purposes for which it is suitable. But its use as the principal binder in porous masonry construction can be quite damaging and destructive.

Illustration 12. This illustration of stucco repairs shows the original lime stucco, a dark natural cement stucco from the period of the 1886 earthquake repairs and grey portland cement stucco repairs of the twentieth century. The relatively porous lime and natural cement stuccoes are performing well. The denser portland cement is accelerating the deterioration of the surrounding stuccoes.

The mortars produced with portland cement differ in several significant ways from the lime-based mortars. The coefficient of expansion of the dense portland mortars is twice that of porous bricks, thus all expansion and contraction forces normally assumed by the mortar joints must be absorbed by the bricks. The portland mortars are relatively impermeable to water, requiring all evaporation of liquid water from within the masonry to occur through the bricks, thus making the bricks the sacrificial surface. Portland mortars also contain approximately seven times the amount of soluble salts as lime mortars, and their use can result in the introduction of additional damaging materials into the soft masonry. Upon setting portland mortars shrink considerably, often cracking and allowing water into the joint. Lime mortars actually increase in volume upon setting, compacting the joint further.

The direct effect of excessive moisture and salts upon masonry makes the identification of problem areas straightforward. Areas of masonry directly beneath a leaking downspout or gutter eventually show signs of stucco exfoliation, mortar erosion or the loss of brick surfaces. Masonry immediately above grade areas where surface water collects will develop spreading evaporation zones, a line of salt formation in the tide zone and the exfoliation of the mortar, stucco, and brick. In the latter case, areas of rising damp may develop which eventually affect adjacent elements, such as floor joists and interior plaster.

Certain areas or elements of brick buildings are subject to an increased rate of material loss due to their location and detailing. Chimneys and parapet walls are exposed to moisture on more than one surface, increasing their average moisture content. Likewise, masonry below the water table level is in direct contact with water, and for extended periods. Some original details use masonry as part of the water carry-off, or water shedding system. Projecting brick cornices, the top surface of parapet walls and masonry abutting roof planes are subject to a higher rate of joint scouring.

One particular masonry problem in Charleston is a result of a change in the exposure of the masonry. Buildings whose party walls were constructed against existing neighboring buildings can be subjected to quite serious moisture penetration if the earlier building is removed. The newly exposed side elevation will not contain any exterior weather joints, leaving the wall open to high absorption rates through the joints.

The start of all successful repair programs examines the causes and contributing factors of each deterioration process. Until the source of water entry is controlled, all masonry repairs, regardless of the materials employed, are of little value. The corrective measures should involve the repair or redetailing of architectural details such as flashing, roof coverings, surface drains, deteriorated wood elements, etc. The application of sealants, water repellents and waterproof coatings should not be considered. Most of these treatments, as advertised, do allow some flow of water vapor through the treated surface. The majority of the moisture in porous masonry is in the form of liquid water. All of the coatings reduce the porosity at the masonry surface, thus the effect is actually an increase in the total moisture levels within the construction, generally concentrated beneath the less porous surface. This concentration zone will contain a corresponding higher level of soluble salts, increasing the possibility of surface exfoliation. The effect of the masonry sealers is similar to that of dense stuccoes, resulting in a decrease in surface evaporation, and an increase in moisture content.

The failure of most masonry repair projects results from the treatment of the effects of a deterioration problem without correcting the cause of the problem and the use of masonry mortars or stuccoes which are not designed for porous masonry. As described above, any decrease in the porosity of the mortar or stucco will result in an increase in the moisture level in the masonry. The reduced porosity directly reduces the evaporation ability of the masonry surfaces. Thus, if a hard, dense portland mortar or stucco is used, for example, in an area at the base of a building the moisture within the wall must travel above the repair area to reach areas of increased evaporation (*Illustration 11*). If the source of the water is not reduced or eliminated, new areas of unaffected masonry will then be subjected to the same process that caused the lower masonry to deteriorate. It is commonly assumed that an increase in the strength and density of the mortars and stuccoes will increase the durability of the masonry construction. The actual effect is an increase in both the rate of deterioration and in the size of the affected area.

The normal repair of masonry construction involves the replacement of damaged or missing mortar joints, the replacement of broken and exfoliated bricks, the resetting of loose bricks, and the repair of the stucco. Only those mortar joints which are open, missing, or eroded should be repointed. It is extremely rare for a building to require complete repointing. In severe cases only one-third to one-half of the joints will require repointing. When one discovers a masonry building which has been completely repointed, it is an indication of either the misunderstanding of the integrity of historic masonry or the inability of the mason to match the existing joint tooling details (*Illustrations 13, 14, 15 and 16*).

The specific details of the repair of porous masonry are described in the outline specifications. All repairs should be performed with nonmechanical hand tools (*Illustration 18*). In the preparation for repointing the joints must be raked out to a minimum depth equal to two and a half times the joint width. The masonry must be damp before repointing to prevent the bricks from absorbing the moisture from the pointing mortar. The pointing mortar must be installed in layers to ensure full

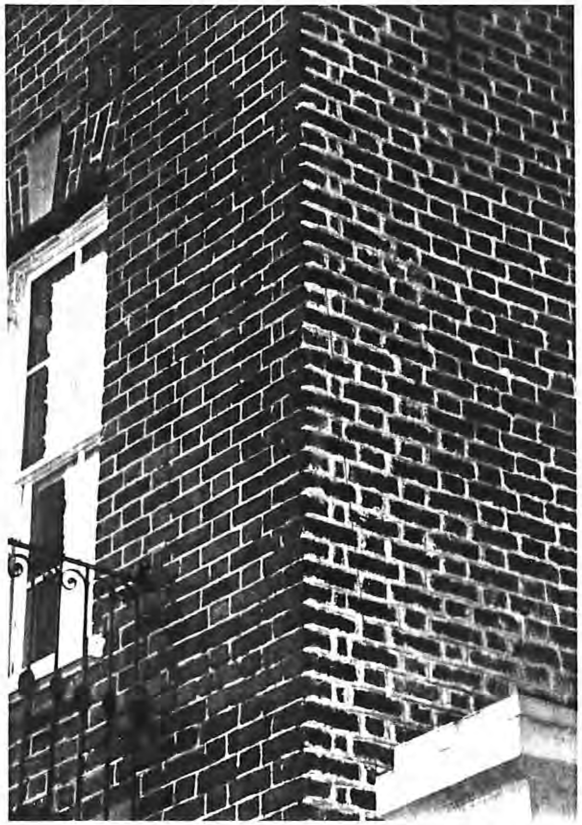
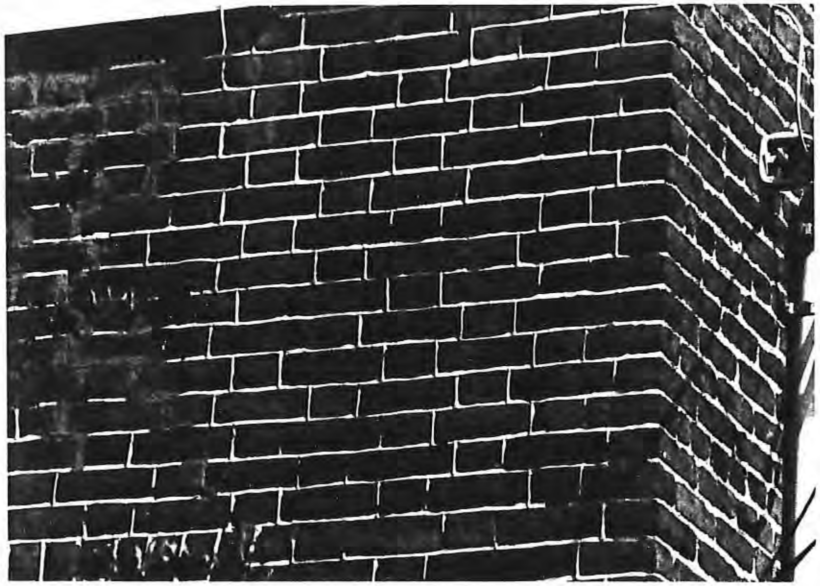
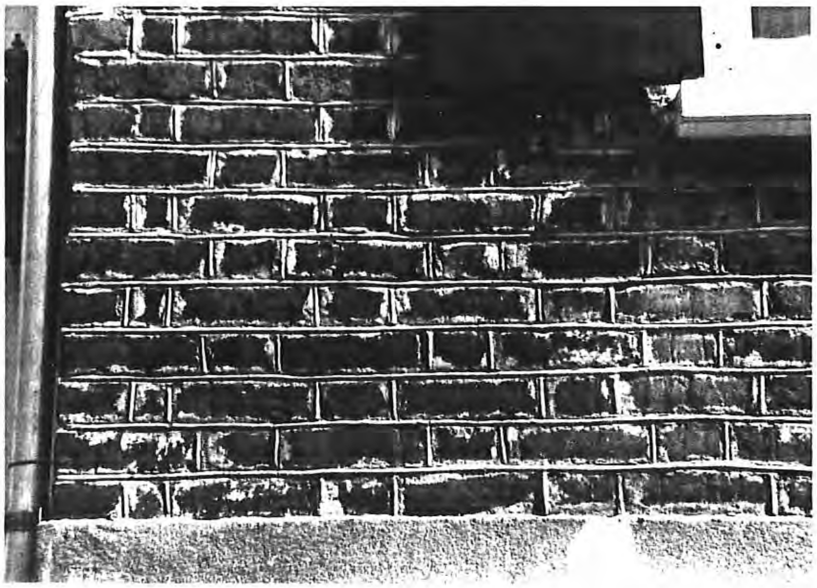


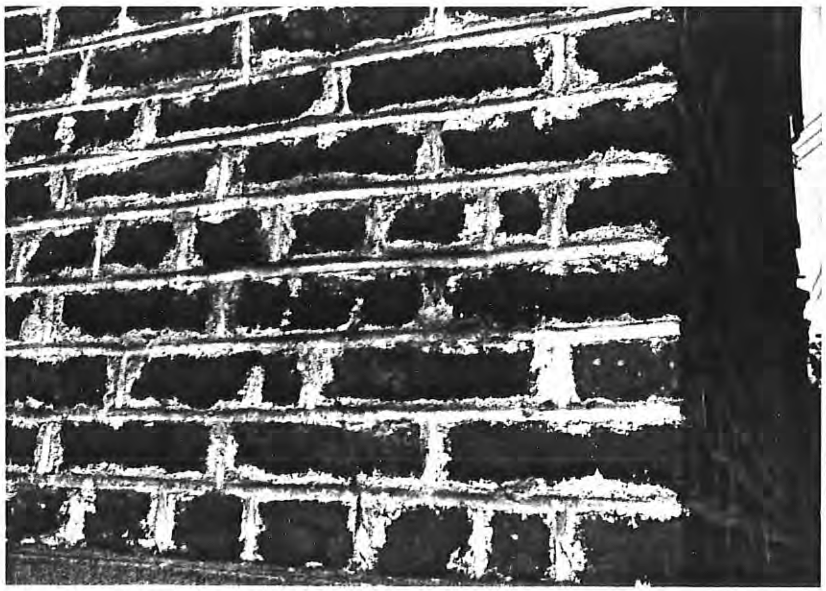
Illustration 13. Seemingly small changes in the size or tooling of the mortar joints can produce dramatic changes in the appearance of a structure. Here, the use of a modern joint tool for the repointing of the side elevation produced an unfortunate alteration to an otherwise exceptional exterior.

compaction and adhesion to the brick joint surfaces. The tooling of the mortar joints must be performed at the point where the mortar is sufficiently hard to receive the tooling but not so set that the tooling "burns" the mortar The most important portion of a repointing project following the proper placement of the mortar is the moisture curing of the mortar. The new



Illustrations 14, 15 and 16. These three examples of masonry are contemporary. They were constructed with the same details. The top example retains its original ribbon joint detailing. The two lower examples illustrate the effects of fully repointing with a grey portland cement mortar and modern masonry tools.





pointing must be kept damp and free from extremes of temperature until it has set.

The successful match of the new pointing to the original mortar is dependent upon the final tooling of the joints. None of the common modern mason's tools can produce the tight, dense, regular joints of the 'V', ribbon and tuck point profiles (*Illustrations 14, 15, 16 and 17*). This is especially true of the mason's pointing trowel. Tools should be fabricated or purchased from specialty supply firms. If the accurate reproduction of the joint details cannot be performed, then an alternate joint profile could be substituted. A square faced, compacted joint recessed approximately 1/4 inch from the brick surface will produce a weather resistant joint that will at least not increase the visual exposure of the mortar. This is not a preferred method, but one which can compensate for a lack of masonry skill and prevent the appearance of "smear" joints that are fairly common in the repair work in Charleston.

The repair of stucco is also detailed in the specifications. It is important to note that many examples of early stucco exist from which can be described the original appearance of this material (*Illustrations 19 and 20*). Stucco repairs should begin with the careful documentation of the scoring detailing and spacing. All repairs to backup masonry should be performed as described for brick and pointing repairs. The stucco should be repaired in layers, and carefully cut into the existing stucco. As with the mortar repairs, only damaged, exfoliated areas should be replaced.

There are many similarities between the repair of stucco and the repointing of masonry. The prewetting of the masonry is essential to prevent the extraction of moisture from the stucco. The time required between the application of

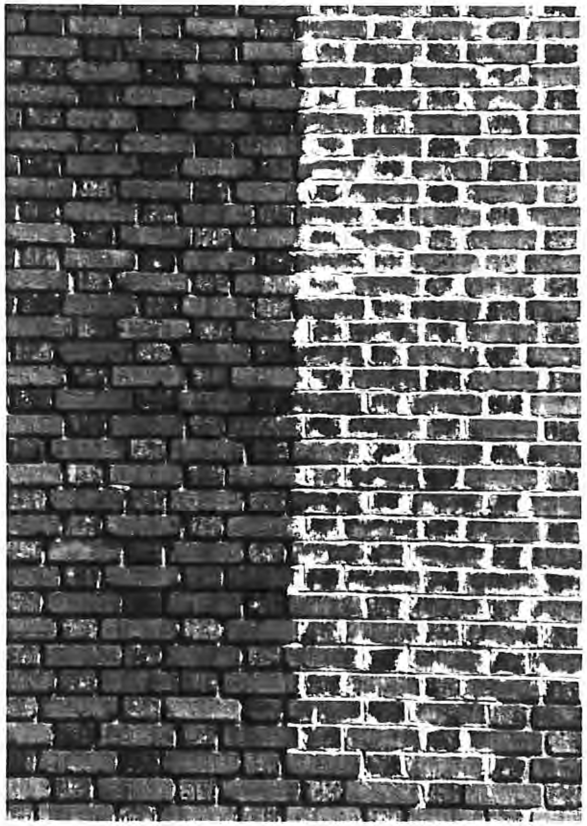


Illustration 17. This early twentieth century example of recessed mortar joints has deep shadow lines. The repointing to the right altered the original detailing by filling the joints. The alteration provides no additional weather resistance to the construction. The actual effect of the repair will likely be an increased need for maintenance of the repair area due to the shallow depth of the new pointing.

layers and the precautions and requirements for moisture curing the stucco are the same as for the repair of mortar. Pneumatic tools, sand or water blasting and grinders should never be used to remove deteriorated stucco (*Illustration 22*). Great care should be taken to prevent damage to the brick substrate. If tooled mortar joints are encountered in the repairs they should be retained beneath the new repair stucco (*Illustration 21*).

The cleaning of paint and soil from masonry surfaces will cause severe damage if the cleaning method removes or alters the surface of the bricks, mortars, or stucco. Commercial cleaners for removing soil and dirt generally contain an acid, such as hydrofluoric. The acid is quite effective in removing the dirt; indeed, nearly all of the commercial cleaners are effective in removing soiling and dirt. Because of the aggressive nature of these cleaners great care should be taken to follow all of the manufacturer's instructions. Acids such as hydrofluoric can etch brick surfaces, while the binders of the mortars are soluble in all acids. The cleaning process can

Illustration 18. All repointing joint preparations should be performed with hand tools. Here, a rotary disc saw was used to remove the old mortar. The saw cut into the brick edges, widening the joints and damaging the bricks above the vertical joints. Even after the use of the saw, hand tools are required to remove the mortar still attached to the brick surfaces.

Illustration 19. The gate house at the Manigault House demonstrates the durability of original lime stuccoes and lime repair stuccoes.

also result in other long-term problems, for one of the products of treating an alkaline material such as masonry with an acid is the formation of salts. The appropriate cleaners and methods will remove an acceptable amount of the dirt without affecting the masonry surface.

Because of the potential for damage one should always use the least aggressive cleaning product aspossible, beginning with concentrations below the manufacturer's given ratio. One should never use cleaners containing sulfuric acid or hydrochloric acid, especially muriatic acid. All prewashes, prewetting and after-washes, should be used as recommended by the manufacturer. Test panels should be in inconspicuous places and should not be used to test new products. Only cleaners that are known to be safe for use on porous masonry should be employed. Lastly, follow all precautions for each product. Acid cleaners are toxic and can product severe health hazards.

Illustration 20. Many examples of exposed, eighteenth century lime stucco can be found throughout Charleston. This example is the side elevation of a residence on East Battery.

The products for the removal of paint are of two types, either alkaline or solvent. The alkaline strippers are generally caustic soda (sodium hydroxide) or lye (potassium hydroxide). The alkaline materials are the fastest acting, least expensive cleaners, but they have the great disadvantage of requiring neutralization with an acid. This, as described above, will produce soluble salts that may affect the integrity of the masonry. The solvent strippers generally contain methylene chloride and are removed with a pressure wash, a procedure that, if the pressure is too great, can remove the outer face of the mortar joints. Of the two types of paint strippers, the solvent based group is preferred, for they are more controllable, and less likely to cause severe damage.

Many of the other modern practices of cleaning masonry should never be allowed on a historic structure. All abrasive blasts, either wet or dry, regardless of the pressure, are highly destructive (*Illustration 22*). High pressure steam and high pressure water can be equally damaging. Water pressures for washing should not exceed 100-400 psi at a rate of three to four gallons per minute, and only fan tip nozzles should be allowed. The use of mechanical grinders, metal scrappers, and metal brushes will damage the surface of the masonry. Generally, cleaning programs should begin with hand scrubbing using soft bristle brushes and mild detergents. Only after conservative methods have been tried should the more aggressive commercial products be used.

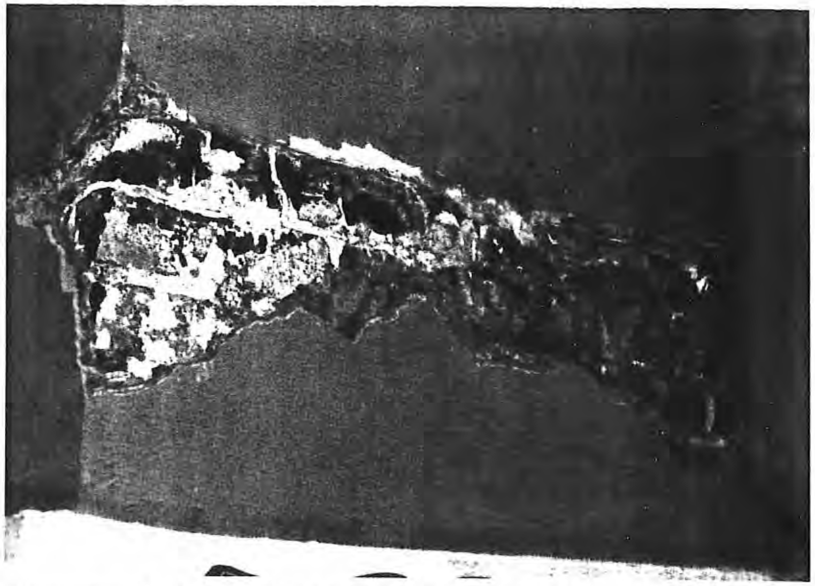


Illustration 21. Many of Charleston's stuccoed buildings were originally of exposed brickwork. When finely tooled mortar joints are found beneath existing stucco they should be carefully preserved beneath the repair stucco. Here, the original joints and brick faces have been severely damaged by the mason's chisel.

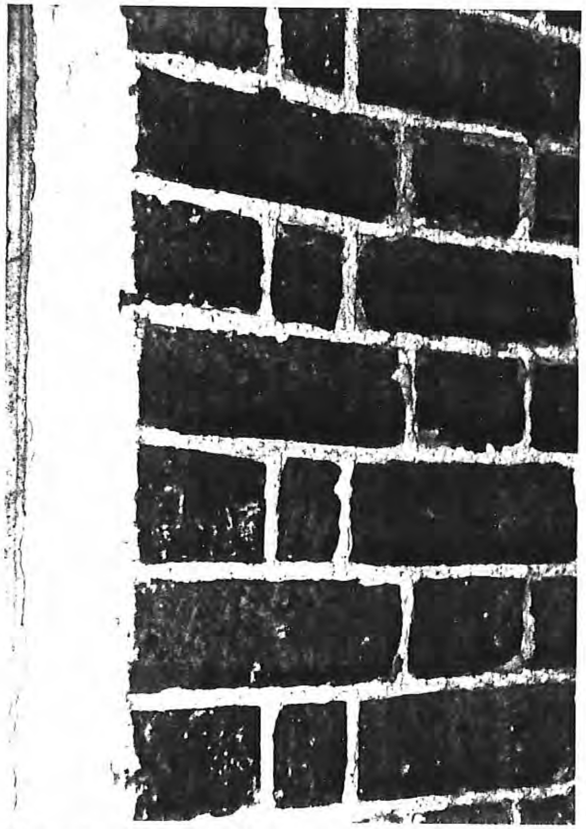


Illustration 22. This damage to the brick and mortar surfaces was produced by sandblasting. The damage is irreversible and will result in the accelerated deterioration of the masonry.

Precautions

The following precautions apply to all masonry repairs to historic buildings.

When removing deteriorated mortars and stuccoes, never use any process that causes the chipping of brick edges or the fracture of brick surfaces.

Never apply commercial sealers or water repellents to masonry surfaces.

In the cleaning of soiled or painted brick, never use abrasive blasts, either wet or dry, mechanical grinders, discs, scrapers or high pressure washes.

Never apply slurry coats of cement over stucco or masonry.

Never apply stucco over deteriorated stucco or eroded mortar joints. Perform all repairs to stucco and mortar joints to serve as a sound substrate for stucco coats or repointing.

Carpentry

Carpentry Repairs

The deterioration of exterior woodwork can be caused by organic or environmental processes. Organic causes include fungal and insect attack. Ultraviolet light and airborne pollutants can also produce the loss of the wood surfaces and coatings. The wood components of all structures require protection from the effects of high moisture, ultraviolet light and pollutants. Many of the deterioration processes that affect masonry construction also adversely affect wood buildings. Protection from deterioration is provided by the roof and water carry-off system, the protective coatings and the architectural details which separate wood from adverse conditions.

The correction of high moisture conditions must accompany or precede all carpentry repairs. All repair programs should begin with an inspection of the building's components to determine the causes of the deterioration. Failure to remedy the causes of the deterioration will cause the early failure of the repairs or new paint (*Illustrations 23 and 24*). Failure to adequately protect wood structures may lead to their loss (*Illustration 25*).

All wood construction requires adequate ventilation to control moisture content and to equalize the absorption and release of moisture on all surfaces. The critical moisture level for wood is 19%. Moisture content above this level allows the growth of fungi and molds. There should be a minimum separation of twelve inches between the soil and the lowest wood element of a structure. Damp crawl spaces and basements may produce enough water vapor to promote fungal growth on the underside of flooring and joists. Proper surface and perimeter drains and drains for the downspouts should be installed to direct the water away from the building.

Moisture levels that may not be a problem for masonry may produce deterioration of adjacent wood elements. In most cases the wood should be isolated from direct contact with the masonry. At masonry bearing pockets for joists and beams the bottom of the wood element should be separated from the masonry with copper flashing. The sides, top and ends of wood members should be separated from masonry by at least one inch. Metal ties that support beams should be inspected for rust and security. The condition of iron ties should be of concern for rust promotes deterioration of the wood. The ties are usually used to make the beams into tie tension members. In eighteen and nineteenth century construction it is common to find the masonry reinforced with a series of wood beams.

The approach to carpentry repair projects should be one of preservation and conservation. The repair instead of the replacement of deteriorated elements should be a condition of all repair programs of Charleston's historic structures. Deteriorated elements may be repaired by full replacement or by replacing the deteriorated area of the affected element. Carpentry repairs should generally use wood that is of the same species as the existing. Most wood used in the construction of Charleston's eighteenth and nineteenth century buildings was cypress. Southern yellow pine was used in the construction of some structures of the mid to late nineteenth century. All replacement wood should be straight grained, free of checks and twists and, if possible, kiln dried. Replacement wood for exterior millwork, clapboards and porch floor should be quarter sawn. The use of flat sawn wood for clapboards and flooring will cause cupping and warping of the boards.

When disassembling millwork nails should be cut with a saw or pulled through the back of the piece to prevent damage to the finished surfaces. All replacement wood should be primed on all surfaces, including ends, before installation to help equalize the moisture level in the new wood. Fasteners should be at least hot dipped galvanized. For siding and flooring cut nails should be used. These nails have a greater resistance to removal than wire nails and will resist the movements of the wood. Brass or stainless steel screws can be used for the installation of moldings or the resetting of moldings such as

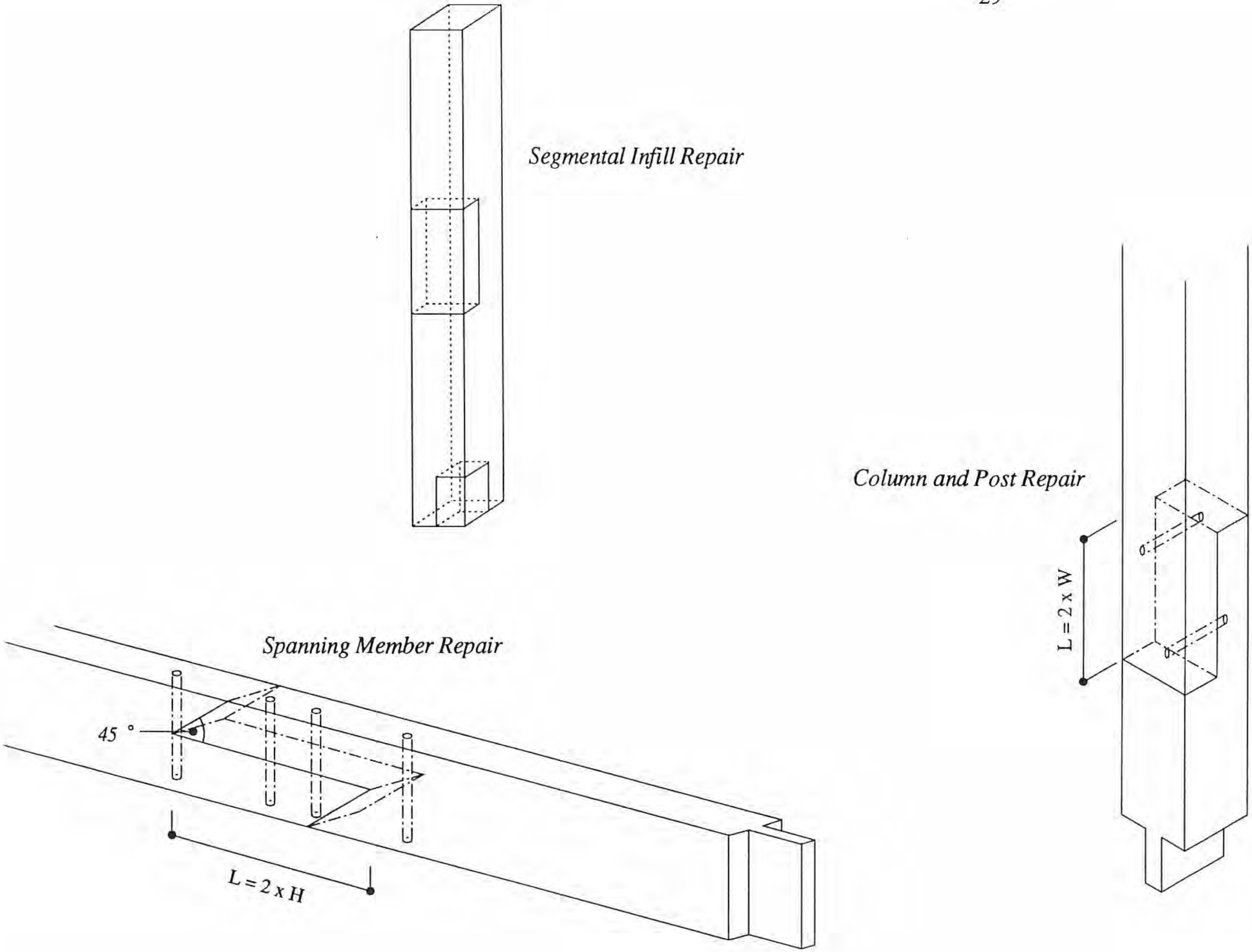
Illustration 23 and 24. The durability of wood construction and its protective coatings is dependent upon the maintenance of the roof, flashing and gutter systems. These leaking built in gutters are responsible for the deterioration of the wood and the failure of the paint.

window back bands.

Deteriorated areas of structural and decorative elements can be repaired by partial replacement of the wood or conservation of the deterioration. Epoxy adhesives, fillers and consolidants can be used to renew deteriorated elements and reduce the scope of full replacement. The deteriorated ends of columns, joists, beams, rafters, handrails, sills, etc., can be replaced with new sections that perform as well as the original areas. Deteriorated areas of moldings, doors, sash, balustrades, architraves, window sills, etc., can be consolidated or replaced with new wood. The epoxy repair techniques are quite useful for the repair of elements that are too valuable to replicate or whose disassembly is too involved.

The success of the epoxy materials is due to their compatibility to wood and their resistance to deterioration. Repairs made with epoxies are more resistent to deterioration than the original wood material. The details of segmental repairs using epoxies are shown in Drawing 3. The techniques of forming the epoxy joints are described in the outline specifications. The epoxy adhesives should be room temperature cure type, gap filling and non-shrinking. The epoxy fillers for repairing small deteriorated areas and checks should be pliable and easily finished with wood working tools. The epoxy consolidant should only be used to consolidate spongy or fairly porous areas of non-structural elements. The consolidant cannot be used to restore the structural integrity to deteriorated load bearing or spanning members. The epoxy consolidants are very useful in the repair of millwork and other decorative elements.

Illustration 25. The exposure of wood elements to weathering, as shown here, requires the installation of additional flashing details and the maintenance of the protective coatings. This example of roof trusses has now been removed due to accelerated deterioration.



Drawing 3. Epoxy repair details.

Painting

Some of the most severe deterioration of the wood elements of Charleston's historic buildings is produced by the abrasive techniques used in the removal of paint. As shown by Illustrations 26, 27, 28, 29, 30 and 31 the use of circular sanding discs and belt sanders can cause irreversible damage to all wood surfaces. The immediate damage results from the reshaping of curved and molded elements and the "scalloping" of smooth, flat surfaces. The alteration of the architectural elements of cornices, portals, columns, balustrades, doors, windows and clapboards should be of immediate concern to those interested in preserving the architectural significance of Charleston's historic buildings. Complete paint removal also removes the architectural evidence which the paint history documents. This includes the complete history of each building's construction, alteration and its appearance at each period. When the exterior paint is to be removed sample areas should be retained in protected areas.

The abrasive removal of paint from exterior wood is relatively quick, but in the long term, it has not proven to be the most successful removal technique. The continued failure of paint on structures that have been previously prepared in this manner attests to the problems the abrasive methods produce (*Illustration 31*). The wood exposed by the circular grinding discs is much more susceptible to moisture absorption. The wood fibers of the original smooth planed surface of the clapboards and fascia contained a minimum of exposed end grain. The rotation of the disc sander alters the orientation of the wood surface. The abrasive discs grind the long wood fibers by cutting across the grain of the wood. This exposes several times more end grain to weathering than the aligned wood grain of the smooth surface. This results in the early failure of the paint system due to the increased absorption of moisture.

Before beginning a painting project one should examine the areas of failed paint. One should be suspicious of peeling paint beneath cornices or adjacent to downspouts. This may be an indication of roof or carpentry problems. The surface

llustration 26. The use of disc sanders and other abrasive tools to remove paint account for the greatest loss of architectural details among Charleston's wooden structures.

condition of the existing paint should also be examined. A chalky or mildewed surface will require scrubbing to remove the loose or organic materials that would prevent bonding of the new paint. Surfaces that remain chalky after washing should be primed.

Sound, uncracked and unalligatored paint that is well bonded will serve as a good base for new paint. The least damaging and soundest means of preparing woodwork for repainting is hand preparation. Hand scraping to remove all loose and alligatored paint followed by edge sanding of the remaining paint, washing of all surfaces with a brush and detergent and priming of all exposed wood is the preferred method. The failure of most painting jobs can be directly linked to inadequate or incorrect surface preparations. The last caution in the preparation of the woodwork is in the use of caulk. Caulk should never be used as a substitute for carpentry repairs. Generally, the horizontal joint between clapboards should not be caulked. This reduces the ventilation within the stud space. Only vertical joints and joints between dissimilar materials, such as masonry and wood, should be caulked.

The choice of painting materials should be based on the composition of the existing paint. If the paint is oil, or alkyd, the new paint should also be oil. If the woodwork has been finished with acrylic paint then the new paint should also be acrylic. All paint coats should be produced by the same manufacturer. Mildewcides should be added to the primer and finish coats. The texture of the finish coats should be as glossy

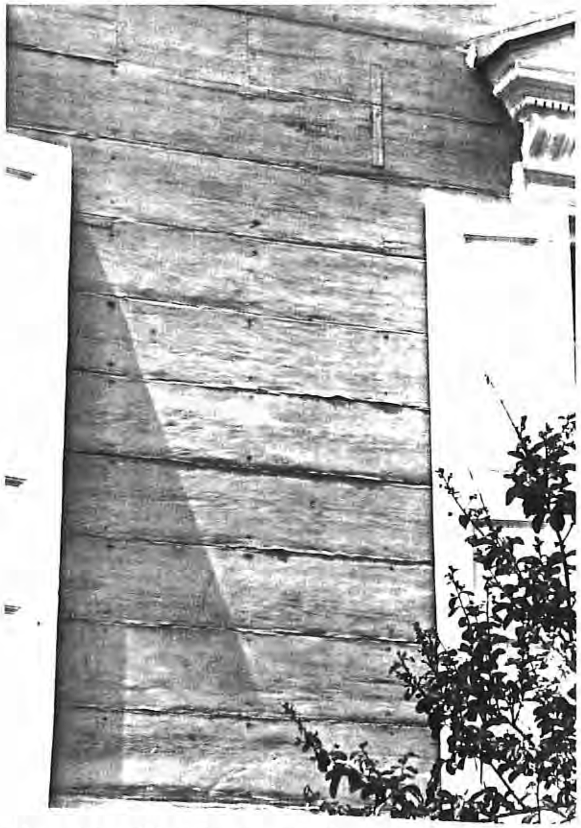
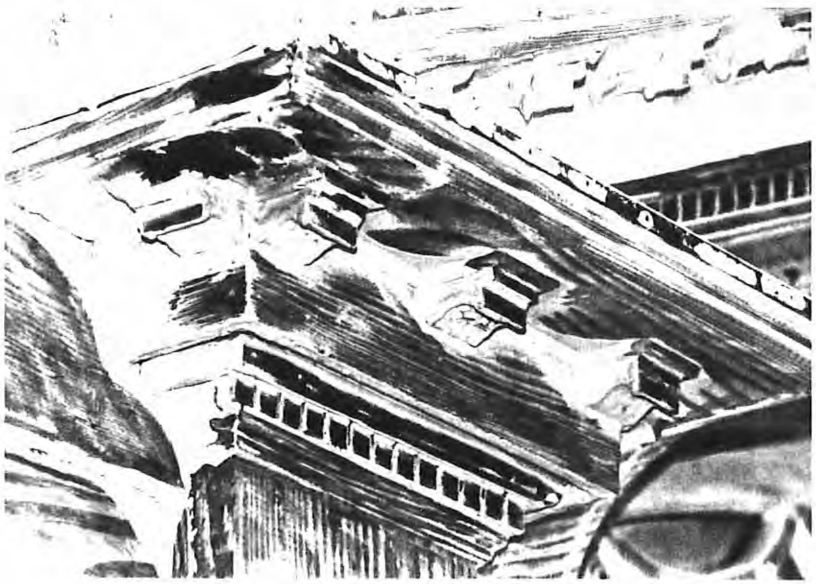


Illustration 27. The use of disc sanders on molded and curved surfaces replaces the radius of the features with a series of ground flats. On smooth elements such as fascia and clapboards the mechanical tools resurface the faces into a sequence of scalloped marks. The disc sanders are successful in removing the paint, but the resulting damage to the structure may prove to be expensive. Because the disc sander always sands across the wood grain the wood elements are more susceptible to moisture absorption and paint failure.

as possible. The matte, or flat, finish coats are more successful at hiding imperfections but the glossy coats shed water more quickly and tend to last longer. One should avoid the use of gelled paint coats. The thicker paints tend to act as a filler. Two thin, well brushed out finish coats are superior to one thick coat.

When paint does have to be removed one should choose the least aggressive and controllable methods. Do not use any material or technique which causes the loss or alteration of the wood surfaces or molding profiles. In addition to the abrasive sanders, this includes open flames and sand or water blasting. The alkaline paint strippers that are typically used to "dip" wood elements can produce even more damage than the sanders. The typical active ingredient in these baths is lye. The binders between the wood fibers are quite soluble in the alkaline solution. The stripper is difficult to neutralize, and if not sufficiently removed from the wood it will continue to strip the paint after the element's reinstallation (*Illustration 32*).

Acceptable methods of paint removal include low heat produced by heat guns and solvent based liquid paint strippers. The heat gun is very controllable and when used with scrappers that have been shaped to the profile of the moldings this method produces the least amount of damage to the wood surfaces



Illustrations 28 and 29. The fine moldings of this entry have been damaged by the disc sander. The cyma recta and cavetto profiles of the smaller moldings have been removed, leaving in their place a rounded, course line. The scalloped texture of the clapboards is typical of the damage produced by the rotary sanders on flat surfaces.

(*Illustration 33*). Electric heat plates can be used to remove paint if they are carefully monitored. The heat that these electric elements produce is very high. The paint, along with the woodwork, can burn very quickly. The charred areas will require removal by hand sanding. As with all paint removal techniques that produce heat fire protection should be provided during the course of the operation.

The most useful solvent paint removers contain methylene

Illustrations 30 and 31. More effects of disc sanding. The architectural moldings of this door have been reduced in thickness. The example at right has been disc sanded before each of the last two paintings. The preparation technique exposed the end grain of the surface wood, resulting in the increased absorption of moisture and the resulting failure of the paint system. The continued use of abrasive sanding on a structure will eventually require the replacement of the exterior siding and fascia.

chloride. These strippers are slower acting than the alkaline strippers but they do not damage the wood. Water based strippers that require a water rinse or water cleaning should be avoided. The use of large amounts of water will raise the grain of the wood and require additional sanding.

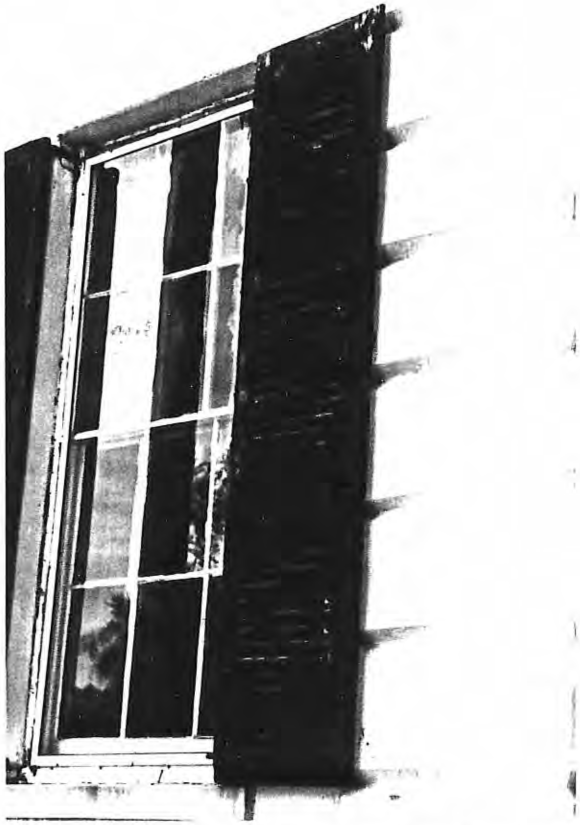


Illustration 32. Wood elements such as doors, sash, shutters and blinds should never be "dipped" in caustic baths. The most common bath solution is lye. This material is quite destructive to the wood fibers and is nearly impossible to remove or "neutralize". These blinds were dipped to remove the accumulated paint. The absorption of the caustic material into the wood is continuing to strip the paint from the surfaces.

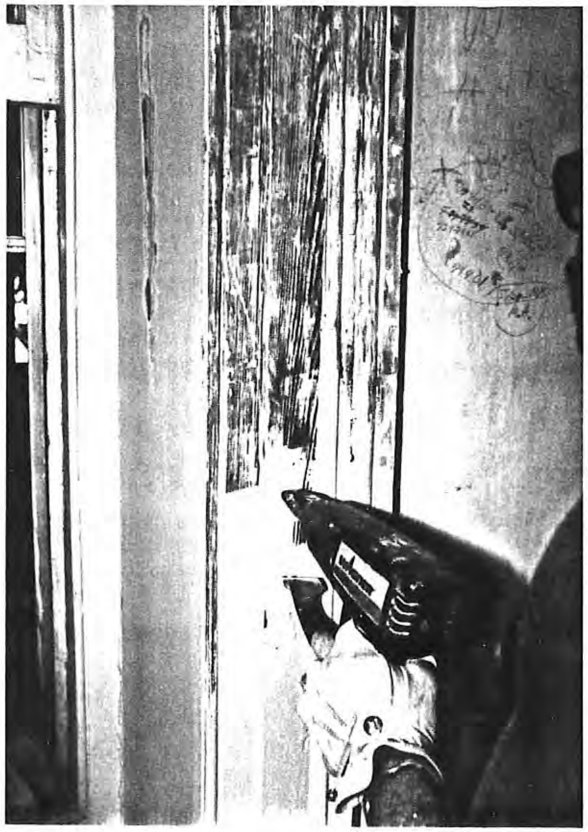


Illustration 33. Less destructive means of paint preparation are available. In areas which must be stripped heat guns can be used. This technique is most effective on molded elements that would be damaged by more aggressive methods.

OUTLINE SPECIFICATIONS
REPOINTING AND REPAIR OF BRICK MASONRY

I.General

1.1 Description of Work

(The details of this portion of the specifications are to be filled in for each specific project).

.1 Identify the types and quantity of masonry repairs.

.2 Identify other associated work that must be completed prior to the masonry repairs.

.3 Identify the type of joint tooling that will be required to match the original masonry. Note that the tooling may differ among the various elevations and elements of the structure. Note also the variations that often occur in the profiles and styles of the mortar joints, such as "V" joint tooling of the horizontal joints and ribbon joint tooling of the vertical joints.

.4 Identify the original types of bedding and pointing mortar. Note that as above the pointing mortars may vary in composition depending on their use and location.

.5 New pointing mortars shall match original in color, texture, porosity, and hardness. Conservation analysis of the existing mortars may be required to identify the original ingredients and their ratio. Allow time in the planning of the project to allow for this analysis.

.6 The scope of repointing shall be limited to just those joints that are open and fully deteriorated. Weathered but intact joints shall not be repointed. The evidences of the wear marks and general weathering of the masonry shall not be altered. It is not the intent of this work to fully "restore" the masonry, but to repair and renew just those details whose deterioration affects the integrity of adjacent elements.

1.2 Related Work

.1 All associated work shall be coordinated with the masonry repairs.

.2 All corrective work of the leaking water carry-off systems, flashing, deteriorated wood lintels, and associated mill work shall be performed, as is practical, before, or in association with the masonry repairs.

1.3 Qualifications

.1 All masonry repairs shall be performed by masons skilled, experienced, and specializing in the type of work specified.

.2 All work shall be supervised and directed by a skilled mason.

1.4 Testing

.1 During the course of the work the mason shall allow the sampling and testing of all masonry materials and mortars to ensure the compliance of the work with the specifications.

.2 Work not conforming to the specifications shall be removed and replaced with no additional cost to the owner.

1.5 Test Panel

.1 Test panels shall be used to demonstrate all tooling, removal techniques and mortar cleaning. Test panels on the historic building shall not be used to demonstrate the abilities of the workmen. This must be demonstrated by prior experience.

.2 For critical or exceptionally fine work it may not be practical to locate panels on the building. Separately constructed test panels my be required.

.3 Test panels on the building shall be located in inconspicuous areas.

.4 Approved test panels shall remain undisturbed and shall be used as a standard for acceptance or rejection of all work.

1.6 Product Samples

.1 Deliver to the owner all package labels and descriptions for each product or ingredient listed in the work.

.2 Submit samples of all special ware prior to their installation in the work.

1.7 Material Storage

.1 All materials are to be kept dry and protected from weather and contamination.

.2 All labels and seals must remain intact until use.

.3 Any material that has deteriorated or been contaminated shall be discarded.

1.8 Local Conditions

.1 All stored materials must be maintained above 40°F.

.2 No mortar shall be placed when the air temperature is 40°F or lower. No antifreeze additives shall be allowed.

.3 Placed work which reaches 32°F during the four days (96 hours) after placement shall be replaced.

.4 No mortar shall be placed when the wall temperature is above 80°F.

.5 All new work shall be protected from drying out for four days after placement.

.6 Protection from higher than 80°F temperatures and drying out shall be accomplished by the procedures outlined in 3.7.

II.Materials

2.1 Lime shall conform to ASTM C-206, Type S.

2.2 Cement shall conform to ASTM C-150 , white Portland cement, Type II. If not available, Type I may be used.

2.3 Sand.

.1 Sand shall conform to ASTM C-144 where standard well graded masonry aggregate is specified.

.2 Ungraded or course sand shall be as specified or described, free of salts and other deleterious material.

2.4 Crushed oyster shell shall be well washed, free of fines, salts, and other deleterious material, and of the following range of sizes:

Sieve #	% Passing Through
#4	100%
#16	0%

2.5 Pigments shall be inorganic pigments for masonry purposes.

2.6 Water shall be potable.

2.7 Bricks.

.1 New brick shall match existing work in color, texture, and all dimensions. Bricks shall be whole and uncut.

.2 Salvage brick matching the existing work in color, texture, and all dimensions may be used if it is hard burned face brick, free of deleterious salts and other materials, and was not previously used in a below water table or chimney stack location.

.3 New special ware bricks shall match the rubbed, gauged, or molded bricks of the water table, belt course, jack arches, cornice, etc., in all dimensions, molded profile, color, and texture.

III.Execution

3.1 Lime Putty.

.1 Lime putty shall be made from Type S hydrated lime by adding full bags of lime to water.

.2 Thoroughly mix into a thick cream consistency.

.3 Allow to stand a minimum of 24 hours before use.

.4 Carefully note wet lime equivalence to dry lime.

.5 Store in covered containers and protect from contamination or freezing.

3.2 Mortar Formulae.

.1 All proportions are given in dry volume.

.2 The equivalent lime putty shall be used for the dry lime volume in the mix.

.3 The exact ingredients for each mortar type shall be determined by the conservation analysis of each mortar.

.4 The range of mortars will generally fall among the following formulae:

Caution: The following ratios of mortar materials are provided to demonstrate the wide range of mortar formulae which occur in Charleston's historic buildings. The following information is not intended to be directly extrapolated for use in the repair of historic structures.

Brick Type	Type S Lime	White Portland Cement	Sand Aggregate	Oyster Shells	Brick Dust
Soft Salmon	2 1/2 - 3	0 - 1	6 1/2 - 9	0 - 2	1/4 - 1
Hand Made Face	2 1/2 - 4	0 - 1	7 - 12	0 - 1	1/4 - 3/4
Rubbed and Gauged	3 - 6	0 - 1	1 - 8 (Fine)	0 - 2	1/4 - 1 1/2
Machine Pressed	1 - 3	0 - 1	3 - 10	0 - 1	1/4 - 1
Extruded	1 - 3	0 - 2	3 - 12	0	1/4 - 1

.5 Formulae for natural cement mortars must be determined by conservation analysis.

3.3 Mortar Color Matching

.1 Match only the interior color of the original mortar. Do not match the color of the soiled, exposed surface of the mortar.

.2 Note that generally the strongest variable in the color of lime mortars is the color of the aggregate. It is preferable to vary the color of the aggregates to match the original color.

.3 The color of pigmented mortars should be matched with masonry pigments.

.4 Test for the accuracy of the reproduced mortar color by carefully measuring and mixing the specified mortar formula. Dry the mortar sample with heat. Break open the sample and compare the color to that of the original mortar. If the color of the sample is not accurate repeat the process of preparing a sample and vary the aggregates and pigments until the desired color is achieved.

.5 Mortar pigments shall not exceed 10% of the weight of the mortar mix. Note that all other materials are specified by volume.

3.4 Mortar Mixing

.1 All measurements of mortar ingredients shall be made with fixed volume units.

.2 No shovel measuring shall be accepted.

.3 Wood boxes equal in volume to each ingredient of the mix may be required if consistent exact mixes are not being produced.

.4 Mechanical batch mixers shall be used.

.5 Lime and aggregates shall be mixed for 5 minutes prior to addition of cement.

.6 After addition of cement batch shall be mixed for a total of 10 minutes.

.7 The amount of water added shall be carefully measured during batch mixing. The amount shall be determined by the plasticity of the mortar. If mortar clinging to the bottom of the mason's trowel is not released by a single slight shake, it is too stiff. If mortar will not cling to the bottom of the trowel, too much water has been added.

.8 Mortars containing any portion of cement must be placed in the work within two hours of its introduction into the mortar mix. Retempering of mortar shall be done with potable water in small amounts from a squeeze bottle or a clean bristle brush. After two hours all unused mortar shall be discarded.

.9 All mixing boards and mechanical mixers shall be thoroughly cleaned between batches.

3.5 Joint Preparation

.1 Only masonry joints that are open, loose, crumbled, or cracked shall be prepared for repointing.

.2 All sound, including weathered, joints shall remain.

.3 All joints to be repointed shall be raked out to a depth equal to 2 1/2 times the width of the joint.

.4 All raking and cutting out shall be performed with masonry chisels and hammers. Chisels shall not be wedge type, but shall easily fit between the bricks to the required depth without touching the brick edges or faces.

.5 No chipping or cutting of the existing brick units shall be allowed or accepted.

.6 No mechanical grinders, cutters, or discs shall be allowed in the work.

.7 All loose material shall be removed from the joints. Excessive water shall not be used, nor high pressure washing.

3.6 Repointing

.1 All precautions and requirements of Section 1.8 above shall be observed.

.2 All joints to be repointed shall be thoroughly wetted with a garden hose to prevent the extraction of the water in the mortar mix by the brick units. The interior of the structure and surrounding areas shall not be wetted.

.3 Pointing shall not begin until all standing water in the joints is absorbed into the masonry.

.4 Pointing tools shall be square faced, and shall be intended for masonry repointing.

.5 All pointing tools shall fit easily into the full depth of the joint without wedging between the bricks. Straight edged hawks shall be used to hold the mortar.

.6 Bring all backup bedding mortars up to a uniform depth equal to 2 1/2 times the width of the joint.

.7 Install pointing mortars in layers not to exceed 3/8" in depth, fully compacting each layer of mortar.

.8 Each successive layer of mortar shall not be installed until the previous mortar is thumbnail hard.

.9 Rewet joints as described above between installation of layers.

.10 Leave each layer of mortar square and smooth.

.11 Remove any loose excess mortar in joint before installing next mortar layer.

.12 Final tooling shall be done when mortar is thumbnail hard.

.13 Tooling for all wall areas shall match the profile of the adjacent original joints.

.14 Tooling for all rubbed, gauged, and molded bricks shall be flush.

.15 No mortar shall be allowed to extend onto the arris (rounded edge) of the brick. Contact of the mortar with the brick shall in all cases be recessed.

.16 Careful placement of pointing mortars should not result in incidental mortar staining of the brick faces.

.17 No mortar shall be allowed to dry on the brick faces.

.18 Mortar shall be removed with soft bristle brushes that have been wetted and dipped in clean sand. Brush across bricks to remove mortar. Care shall be taken, for excessive scrubbing will remove brick surface.

.19 No muriatic acid, after washes, or chemical cleaners shall be allowed. All mortar removal shall be performed at the time of its contact with the brick as described above.

.20 Wash down wall only after initial setting of the mortar, generally following the moisture curing time of the mortar.

3.7 Moisture Curing of Lime Mortar

.1 Provide sufficient moisture in the mortar to permit continuous hydration of the cementitious materials. The most effective procedure for curing shall be based on climatic and job conditions.

.2 Temperature and relative humidity extend or reduce the requirements for rewetting and protection of the mortar. Cold or wet weather lengthens and hot or dry weather shortens the time periods. Moderate changes in temperature and relative humidity can be overcome by providing additional heating materials during cool weather and by reducing the absorption of the masonry by pre-wetting during hot weather.

.3 Some moisture must be retained in or added back to freshly applied mortar. If the relative humidity is relatively high (above 75%) the frequency for re-wetting may be reduced. If it is hot, dry and windy, the frequency of re-wetting must be increased.

.4 The method of curing selected should consider the physical characteristics of the structure as well as the previously mentioned conditions. The methods can be one or a combination of the following.

.01 Moisture curing is accomplished by applying a fine fog spray of water as frequently as required, generally twice daily in the morning and evening. Care must be taken to avoid erosion damage to mortar surfaces.

.02 Plastic film, when taped or weighted down around the perimeter of the repair area, can provide a vapor barrier to retain the moisture between the membrane and masonry. Care must be exercised in placing the film; if too soon, the film may damage the surface texture; if too late, the moisture may have already escaped.

.03 Canvas, cloth, or sheet material barriers can be erected to deflect sunlight and wind, both of which will increase the rate of evaporation.

IV.Deteriorated and Loose Units

4.1Deteriorated Bricks

.1 All broken bricks shall be cut out, as well as the bedding mortars. Headers shall be removed to their full depth in backup masonry. No half-bricks shall be substituted for headers.

.2 Replacement bricks and surrounding masonry shall be thoroughly wetted to prevent the extraction of moisture from the mortar.

.3 Replacement bricks shall be laid in full head and bedding mortar, leaving no voids in the work.

.4 Mortars shall be raked out to the specified depth to allow the installation of the pointing mortar, as described in Sections I, II, and III above.

4.2 Loose Bricks

.1 All brick units which are loose, or become loose as a result of repointing or other repairs, shall be carefully removed from the work.

.2 Loose brick units are defined as any brick which exhibit any perceptible vertical or lateral movement when hand force is applied.

.3 Removal of loose brick shall not cause damage to the loose brick or surrounding brick or sound joints.

.4 Removal shall be by hand tools as described in Section 3.5 above.

.5 All mortar shall be removed from the wall cavity, as well as from the brick which is to be reinstalled.

.6 Replacement of brick shall be as described in Section 4.1 above.

4.3 Repair and Replacement of Molded, Rubbed, and Gauged Brick

.1 All loose rubbed, gauged bricks or molded bricks shall be carefully removed and cleaned of all mortar.

.2 Resetting shall follow the procedure described in 4.1.2 and 4.1.3.

.3 The thin bedding mortar shall be finished as the flush pointing mortar in one step.

.4 All loose or open joints in the rubbed, gauged bricks or molded bricks shall be carefully repointed.

.5 Individual molded bricks to be replaced shall be identified by the project architect or the owner.

.6 Weathered but intact molded bricks shall remain.

OUTLINE SPECIFICATIONS
STUCCO REPAIR

I.General

1.1 Refer to REPOINTING AND REPAIR OF BRICK MASONRY found in these specifications.

1.2 All precautions, qualifications, testing, conditions, work descriptions, material requirements, and directions apply equally to stucco repair.

1.3 Provide a sound substrate for stucco repairs by performing all brick and mortar repairs as directed by REPOINTING AND REPAIR OF BRICK MASONRY specifications.

1.4 Remove all hard stuccoes from masonry faces prior to beginning of masonry repairs.

II.Materials

2.1 All material descriptions and requirements are defined in REPOINTING AND REPAIR OF BRICK MASONRY, Section II.2.1 through 2.6. and Section III.3.1.

III.Execution

3.1 Stucco Formula

.1 Exact ingredients and proportions for each stucco type should be determined by the conservation analysis of samples of the original stucco.

.2 All formulae shall be given in volume proportions.

.3 Stucco formulae for the repair of lime stuccoes from the eighteenth century and early nineteenth century will generally fall within the following mix of materials:

	Type S Lime	White Portland Cement	Sand Aggregate	Brick Dust
Scratch coat	3 - 3 1/2	0 - 1/2	9 - 12	1/4 - 1
Brown coat	3 - 4	0 - 1	9 - 14	1/2 - 1 1/2
Finish coat	3 - 4	0 - 1	9 - 14	1/2 - 1 1/2

.4 Formulae for natural cement stuccoes must be determined by conservation analysis.

3.2 Stucco Color Matching

.1 Stucco color matches shall be by the same method and description as found in REPOINTING AND REPAIR OF BRICK MASONRY, Section III.3.3. The terms mortar and stucco shall be interchangeable.

3.3 Mixing

.1 Stucco mixing shall be performed as described in REPOINTING AND REPAIR OF BRICK MASONRY, Section III.3.4. The terms mortar and stucco shall be interchangeable.

3.4 Preparation

.1 All loose, exfoliated, eroded and unkeyed stucco shall be carefully removed down to brick substrate.

.2 All stucco residue shall be removed from brick surfaces using wood scrapers.

.3 Care shall be taken to prevent scoring, chipping, or breaking surface of brick.

.4 All unsound mortar joints shall be repointed; all broken and deteriorated brick shall be replaced; and all loose brick shall be relayed, all as specified in REPOINTING AND REPAIR OF BRICK MASONRY.

.5 Remove stucco to sound, well keyed surrounding stucco.

.6 Undercut edges of remaining stucco at a 45° angle.

.7 Do not leave edges of remaining stucco jagged; cut in straight lines as is practical.

.8 For critical, exposed work cut stucco along the existing score lines.

.9 To increase keying of stucco to substrate mortar joints may be raked back by hand to a depth equal to 1/2 the width of the joint. This is not to be performed if mortar joints are finished with a tooled weather joint. The presence of tooled joints is evidence that the brickwork was originally exposed and was later stuccoed. This evidence shall not be altered.

3.5 Application of Stucco

.1 The stucco is to be installed in three coats.

.2 All surfaces to be stuccoed shall be free of loose material, dust, and residue from old stucco.

.3 Masonry to be stuccoed shall be well wetted with a garden hose prior to stucco first coat application to prevent the absorption of water from stucco.

.4 No bonding agents shall be allowed in the mixes or on surfaces.

.5 Apply stucco scratch coat, applying sufficient pressure to completely fill irregularities of substrate.

.6 Sharply abut the undercut edge of existing stucco. Do not allow scratch coat to increase in thickness at the undercut edge.

.7 Cut the surface of scratch coat in diagonal, crossing strokes to provide keying for next coat.

.8 Allow scratch coat to set to thumb print hardness before applying next coat.

.9 Remoisten surface of stucco coat as described in 3.5.3.

.10 Apply brown coat of stucco, trowelled smooth and level.

.11 Sharply abut the edge of existing stucco. Do not bring flush with existing stucco surface.

.12 Apply finish stucco coat when brown coat is thumb print hard.

.13 Remoisten stucco surface as described in 3.5.3.

.14 Surface of finish coat shall match the texture of the existing finish coat. Most lime stuccoes were finished with a smooth steel trowel.

.15 Do not overwork the finish coat.

.16 Do not extend stucco finish coat onto surface of existing stucco. Feathered edges in new work shall not be accepted.

.17 Score stucco surface to match the geometry of the original scoring when finish coat is thumbnail hard.

.18 Use a straight edge guide for all scoring, held in place by a second workman.

.19 Scoring shall match original in depth, profile, pattern and texture.

.20 Remove excess stucco from scored edges. Do not change the texture of the stucco surface in doing so.

.21 Provide protection during curing for four full days as described in REPOINTING AND REPAIR OF BRICK MASONRY, Section III.3.7.

3.6 Repair of Cracks in Stucco

.1 All of Sections I -III above apply.

.2 Remove stucco along crack to a minimum width of 3 inches.

.3 Leave existing stucco edges undercut at 45° angle.

.4 Perform all mortar and brick repairs as described above.

.5 Install three coats of stucco as described above.

CARPENTRY REPAIRS

I.General

1.1Description of Work

.1 Carpentry repairs shall be performed on all deteriorated wood elements, defined as either being structural elements or architectural millwork.

.2 Repair to structural elements shall involve repair of existing elements and replication and installation of replacement elements.

.3 Repairs to architectural millwork shall involve resetting of millwork, repair of existing millwork, and replication and installation of replacement millwork.

1.2 Related Work

.1 Coordinate and perform the repair of all surrounding and adjacent masonry.

.2 All corrective work involving the water carry-off system and surface drainage shall be performed before or coordinated with the carpentry repairs.

1.3 Precautions

.1 Great care shall be taken in the disassembly of architectural millwork and structural elements to prevent damage to these elements and to insure that they can be reinstalled in the work.

.2 In the performance of the work, note and report to the owner all discoveries of hidden deterioration or sources of deterioration.

1.4 Qualifications

.1 All tradesmen performing the work shall be skilled and experienced in each type of work specified.

1.5 Product Samples

.1 Supply three-foot lengths of millwork wood species that demonstrate the general quality of replacement finish wood.

.2 Supply owner with treatment plans, written description of preserving treatment standard, and retention.

.3 Supply owner with manufacturer's labels and product description for all adhesives, fillers, consolidants, coatings and pain used in the work.

1.6 Material Storage

.1 All wood elements removed from the work that are to be reinstalled shall be stored in a secure, dry , and protected area.

.2 All replacement millwork shall be delivered to the site as it is required for installation in the work. Long-term storage at the site shall be avoided.

.3 All products shall be delivered in original unopened containers, protected from freezing, and stored in a protective area to prevent contamination.

1.7 Local Conditions

.1 Painting shall not be performed below 50° F.

.2 Epoxy products shall not be sued below 50° F.

.3 The warm weather temperature for epoxy use shall be as specified by the manufacturer.

.4 All repair areas and newly installed wood elements shall be protected from rain and weather and until areas are closed and finish paint coats are applied.

II.Materials

2.1 Structural Wood

.1 Wood for structural repairs shall be of dense heart cypress or hear yellow pine; free of excessive knots, checks and twists; kiln dried to 19 percent moisture content or less; and when used as a spanning member, shall generally be graded Structural Select.

.2 Note that in exposed positions structural replacement material may also be required to match the species and appearance of existing wood elements.

2.2 Preservative Treated Wood

.1 Where lumber or wood is required to be treated, comply with the requirements of the American Wood Preservers Bureau.

.2 Wood in contact with concrete, masonry, or steel shall comply with AWPB LP-2, kiln-dry to 19 percent or less.

.3 Wood in contact with epoxy adhesives in on-site repairs which require treatment shall be flushed with a non-oil type wood preservative, such as Osmose.

2.3 Architectural Millwork

.1 All wood for millwork shall be straight grained, free of checks, knots, splits, twists, cupping, and warps.

.2 Wood species shall match the original, or be heart wood of dense cypress, redwood, juniper, or dense yellow pine.

.3 Generally all clapboards, flooring, and fascias shall be special cut quarter sawn or radically sawn material.

2.4 Fasteners

.1 All structural repair fasteners, including nuts, washers, bolts and ties, shall be protected from rusting by using a minimum of hot dip galvanized.

.2 All screws shall be of brass or stainless steel and of sufficient length of penetrate backing material a minimum of one inch.

.3 All nails for exterior millwork shall be a minimum of hot dip galvanized. No wire finish nails or electroplated nails shall be allowed.

.4 All nails for siding, clapboard, decking or other elements where twisting is a problem shall be installed with cut nails having sufficient head sizes to prevent their being pulled through. Cut nails shall be hot dipped galvanized, such as produced by the Tremont Nail company, PO Box 111, Wareham, MA 02571. 617-295-0038.

.5 Structural repair nailing shall be made with ring shank nails or better, as produced by Swan Secure Products, Inc., 1701 Parkman Avenue, Baltimore, MD 21280, 301-646-2800, or equal.

2.5 Epoxy Resins

.1 Epoxy adhesives shall be equal to Wood Epox by Abatron, Inc., 141 Center Drive, Gilberts, IL 60136, 312/426-2200, or E-152, by Allied Resin, Weymouth Industrial Park, East Weymouth, Mass. 02189, 617/337-6070.

.2 Epoxy filler shall be equal to Wood Epox by Abatron.

.3 Epoxy consolidant shall be equal to LiquidWood by Abatron. Other epoxy consolidants must meet the criteria of a final hardness approximately equal to the fiber strength of the wood and a minimum pot life of one hour.

III.Execution of Structural Repairs

3.1 Disassemble all associated elements as required.

3.2 Remove architectural millwork by cutting through shaft of nail fasteners. Do not pull nails through; this will damage millwork. Use hacksaw blades mounted in handles intended for that purpose.

3.3 Repairs by Full Replacement

.1 Replace deteriorated element in kind as specified.

.2 At masonry bearing points, separate wood from masonry by installing 16 oz. copper flashing beneath wood.

.3 At masonry pockets, ensure wood is not in contact with masonry. Provide for free air flow at top, sides, and end of wood element.

.4 At structural bearing points which must resist lateral movement, such as at portico tie beam locations, ensure that the mechanical fasteners are secure, well attached to the wood member and capable of resisting the lateral forces.

.5 Reassemble connecting elements.

.6 All structural attachments shall be made in the same manner as originally detailed. In exposed positions, existing connection details shall be replicated.

3.4 Repairs Made By Segmental Infill

.1 All structural repairs shall be made in strict accordance with local codes and shall meet or exceed structural requirements for each structural element.

.2 Only elements which have deteriorated through fungal or insect attack shall be repaired by partial replacement.

.3 Elements whose integrity has been compromised by crushing of the wood fiber or shearing shall be considered to be structurally inadequate. These latter conditions may require upgrading of the element or structural system. This work is not covered within these outline specifications.

.4 Replacement wood shall be of the same species and similar grain, free of knots and checks.

.5 Partial replacement in isolated areas, such as beneath bearing points of studs and posts, shall be repaired by the following method:

.01 Sharply cut away all deteriorated wood plus a minimum of one inch of sound wood.

.02 Leave faces of cut-out area square and parallel.

.03 Cut replacement block to fit snugly but not tight, with not more than an 1/8" cut gap at all meeting surfaces.

.04 Ensure that moisture content of both member to be repaired and replacement wood have moisture contents in the range of 8-14 percent.

.05 Mix epoxy according to manufacturer's instructions and precautions. Note that once Part A and Part B of epoxies are combined the chemical process by which setting occurs cannot be stopped. Therefore, mix only sufficient epoxy to repair areas that have been prepared.

.06 Fully coat all mating surfaces of wood member and repair block.

.07 Place block into cut-out area, ensuring that all coated faces are in full contact, with no voids or gaps. Tap block into place and clamp for 48 hours.

.08 Remove excess adhesive from glue line.

.09 Ensure that new area is not disturbed during setting period.

.010 In exposed areas neatly tool adhesive at glue line being careful to scrape it from adjacent surfaces.

.6 Replacement of sections of wood elements such as end bearing points of beams, tenon joint ends or deteriorated mid-sections of spanning members, shall be repaired by the following method:

.01 All procedures for removing deteriorated wood and installing new wood described above in 3.4 apply except for the forming of the connector joint.

.02 Replacement sections shall replicate the original area in dimensions and the connection details with associated elements.

.03 Joints shall be cut in the horizontal plane, parallel to the span.

.04 Joints shall be lap type, and shall extend a minimum distance equal to twice the member's longest sectional dimension.

.05 The lap ends shall meet at a 45° angle.

.06 Bolts with nuts and washers shall be used to secure the joint after assembly with epoxy adhesive.

.07 Predrill all holes and check fit of joints.

.08 Bolt locations shall be at either end of joint beyond cut-out area and two equally spaced locations along joint length.

IV.Execution of Architectural Millwork Repairs

4.1 Millwork shall be repaired by repair of existing elements or replacement in-kind.

4.2 Repair of Existing Millwork

.1 Secure all loose moldings and other millwork by removing built-up caulk, paint, and debris from behind element. Secure with nails as specified. Properly sized screws may be used if guide holes are predrilled and the screw is countersunk and plugged.

.2 All cuts in vertical elements such as corner verticals, architrave backbands, etc., shall be made at a 45° angle sloping down and to the exposed surface. Mating surfaces shall be oil primed before assembly.

.3 Siding Repairs

.01 Replace all split or deteriorated siding.

.02 Joints of replacement siding shall meet at center line of nailers.

.03 Prime all surfaces, including the joints, before installation.

.04 Never install a vapor barrier, loose or batt insulation or solid sheathing across stud faces or within the stud spaces. Do not interfere with the free flow of air within the stud spaces.

.05 Lap joints of the siding shall not be caulked. Caulking shall be allowed only at the vertical joints.

.06 Where practical place siding butt joints beneath the drips of window sills or other protected areas.

.07 Butt joints shall be staggered with a minimum of three courses of siding between aligned joints.

.4 Segmental and Infill Repair of Architectural Millwork

.01 The use of epoxy adhesives in performing wood repairs, as described in 3.4 above, may also be used in the repair of architectural millwork.

.02 In the same manner, deteriorated areas of column shafts, capitals and bases, handrails, balusters, doors, sash, window and door sills, brackets, etc., can all be repaired with epoxy joints as described.

.03 The exposure to view of millwork requires additional attention to the clean cutting of joints and the finishing of the glue lines.

.04 Epoxy adhesives shall not be allowed to cure on adjacent surfaces.

.05 In repairing molded or curved surfaces such as column fluting and sill nosing, larger wood blocks can be used and molded in place after the setting of the epoxy. This assures a match in profile between the old and new lines.

.06 Generally the repair of nonstructural millwork with epoxies does not require the use of fasteners. Clamp and allow to set for 48 hours.

.07 Small checks, deteriorated areas, or missing features can be filled or formed with the epoxy adhesive. Wood shaping and cutting tools should be employed.

.5 Consolidation of Deteriorated Wood

.01 Epoxy consolidants designed for the purpose shall be used to consolidate spongy and moderately deteriorated wood.

.02 Consolidation shall be used to bind weakened wood fibers of wood elements. Consolidants shall not be used as void fillers. See 4.2.4 above.

.03 Areas to be consolidated must be dry, with a moisture content of 8-14 percent.

.04 If above 14 percent moisture content, protect from moisture and apply low radiant heat or heat from a heat gun. Caution must be exercised to ensure that wood is not charred and that all hazard of fire is avoided.

.05 Consolidation occurs principally through absorption through the end grain of the wood. Drill 1/4" or smaller holes in wood of treated area across the grain of the wood. Space holes a maximum of 2" apart in all directions.

.06 The hole size should be reduced for highly decorative or valuble elements. Teh epoxy can be introduced through the unexposed surfaces of the element, such as the back.

.07 Mix epoxy consolidant according to manufacturer's instructions, precautions, and environment requirements.

.08 Install consolidant in spongy wood and in drilled holes using applicator supplied by manufacturer or plastic squeeze bottles with small diameter nozzles.

.09 Do not overfill holes.

.010 If consolidant runs from lower drilled holes, checks, or openings, fill these with modeling clay.

.011 Consolidation process will require two to five applications of consolidant.

.012 Allow consolidant to set between applications, generally equal to its stated pot life.

.013 Observe exothermic reaction of epoxy, for this results in the production of heat.

.014 Do not reuse applicator bottles from previous application. Allow epoxy to set and remove as a solid.

.015 Do not allow epoxy to cure on adjacent surfaces.

.016 After consolidation is complete, fill any open access drill holes or checks with epoxy adhesive/filler as described in 4.2.4.07 above.

4.3 Replacement Millwork.

.1 All repair elements and replacement elements shall match the original in all dimensions, molded profiles and joinery detailing of connections.

.2 Replacement wood shall be select, free of knots, checks, twists, and warps, and shall be of the same species as original or of dense cypress, redwood, juniper, or dense pine.

.3 No applied beaded or molded edges shall be accepted. All mold edge details shall be molded onto the larger element.

.4 Larger elements such as door and window sills, handrails, posts, columns, and turnings that cannot be produced from single wood sections as was original shall be made from glued smaller sections. Glue shall be waterproof epoxy as detailed in 2.5.1. Weather or water resistant glues shall not be accepted. Wood grain of joined sections shall be similar. All wood species shall be the same.

.5 Glue lines shall not occur in weather faces wherever possible.

.6 Molded profiles shall be taken from unweathered elements that have had all paint carefully removed. See specifications for repaint removal in PAINTING.

.7 If possible, deliver to the millwork supplier prepared sections or elements of original millwork.

.8 Samples of each millwork profile and assembly shall be submitted to the owner for approval prior to running of moldings.

.9 All assemblies such as doors, sash, blinds, brackets, balustrades, etc., shall be fully primed before assembly on all surfaces including mortises, tenons, and all ends, with oil primer. The exception to this is where such priming would interfere with the action of adhesive.

.10 All field cuts and assemblies shall be fully primed with oil primer before installation. This applies to all butt and miter joints.

PAINTING

I.General

1.1 Description of Work

.1 Only alligatored, peeling, and blistered areas of paint shall be removed down to wood substrate.

.2 Sound, well attached areas of paint shall not be removed.

1.2 Related Work

.1 All carpentry repairs and water carry-off system repairs shall be completed before commencement of painting.

1.3 Qualifications

.1 Only experienced tradesmen, skilled in the specific surface preparation techniques specified, shall be employed on the project.

.2 All work shall be supervised and directed by a skilled painter.

1.4 Product Samples

.1 Clean, fully legible labels from all products used on the project shall be delivered to the owner.

1.5 Material Storage

.1 All materials are to be delivered to the site in original, new and unopened containers bearing the manufacturer's name and label, analysis and application instructions.

.2 All materials not in use shall be in tightly covered containers, and stored at temperatures as recommended by the manufacturer.

1.6 Local Conditions

.1 Paint shall not be applied in rainy weather, or in temperatures below 50° F.

.2 Paint shall not be applied in full sunlight in temperatures above 80° F.

II.Materials

2.1 All paints shall be the best line as manufactured by known national companies, containing the highest percentage of binders for exterior paints.

2.2 All primers shall be oil with mildewcide added.

2.3 Primers for weathered wood shall be oil, cut with 1 quart of mineral spirits per each gallon primer.

2.4 Finish Coats

.1 Finish coats over existing acrylic or latex finish coats shall be acrylic with mildewcide added.

.2 Finish coats over existing oil finish coats shall be oil or alkyd with mildewcide added.

2.5 All paints shall be provided by the same manufacturer.

III.Color Matching

3.1 All color matching of finish paints shall be performed by experienced tradesmen.

3.2 Additional pigment required to match selected colors shall not exceed the Critical Pigment Volume Concentration as specified by the manufacturer.

3.3 Examples of custom colors to be matched shall be provided by the owner.

3.4 Matched colors shall be applied to oil primed 12-inch square masonite boards, well cured, and submitted to the owner for approval.

3.5 Only approved colors shall be delivered to the project site.

IV.Surface Preparation

4.1 All surfaces to be painted shall be tightly bonded to existing paint or sound wood.

4.2 Hand scrape all loose, chipping or peeling areas of paint to remove same. Scrapers shall have rounded corners.

4.3 Hand sand all sharp edges of paint to feather into new work.

4.4 Remove all soil, dust, organic materials, and mildew from all surfaces to be painted.

4.5 To remove mildew scrub affected areas with the following solution using bristle brushes:

3 quarts water

1 pint liquid bleach

2/3 cup Trisodium Phosphate (TSP)

1/2 cup detergent

4.6 Thoroughly rinse to remove all residue. Failure to remove TSP from surfaces may result in the reoccurrance of the mildew.

4.7 To remove chalky surfaces scrub affected areas with a solution of 1/4 cup detergent per gallon of water, thoroughly rinsed afterwards.

V.Paint Removal Techniques Not To Be Allowed

5.1 Any process or technique which causes or produces the loss or alteration of wood surfaces, molding profiles or wood textures.

5.2 The excluded techniques include:

.1 All rotary disc sanding.

.2 Belt sanding which fully penetrates paint layers and exposes wood surfaces.

.3 All open flame burning techniques.

.4 All alkaline solutions which come in contact with wood.

.5 Radiant heat sources, such as heat plates, which cause charring of wood surfaces.

.6 All abrasive blasts, either wet or dry, exclusive of aggregate, grit employed or pressures.

.7 All high pressure washes, high pressure being defined as pressures at the washer tip higher than 400 psi.

.8 Alkaline dipping solutions.

.9 Water-based strippers which require a water rinse and solvent cleanup.

VI.Acceptable Paint Removal Techniques

6.1 Solvent Base or Methylene Chloride Liquid Strippers

.1 Follow all manufacturer's instructions for worker protection, site protection, control of residue, application procedures and cleanup.

.2 Remove softened paint layers with scrapers and shavehooks that closely fit the profile of all molded surfaces. All scrapers shall have rounded corners to prevent gouging and scoring of the wood surface.

.3 Fully remove stripping residue from all wood surfaces and all wood joints. Hand sand as required.

.4 Deposit all stripping residue into containers that can be sealed.

.5 Dispose of contained residue according to local guidelines and restrictions.

6.2 Heat Guns

.1 Soften paint layers with heat from commercial electric heat gun at temperatures below 750° F.

.2 Provide protection of electrical circuits and supplies.

.3 Remove softened paint with scrapers as described in 6.1.2.

.4 Contain and dispose of paint residue as described in 6.1.4 and 6.1.5.

.5 Protect all window glass from extremes of heat.

.6 Hand sand as required to produce smooth surface.

6.3 Enclosed Flame Radiant Heat Paint Stripper

.1 Propane radiant stripper may be used if the criteria of no burning or charring of the wood can be met.

.2 The operator shall observe the effect of the heating of the paint to prevent the scorching of the wood.

.3 Scraping, residue containment and surface cleanup shall be as described in 6.1.2 through 6.1.5.

VII. Application

7.1 All prepared exposed wood shall receive one coat of oil primer fully brushed out.

7.2 All chalky surfaces which have been thoroughly washed but which remain chalky shall be primed with oil primer.

7.3 All open vertical wood joints shall be caulked with acrylic or polysulphide caulk.

7.4 Mix all paints according to manufacturer's instructions.

7.5 Observe all surface moisture level requirements.

7.6 Apply two finish coats, well brushed out, being careful not to fill architectural moldings and details with paint.

7.7 Allow 24 hours of drying time between coats.

7.8 Paint edges adjoining other materials or colors shall be sharp and clean, without overlapping.

VIII. Cleanup

8.1 All residue, spills and overlaps shall be carefully removed from adjacent materials and work.

8.2 All surplus and leftover materials shall be removed.

8.3 The contractor shall clean up and dispose of all project debris created by the work, and leave the premises in good condition, acceptable to the owner.

*The activity that is the subject of this publication has been funded in part with federal funds from the National Park Service, United States Department of the Interior, and administered by the South Carolina Department of Archives and History. The contents and opinions do not necessarily reflect the views of the Department of the Interior, nor does the mention of trade marks or commercial products constitute endorsement or recommendation by the Department of the Interior.