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Preservation Briefs provide guidance on **preserving, rehabilitating, and restoring** historic buildings. These NPS Publications help historic building owners recognize and resolve common problems prior to work. The briefs are especially useful to **Historic Preservation Tax Incentives Program** applicants because they recommend methods and approaches for rehabilitating historic buildings that are consistent with their historic character.

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PRESERVATION BRIEFS

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Repointing Mortar Joints in Historic Masonry Buildings

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

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Soft mortar for repointing. Photo: John P. Speweik.

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

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

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

Historical Background

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

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

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

Identifying the Problem Before Repointing

The decision to repoint is most often related to some obvious sign of deterioration, such as disintegrating mortar, cracks in mortar joints, loose bricks or stones, damp walls, or damaged plasterwork. It is, however, erroneous to assume that repointing alone will solve deficiencies that result from other problems. The root cause of the deterioration—leaking roofs or gutters, differential settlement of the building, capillary action causing rising damp, or extreme weather exposure—should always be dealt with prior to beginning work.

Without appropriate repairs to eliminate the source of the problem, mortar deterioration will continue and any repointing will have been a waste of time and money.

Use of Consultants

Because there are so many possible causes for deterioration in historic buildings, it may be desirable to retain a consultant, such as a historic architect or architectural conservator, to analyze the building. In addition to determining the

most appropriate solutions to the problems, a consultant can prepare specifications which reflect the particular requirements of each job and can provide oversight of the work in progress. Referrals to preservation consultants frequently can be obtained from State Historic Preservation Offices, the American Institute for Conservation of Historic and Artistic Works (AIC), the Association for Preservation Technology (APT), and local chapters of the American Institute of Architects (AIA).

Finding an Appropriate Mortar Match

Preliminary research is necessary to ensure that the proposed repointing work is both physically and visually appropriate to the building. Analysis of unweathered portions of the historic mortar to which the new mortar will be matched can suggest appropriate mixes for the repointing mortar so that it will not damage the building because it is excessively strong or vapor impermeable.

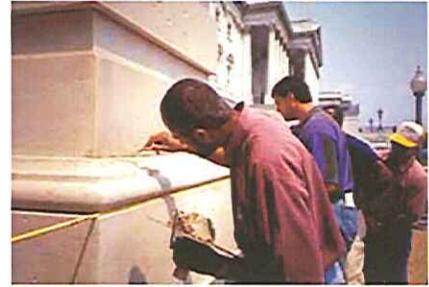
Examination and analysis of the masonry units—brick, stone or terra cotta—and the techniques used in the original construction will assist in maintaining the building's historic appearance. A simple, non-technical, evaluation of the masonry units and mortar can provide information concerning the relative strength and permeability of each—critical factors in selecting the repointing mortar—while a visual analysis of the historic mortar can provide the information necessary for developing the new mortar mix and application techniques.

Although not crucial to a successful repointing project, for projects involving properties of special historic significance, a mortar analysis by a qualified laboratory can be useful by providing information on the original ingredients. However, there are limitations with such an analysis, and replacement mortar specifications should not be based solely on laboratory analysis. Analysis requires interpretation, and there are important factors which affect the condition and performance of the mortar that cannot be established through laboratory analysis. These may include: the original water content, rate of curing, weather conditions during original construction, the method of mixing and placing the mortar, and the cleanliness and condition of the sand. *The most useful information that can come out of laboratory analysis is the identification of sand by gradation and color.* This allows the color and the texture of the mortar to be matched with some accuracy because sand is the largest ingredient by volume.

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

- The new mortar must match the historic mortar in **color, texture and tooling**. (If a laboratory analysis is undertaken, it may be possible to match the binder components and their proportions with the historic mortar, if those materials are available.)
- The **sand must match the sand** in the historic mortar. (The color and texture of the new mortar will usually fall into place if the sand is matched successfully.)
- The new mortar must have **greater vapor permeability** and be **softer** (measured in compressive strength) than the masonry units.
- The new mortar must be **as vapor permeable** and **as soft or softer** (measured in compressive strength) than the historic mortar. (Softness or hardness is not necessarily an indication of permeability; old, hard lime mortars can still retain high permeability.)

Mortar Analysis



Masons practice using lime putty mortar to repair historic marble. Photo: NPS files.



This late 19th century granite has recently been repointed with the joint profile and mortar color carefully matched to the original. Photo: NPS files.

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



This mortar is the proper consistency for repointing historic brick.
Photo: John P. Speweik.

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

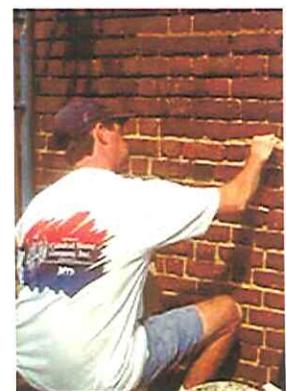
The drawback of most mortar analysis methods is that mortar samples of known composition have not been analyzed in order to evaluate the method. Historic mortars were not prepared to narrowly defined specifications from materials of uniform quality; they contain a wide array of locally derived materials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

Properties of Mortar

Mortars for repointing should be softer or more permeable than the masonry units and no harder or more impermeable than the historic mortar to prevent damage to the masonry units. It is a common error to assume that hardness or high strength is a measure of appropriateness, particularly for lime-based historic mortars. Stresses within a wall caused by expansion, contraction, moisture migration, or settlement must be accommodated in some manner; in a masonry wall, these stresses should be relieved by the mortar rather than by the masonry units. A mortar that is stronger in compressive strength than the masonry units will not "give," thus causing stresses to be relieved through the masonry units—resulting in permanent damage to the masonry, such as cracking and spalling, that cannot be repaired easily.

While stresses can also break the bond between the mortar and the masonry units, permitting water to penetrate the resulting hairline cracks, this is easier to correct in the joint through repointing than if the break occurs in the masonry units.

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



moisture vapor to migrate out of the wall and evaporate, the result will be damage to the masonry units.

This early 19th century building is being repointed with lime mortar. Photo: Travis McDonald.

Components of Mortar

Sand

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

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

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

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

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

Lime

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

Lime, itself, when mixed with water into a paste is very plastic and creamy. It will remain workable and soft indefinitely, if stored in a sealed container. Lime (calcium hydroxide) hardens by carbonation absorbing carbon dioxide primarily from the air, converting itself to calcium carbonate. Once a lime and sand mortar is mixed and placed in a wall, it begins the process of carbonation. If lime mortar is left to dry too rapidly, carbonation of the mortar will be reduced, resulting in poor adhesion and poor durability. In addition, lime mortar is slightly water soluble and thus is able to re-seal any hairline cracks that may develop during the life of the mortar. Lime mortar is soft, porous, and changes little in volume during temperature fluctuations thus making it a good choice for historic



buildings. *Because of these qualities, high calcium lime mortar may be considered for many repointing projects, not just those involving historic buildings.*

Caulking was inappropriately used here in place of mortar on the top of the wall. As a result, it has not been durable. Photo: NPS files.

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

Lime Putty

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

Portland Cement

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

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

Masonry Cement

Masonry cement is a preblended mortar mix commonly found at hardware and home repair stores. It is designed to produce mortars with a compressive strength of 750 psi or higher when mixed with sand and water at the job site. It may contain hydrated lime, but it always contains a large amount of portland cement, as well as ground limestone and other workability agents, including air-entraining agents. Because masonry cements are not required to contain hydrated lime, and generally do not contain lime, they produce high strength mortars that can damage historic masonry. *For this reason, they generally are not recommended for use on historic masonry buildings.*

Lime Mortar (pre-blended)

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

Water

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

Other Components

Historic components

In addition to the color of the sand, the texture of the mortar is of critical importance in duplicating historic mortar. Most mortars dating from the mid-19th century on—with some exceptions—have a fairly homogeneous texture and color. Some earlier mortars are not as uniformly textured and may contain lumps of partially burned lime or "dirty lime", shell (which

often provided a source of lime, particularly in coastal areas), natural cements, pieces of clay, lampblack or other pigments, even animal hair. The visual characteristics of these mortars can be duplicated through the use of similar materials in the repointing mortar.

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

Pigments

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

Modern Components

Admixtures are used to create specific characteristics in mortar, and whether they should be used will depend upon the individual project. *Air entraining agents*, for example, help the mortar to resist freeze-thaw damage in northern climates. *Accelerators* are used to reduce mortar freezing prior to setting while *retarders* help to extend the mortar life in hot climates. Selection of admixtures should be made by the architect or architectural conservator as part of the specifications, not something routinely added by the masons.

Generally, modern chemical additives are unnecessary and may, in fact, have detrimental effects in historic masonry projects. The use of antifreeze compounds is not recommended. They are not very effective with high lime mortars and may introduce salts, which may cause efflorescence later. A better practice is to warm the sand and water, and to protect the completed work from freezing. No definitive study has determined whether air-entraining additives should be used to resist frost action and enhance plasticity, but in areas of extreme exposure requiring high-strength mortars with lower permeability, air-entrainment of 10-16 percent may be desirable (see formula for "severe weather exposure" in Mortar Type and Mix). Bonding agents are not a substitute for proper joint preparation, and they should generally be avoided. If the joint is properly prepared, there will be a good bond between the new mortar and the adjacent surfaces. In addition, a bonding agent is difficult to remove if smeared on a masonry surface.

Mortar Type and Mix

Mortars for repointing projects, especially those involving historic buildings, typically are custom mixed in order to ensure the proper physical and visual qualities. These materials can be combined in varying proportions to create a mortar with the desired performance and durability. The actual specification of a particular mortar type should take into consideration all of the factors affecting the life of the building including: current site conditions, present condition of the masonry, function of the new mortar, degree of weather exposure, and skill of the mason.



Here, a hammer and chisel are being correctly used to prepare a joint for

Thus, no two repointing projects are exactly the same. Modern materials specified for use in repointing mortar should conform to specifications of the American Society for Testing and Materials (ASTM) or comparable federal specifications, and the resulting mortar should conform to ASTM C 270, Mortar for Unit Masonry.

Specifying the proportions for the repointing mortar for a specific job is not as difficult as it might seem. Five mortar types, each with a corresponding recommended mix, have been established by ASTM to distinguish high strength mortar from soft flexible mortars. The ASTM designated them in decreasing order of approximate general strength as Type M (2,500 psi), Type S (1,800 psi), Type N (750 psi), Type O (350 psi) and Type K (75 psi). (The letters identifying the types are from the words MASON WORK using every other letter.) Type K has the highest lime content of the mixes that contain portland cement, although it is seldom used today, except for some historic preservation projects. The designation "L" in the accompanying chart identifies a straight lime and sand mix.

repointing. Photo: John P. Speweik.

Specifying the appropriate ASTM mortar by proportion of ingredients, will ensure the desired physical properties. Unless specified otherwise, measurements or proportions for mortar mixes are always given in the following order: cement-lime-sand. Thus, a Type K mix, for example, would be referred to as 1-3-10, or 1 part cement to 3 parts lime to 10 parts sand. Other requirements to create the desired visual qualities should be included in the specifications.

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

Budgeting and Scheduling

Repointing is both expensive and time consuming due to the extent of handwork and special materials required. It is preferable to repoint only those areas that require work rather than an entire wall, as is often specified. But, if 25 to 50 per cent or more of a wall needs to be repointed, repointing the entire wall may be more cost effective than spot repointing.

Total repointing may also be more sensible when access is difficult, requiring the erection of expensive scaffolding (unless the majority of the mortar is sound and unlikely to require replacement in the foreseeable future). Each project requires judgement based on a variety of factors. Recognizing this at the outset will help to prevent many jobs from becoming prohibitively expensive.

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

The relationship of repointing to other work proposed on the building must also be recognized. For example, if paint removal or cleaning is anticipated, and if the mortar joints are basically sound and need only selective repointing, it is generally better to postpone repointing until after completion of these activities. However, if the mortar has eroded badly, allowing moisture to penetrate deeply into the wall, repointing should be accomplished before cleaning. Related work, such as structural or roof repairs, should be scheduled so that they do not interfere with repointing and so that all work can take maximum advantage of erected scaffolding.

Building managers also must recognize the difficulties that a repointing project can create. The process is time consuming, and scaffolding may need to remain in place for an extended period of time. The joint preparation process can be quite noisy and can generate large quantities of dust which must be controlled, especially at air intakes to protect human health, and also where it might damage operating machinery. Entrances may be blocked from time to time making access difficult for both building tenants and visitors. Clearly, building managers will need to coordinate the repointing work with other events at the site.

Contractor Selection

The ideal way to select a contractor is to ask knowledgeable owners of recently repointed historic buildings for recommendations. Qualified contractors then can provide lists of other repointing projects for inspection. More commonly, however, the contractor for a repointing project is selected through a competitive bidding process over which the client or consultant has only



When repairing this stone wall, the mason matched the raised profile of the original tuckpointing. Photo: NPS files.



A mechanical grinder improperly used to cut out the horizontal joint and incompatible repointing have seriously damaged

the 19th century brick.
Photo: NPS files.

limited control. In this situation it is important to ensure that the specifications stipulate that masons must have a minimum of five years' experience with repointing historic masonry buildings to be eligible to bid on the project. Contracts are awarded to the lowest responsible bidder, and bidders who have performed poorly on other projects usually can be eliminated from consideration on this basis, even if they have the lowest prices.

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

Execution of the Work

Test Panels

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



Unskilled repointing has negatively impacted the character of this late-19th century building.
Photo: NPS files.

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

Joint Preparation

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

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

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

However, small pneumatically-powered chisels generally can be used safely and effectively to remove mortar on historic buildings as long as the masons maintain appropriate control over the equipment. Under certain circumstances, thin diamond-bladed grinders may be used to cut out *horizontal* joints only on hard portland cement mortar common to most early-20th century masonry buildings. Usually, automatic tools most successfully remove old mortar without damaging the masonry units when they are used in combination with hand tools in preparation for repointing. Where horizontal joints are uniform and fairly wide, it may be possible to use a power masonry saw to assist the removal of mortar, such as by cutting along the middle of the joint; final mortar removal from the sides of the joints still should be done with a hand chisel and hammer. Caulking cutters with diamond blades can sometimes be used successfully to cut out joints without damaging the masonry. Caulking cutters are slow; they do not rotate, but vibrate at very high speeds, thus minimizing the possibility of damage to masonry units. Although mechanical tools may be safely used in limited circumstances to cut out horizontal joints in preparation for repointing, they should never be used on vertical joints because of the danger of slipping and

cutting into the brick above or below the vertical joint. Using power tools to remove mortar without damaging the surrounding masonry units also necessitates highly skilled masons experienced in working on historic masonry buildings. Contractors should demonstrate proficiency with power tools before their use is approved.

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

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

Mortar Preparation

Mortar components should be measured and mixed carefully to assure the uniformity of visual and physical characteristics. Dry ingredients are measured by volume and thoroughly mixed before the addition of any water. Sand must be added in a damp, loose condition to avoid over sanding. Repointing mortar is typically pre-hydrated by adding water so it will just hold together, thus allowing it to stand for a period of time before the final water is added. Half the water should be added, followed by mixing for approximately 5 minutes. The remaining water should then be added in small portions until a mortar of the desired consistency is reached. The total volume of water necessary may vary from batch to batch, depending on weather conditions. It is important to keep the water to a minimum for two reasons: first, a drier mortar is cleaner to work with, and it can be compacted tightly into the joints; second, with no excess water to evaporate, the mortar cures without shrinkage cracks. Mortar should be used within approximately 30 minutes of final mixing, and "retempering," or adding more water, should not be permitted.

Using Lime Putty to Make Mortar

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

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

If portland cement is specified in a lime putty and sand mortar—Type O (1:2:9) or Type K (1:3:11)—the portland cement should first be mixed into a slurry paste before adding it to the lime putty and sand. Not only will this ensure that the portland cement is evenly distributed throughout the mixture, but if dry portland cement is added to wet ingredients it tends to "ball up," jeopardizing dispersion. (Usually water must be added to the lime putty and sand anyway once the portland cement is introduced.) Any color pigments should be added at this stage and mixed for a full five minutes. The mortar should be used within 30 minutes to 12 hours and it should not be retempered. Once portland cement has been added the mortar can no longer be stored.

Filling the Joint

Where existing mortar has been removed to a depth of greater than 1 inch, these deeper areas should be filled first, compacting the new mortar in several layers. The back of the entire joint should be filled successively by applying approximately 1/4 inch of mortar, packing it well into the back corners. This application may extend along the wall for several feet. As soon as the mortar has reached thumb-print hardness, another 1/4 inch layer of mortar—approximately the same thickness—may be applied. Several layers will be needed to fill the joint flush with the outer surface of the masonry. It is important to allow each layer time to harden before the next layer is applied; most of the mortar shrinkage occurs during the hardening process and layering thus minimizes overall shrinkage.

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

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

Curing Conditions

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

Aging the Mortar

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

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



This 18th century pediment and surrounding wall exhibit distinctively different mortar joints. Photo: NPS files.

Cleaning the Repointed Masonry

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

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

Several precautions should be taken if a freshly repointed masonry wall is to be cleaned. First, the mortar should be fully hardened before cleaning. Thirty days is usually sufficient, depending on weather and exposure; as mentioned previously, the mortar will continue to cure even after it has hardened. Test panels should be prepared to evaluate the effects of different cleaning methods. Generally, on newly repointed masonry walls, only very low pressure (100 psi) water washing supplemented by stiff natural bristle or nylon brushes should be used, except on glazed or polished surfaces, where only soft cloths should be used.**

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

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

***Additional information on masonry cleaning is presented in Preservation Briefs 1: Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings, Robert C. Mack, FAIA, and Anne E. Grimmer, Washington, D.C.: Technical Preservation Services, National Park Service, U.S. Department of the Interior, 2000; and Keeping it Clean: Removing Exterior Dirt, Paint, Stains & Graffiti from Historic Masonry Buildings, Anne E. Grimmer, Washington, D.C.: Technical Preservation Services, National Park Service, U.S. Department of the Interior, 1988.*

Visually Examining the Mortar and the Masonry Units

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

Mortar samples should be chosen carefully, and picked from a variety of locations on the building to find unweathered mortar, if possible. Portions of the building may have been repointed in the past while other areas may be subject to conditions causing unusual deterioration. There may be several colors of mortar dating from different construction periods or sand used from different sources during the initial construction. Any of these situations can give false readings to the

visual or physical characteristics required for the new mortar. Variations should be noted which may require developing more than one mix.

1. Remove with a chisel and hammer three or four unweathered samples of the mortar to be matched from several locations on the building. (Set the largest sample aside--this will be used later for comparison with the repointing mortar). Removing a full representation of samples will allow selection of a "mean" or average mortar sample.
2. Mash the remaining samples with a wooden mallet, or hammer if necessary, until they are separated into their constituent parts. There should be a good handful of the material.
3. Examine the powdered portion—the lime and/or cement matrix of the mortar. Most particularly, note the color. There is a tendency to think of historic mortars as having white binders, but grey portland cement was available by the last quarter of the 19th century, and traditional limes were also sometimes grey. Thus, in some instances, the natural color of the historic binder may be grey, rather than white. The mortar may also have been tinted to create a colored mortar, and this color should be identified at this point.
4. Carefully blow away the powdery material (the lime and/or cement matrix which bound the mortar together).
5. With a low power (10 power) magnifying glass, examine the remaining sand and other materials such as lumps of lime or shell.
6. Note and record the wide range of color as well as the varying sizes of the individual grains of sand, impurities, or other materials.

Other Factors to Consider

Color

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

Pointing Style

Close examination of the historic masonry wall and the techniques used in the original construction will assist in maintaining the visual qualities of the building. Pointing styles and the methods of producing them should be examined. It is important to look at both the horizontal and the vertical joints to determine the order in which they were tooled and whether they were the same style. Some late-19th and early-20th century buildings, for example, have horizontal joints that were raked back while the vertical joints were finished flush and stained to match the bricks, thus creating the illusion of horizontal bands. Pointing styles may also differ from one facade to another; front walls often received greater attention to mortar detailing than side and rear walls. **Tuckpointing** is not true repointing but the application of a raised joint or lime putty joint on top of flush mortar joints. **Penciling** is a purely decorative, painted surface treatment over a mortar joint, often in a contrasting color.

Masonry Units

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

Matching Color and Texture of the Repointing Mortar

New mortar should match the unweathered interior portions of the historic mortar. The simplest way to check the match is to make a small sample of the proposed mix and allow it to cure at a temperature of approximately 70 degrees F for about

a week, or it can be baked in an oven to speed up the curing; this sample is then broken open and the surface is compared with the surface of the largest "saved" sample of historic mortar.

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

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

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

Mortar Types (Measured by volume)

Designation	Cement	Hydrated Lime or Lime Putty	Sand
M	1	1/4	3 - 3 3/4
S	1	1/2	4-4 1/2
N	1	1	5-6
O	1	2	8-9
K	1	3	10-12
"L"	0	1	2 1/4-3

Suggested Mortar Types for Different Exposures

Masonry Material	Exposure		
	Sheltered	Moderate	Severe
Very durable: granite, hard-cored brick, etc.	O	N	S
Moderately durable: limestone, durable stone, molded brick	K	O	N
Minimally durable: soft hand-made brick	"L"	K	O

Summary and References

For the Owner/Administrator

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

For the Architect/Consultant

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

For the Masons

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

Conclusion

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

Useful Addresses

Brick Institute of America

1490 Commerce Park Drive
Reston, VA 22091

National Lime Association

200 N. Glebe Road, Suite 800
Arlington, VA 22203

Portland Cement Association

5420 Old Orchard Road
Skokie, IL 60077

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October 1998

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PRESERVATION BRIEFS

9 The Repair of Historic Wooden Windows

John H. Myers

[Architectural or Historical Significance](#)

[Physical Evaluation](#)

[Repair Class I: Routine Maintenance](#)

[Repair Class II: Stabilization](#)

[Repair Class III: Splices and Parts Replacement](#)

[Weatherization](#)

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Historic six-over-six windows--preserved. Photo: NPS files.

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

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

Architectural or Historical Significance

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

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

After all of the factors have been evaluated, **windows should be considered significant to a building if they:**

1. are original,
2. reflect the original design intent for the building,
3. reflect period or regional styles or building practices,
4. reflect changes to the building resulting from major periods or events, or
5. are examples of exceptional craftsmanship or design.

Once this evaluation of significance has been completed, it is possible to proceed with planning appropriate treatments, beginning with an investigation of the physical condition of the windows.

Physical Evaluation

The key to successful planning for window treatments is a careful evaluation of existing physical conditions on a unit-by-unit basis. A graphic or photographic system may be devised to record existing conditions and illustrate the scope of any necessary repairs. Another effective tool is a window schedule which lists all of the parts of each window unit. Spaces by each part allow notes on existing conditions and repair instructions. When such a schedule is completed, it indicates the precise tasks to be performed in the repair of each unit and becomes a part of the specifications. **In any evaluation, one should note at a minimum:**

1. window location
2. condition of the paint
3. condition of the frame and sill
4. condition of the sash (rails, stiles and muntins)
5. glazing problems
6. hardware, and



Windows are frequently important visual focal points, especially on simple facades such as this mill building. Replacement of the multi-pane windows with larger panes could dramatically alter the appearance of the building. Photo: NPS files.

7. the overall condition of the window (excellent, fair, poor, and so forth)

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

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

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

An ice pick or an awl may be used to test wood for soundness. The technique is simply to jab the pick into a wetted wood surface at an angle and pry up a small section of the wood. Sound wood will separate in long fibrous splinters, but decayed wood will lift up in short irregular pieces due to the breakdown of fiber strength.

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

Following the inspection and analysis of the results, the scope of the necessary repairs will be evident and a plan for the rehabilitation can be formulated. **Generally the actions necessary to return a window to "like new" condition will fall into three broad categories:**

1. **routine maintenance procedures,**
2. **structural stabilization, and**
3. **parts replacement.**

These categories will be discussed in the following sections and will be referred to respectively as **Repair Class I, Repair Class II,** and **Repair Class III.** Each successive repair class represents an increasing level of difficulty, expense, and work



Deterioration of poorly maintained windows usually begins on horizontal surfaces and at joints, where water can collect and saturate the wood. Photo: NPS files.

time. Note that most of the points mentioned in Repair Class I are routine maintenance items and should be provided in a regular maintenance program for any building. The neglect of these routine items can contribute to many common window problems.

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

Repair Class I: Routine Maintenance

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

The routine maintenance required to upgrade a window to "like new" condition normally includes the following steps:

1. some degree of interior and exterior paint removal,
2. removal and repair of sash (including reglazing where necessary),
3. repairs to the frame,
4. weatherstripping and reinstallation of the sash, and
5. repainting.

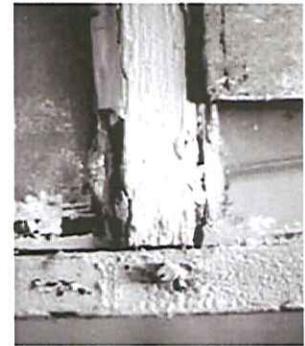
These operations are illustrated for a typical double-hung wooden window, but they may be adapted to other window types and styles as applicable.

Historic windows have usually acquired many layers of paint over time. Removal of excess layers or peeling and flaking paint will facilitate operation of the window and restore the clarity of the original detailing. Some degree of paint removal is also necessary as a first step in the proper surface preparation for subsequent refinishing (if paint color analysis is desired, it should be conducted prior to the onset of the paint removal). There are several safe and effective techniques for removing paint from wood, depending on the amount of paint to be removed.

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

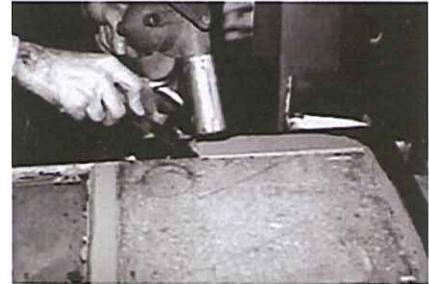


After removing paint from the seam between the interior stop and the jamb, the stop can be pried out and gradually worked loose using a pair of putty knives as shown. Photo: NPS files.



This historic double-hung window has many layers of paint, some cracked and missing putty, slight separation at the joints, broken sash cords, and one cracked pane. Photo: NPS files.

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



Sash can be removed and repaired in a convenient work area. Paint is being removed from this sash with a hot air gun. Photo: NPS files.

The sash can be stripped of paint using appropriate techniques, but if any heat treatment is used, the glass should be removed or protected from the sudden temperature change which can cause breakage. An overlay of aluminum foil on gypsum board or asbestos can protect the glass from such rapid temperature change. It is important to protect the glass because it may be historic and often adds character to the window. Deteriorated putty should be removed manually, taking care not to damage the wood along the rabbet. If the glass is to be removed, the glazing points which hold the glass in place can be extracted and the panes numbered and removed for cleaning and reuse in the same openings. With the glass panes out, the remaining putty can be removed and the sash can be sanded, patched, and primed with a preservative primer. Hardened putty in the rabbets may be softened by heating with a soldering iron at the point of removal. Putty remaining on the glass may be softened by soaking the panes in linseed oil, and then removed with less risk of breaking the glass. Before reinstalling the glass, a bead of glazing compound or linseed oil putty should be laid around the rabbet to cushion and seal the glass. Glazing compound should only be used on wood which has been brushed with linseed oil and primed with an oil based primer or paint. The pane is then pressed into place and the glazing points are pushed into the wood around the perimeter of the pane.

The final glazing compound or putty is applied and beveled to complete the seal. The sash can be refinished as desired on the inside and painted on the outside as soon as a "skin" has formed on the putty, usually in 2 or 3 days. Exterior paint should cover the beveled glazing compound or putty and lap over onto the glass slightly to complete a weather-tight seal. After the proper curing times have elapsed for paint and putty, the sash will be ready for reinstallation.

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

The operations just discussed summarize the efforts necessary to restore a window with minor deterioration to "like new" condition. The techniques can be applied by an unskilled person with minimal training and experience. To demonstrate the practicality of this approach, and photograph it, a Technical Preservation Services staff member repaired a wooden double-hung, two over two window which had been in service over ninety years. The wood was structurally sound but the window had one broken pane, many layers of paint, broken sash cords and inadequate, worn-out weatherstripping. The staff member found that the frame could be stripped of paint and the sash removed quite easily. Paint, putty and glass removal required about one hour for each sash, and the



Following the relatively simple repairs, the window is weathertight, like new in appearance, and serviceable for many years to come. Photo: NPS files.

reglazing of both sash was accomplished in about one hour. Weatherstripping of the sash and frame, replacement of the sash cords and reinstallation of the sash, parting bead, and stop required an hour and a half. These times refer only to individual operations; the entire process took several days due to the drying and curing times for putty, primer, and paint, however, work on other window units could have been in progress during these lag times.

Repair Class II: Stabilization

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

One established technique for repairing wood which is split, checked or shows signs of rot, is to:

1. dry the wood,
2. treat decayed areas with a fungicide,
3. waterproof with two or three applications of boiled linseed oil (applications every 24 hours),
4. fill cracks and holes with putty, and
5. after a "skin" forms on the putty, paint the surface.

Care should be taken with the use of fungicide which is toxic. Follow the manufacturers' directions and use only on areas which will be painted. When using any technique of building up or patching a flat surface, the finished surface should be sloped slightly to carry water away from the window and not allow it to puddle. Caulking of the joints between the sill and the jamb will help reduce further water penetration.



This illustrates a two-part epoxy patching compound used to fill the surface of a weathered sill and rebuild the missing edge. When the epoxy cures, it can be sanded smooth and painted to achieve a durable and waterproof repair. Photo: NPS files.

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

Wood may also be strengthened and stabilized by consolidation, using semirigid epoxies which saturate the porous decayed wood and then harden. The surface of the consolidated wood can then be filled with a semirigid epoxy patching compound, sanded and painted. Epoxy patching compounds can be used to build up missing sections or decayed ends of members. Profiles can be duplicated using hand molds, which are created by pressing a ball of patching compound over a sound section of the profile which has been rubbed with butcher's wax. This can be a very efficient technique where there are many typical repairs to be done. The process has been widely used and proven in marine applications; and proprietary products are available at hardware and marine supply stores. Although epoxy materials may be comparatively expensive, they hold the promise of being among the most durable and long lasting materials available

for wood repair. More information on epoxies can be found in the publication "Epoxies for Wood Repairs in Historic Buildings," cited in the bibliography.

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

Repair Class III: Splices and Parts Replacement

When parts of the frame or sash are so badly deteriorated that they cannot be stabilized there are methods which permit the retention of some of the existing or original fabric. These methods involve replacing the deteriorated parts with new matching pieces, or splicing new wood into existing members. The techniques require more skill and are more expensive than any of the previously discussed alternatives. It is necessary to remove the sash and/or the affected parts of the frame

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

The repairs discussed in this section involve window frames which may be in very deteriorated condition, possibly requiring removal; therefore, caution is in order. The actual construction of wooden window frames and sash is not complicated. Pegged mortise and tenon units can be disassembled easily, if the units are out of the building. The installation or connection of some frames to the surrounding structure, especially masonry walls, can complicate the work immeasurably, and may even require dismantling of the wall. **It may be useful, therefore, to take the following approach to frame repair:**

1. conduct regular maintenance of sound frames to achieve the longest life possible,
2. make necessary repairs in place, wherever possible, using stabilization and splicing techniques, and
3. if removal is necessary, thoroughly investigate the structural detailing and seek appropriate professional consultation.

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

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

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

Weatherization

A window which is repaired should be made as energy efficient as possible by the use of appropriate weatherstripping to reduce air infiltration. A wide variety of products are available to assist in this task. Felt may be fastened to the top,

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

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

Window Replacement

Although the retention of original or existing windows is always desirable and this Brief is intended to encourage that goal, there is a point when the condition of a window may clearly indicate replacement. The decision process for selecting replacement windows should not begin with a survey of contemporary window products which are available as replacements, but should begin with a look at the windows which are being replaced. **Attempt to understand the contribution of the window(s) to the appearance of the facade including:**

1. the pattern of the openings and their size;
2. proportions of the frame and sash;
3. configuration of window panes;
4. muntin profiles;
5. type of wood;
6. paint color;
7. characteristics of the glass; and
8. associated details such as arched tops, hoods, or other decorative elements.

Develop an understanding of how the window reflects the period, style, or regional characteristics of the building, or represents technological development.

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

Consider energy efficiency as one of the factors for replacements, but do not let it dominate the issue. Energy conservation is no excuse for the wholesale destruction of historic windows which can be made thermally efficient by historically and aesthetically acceptable means. In fact, a historic wooden window with a high quality storm window added should thermally

outperform a new double-glazed metal window which does not have thermal breaks (insulation between the inner and outer panes intended to break the path of heat flow). This occurs because the wood has far better insulating value than the metal, and in addition many historic windows have high ratios of wood to glass, thus reducing the area of highest heat transfer. One measure of heat transfer is the U-value, the number of Btu's per hour transferred through a square foot of material. When comparing thermal performance, the lower the U-value the better the performance. According to ASHRAE 1977 Fundamentals, the U-values for single glazed wooden windows range from 0.88 to 0.99. The addition of a storm window should reduce these figures to a range of 0.44 to 0.49. A non-thermal break, double-glazed metal window has a U-value of about 0.6.

Summary and References

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

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

1981

Reading List

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Technical Preservation Services

National Park Service
U.S. Department of the Interior

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

PRESERVATION BRIEFS

11

Rehabilitating Historic Storefronts

H. Ward Jandl

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The Joy Building from "Early Illustrations and Views of American Architecture" by Edmund V. Gillon, Jr. Photo: Courtesy, Dover Publications, Inc.

The storefront is the most important architectural feature of many historic commercial buildings. It also plays a crucial role in a store's advertising and merchandising strategy to draw customers and increase business. Not surprisingly, then, the storefront has become the feature most commonly altered in a historic commercial building. In the process, these alterations may have completely changed or destroyed a building's distinguishing architectural features that make up its historic character.

As more and more people come to recognize and appreciate the architectural heritage of America's downtowns, however, a growing interest can be seen in preserving the historic character of commercial buildings. The sensitive rehabilitation of storefronts can result not only in increased business for the owner but can also provide evidence that downtown revitalization efforts are succeeding.

Once a decision is made to rehabilitate a historic commercial building, a series of complex decisions faces the owner, among them:

- if the original storefront has survived largely intact but is in a deteriorated condition, what repairs should be undertaken?

- if the storefront has been modernized at a later date, should the later alterations be kept or the building restored to its original appearance or an entirely new design chosen?
- if the building's original retail use is to be changed to office or residential, can the commercial appearance of the building be retained while accommodating the new use?

This Preservation Brief is intended to assist owners, architects, and planning officials in answering such questions about how to evaluate and preserve the character of historic storefronts. In so doing, it not only addresses the basic design issues associated with storefront rehabilitation, but recommends preservation treatments as well. Finally, although the Brief focuses on storefront rehabilitation, it is important to review this specific work in the broader context of preserving and maintaining the overall structure. Money spent on storefront rehabilitation may be completely wasted if repair and maintenance problems on the rest of the building are neglected.

Historical Overview

Commercial establishments of the 18th and early 19th centuries were frequently located on the ground floor of buildings and, with their residentially scaled windows and doors, were often indistinguishable from surrounding houses. In some cases, however, large bay or oriel windows comprised of small panes of glass set the shops apart from their neighbors. Awnings of wood and canvas and signs over the sidewalk were other design features seen on some early commercial buildings. The ground floors of large commercial establishments, especially in the first decades of the 19th century, were distinguished by regularly spaced, heavy piers of stone or brick, infilled with paneled doors or small paned window sash.

Entrances were an integral component of the facade, typically not given any particular prominence although sometimes wider than other openings.

The ready availability of architectural cast iron after the 1840s helped transform storefront design as architects and builders began to experiment using iron columns and lintels at the ground floor level. Simultaneous advances in the glass industry permitted manufacturing of large panes of glass at a reasonable cost. The combination of these two technical achievements led to the storefront as we know it today—large expanses of glass framed by thin structural elements. The advertisement of the merchant and his products in the building facade and display windows quickly became critical factors in the competitive commercial atmosphere of downtowns. In the grouping of these wide-windowed facades along major commercial streets, the image of America's cities and towns radically changed.

The first cast iron fronts were simple post-and-lintel construction with little decoration. As iron craftsmen became more adept and as more ornate architectural styles became popular, cast iron fronts were given Italianate, Venetian Gothic, and French Second Empire details. Cast iron storefronts could be selected directly from catalogs, which began to appear in the early 1850s. Standardized sills, columns, and lintels could be arranged to create fronts of all sizes, styles and configurations. In the 1870s sheet metal storefronts became popular; they were also sold in standardized sizes and configurations through manufacturers' catalogs.

The typical 19th century storefront consisted of single or double doors flanked by display windows. The entrance was frequently recessed, not only to protect the customer from inclement weather but to increase the amount of space in which to display merchandise. In some cases an additional side door provided access to the upper floors. Thin structural members of cast iron or wood, rather than masonry piers, usually framed the storefront. The windows themselves were raised off the ground by wood, cast iron or pressed metal panels or bulkheads; frequently, a transom or series of transoms (consisting of single or multiple panes of glass) were placed above each window and door. The signboard above the storefront (the fascia covering the structural beam) became a prominent part of the building. Canvas awnings, or in some cases tin or wooden canopies, often shaded storefronts of the late 19th century. Iron fronts were frequently put onto existing buildings as a way of giving them an up-to-date appearance. Except for expanding the display window area to the maximum extent possible



This cast iron storefront from the late 19th century has been well maintained over the years. Photo: NPS files.

and the increasing use of canvas awnings, few major technical innovations in storefront design can be detected from the 1850s through 1900.

The first decades of the 20th century saw the growing use of decorative transom lights (often using small prismatic glass panes) above display windows; in some cases, these transoms could be opened to permit air circulation into the store. Electric incandescent lights enabled storeowners to call attention to their entrance and display windows and permitted nighttime shopping. In the 1920's and 1930s a variety of new materials were introduced into the storefront, including aluminum and stainless steel framing elements, pigmented structural glass (in a wide variety of colors), tinted and mirrored glass, glass block and neon.

A bewildering number of proprietary products also appeared during this period, many of which went into storefronts including Aklo, Vitrolux, Vitrolite, and Extrudalite. Highly colored and heavily patterned marble was a popular material for the more expensive storefronts of this period. Many experiments were made with recessed entries, floating display islands, and curved glass. The utilization of neon lighting further transformed store signs into elaborate flashing and blinking creations. During this period design elements were simplified and streamlined; transom and signboard were often combined. Signs utilized typefaces for the period, including such stylized lettering as "Broadway," "Fino" and "Monogram." Larger buildings of this period, such as department stores, sometimes had fixed metal canopies, with lighting and signs as an integral component of the fascia.



This 1930s Moderne storefront has gained significance over time and should be preserved. Photo: NPS files.

Because commercial architecture responds to a variety of factors—environmental, cultural, and economic—distinct regional variations in storefronts can be noted. Fixed metal canopies supported by guy wires, for example, were common in late 19th and early 20th century storefronts in southern states where it was advantageous to have shaded entrances all year long. Such a detail was less common in the northeast where moveable canvas awnings predominated. These awnings could be lowered in summer to keep buildings cooler and raised in winter when sunlight helps to heat the building.

Guidelines for Rehabilitating Existing Historic Storefronts

1. **Become familiar with the style** of your building and the role of the storefront in the overall design. Don't "early up" a front. Avoid stock "lumberyard colonial" detailing such as coach lanterns, mansard overhangings, wood shakes, nonoperable shutters and small paned windows except where they existed historically.
2. **Preserve the storefront's character** even though there is a new use on the interior. If less exposed window area is desirable, consider the use of interior blinds and insulating curtains rather than altering the existing historic fabric.
3. **Avoid use of materials that were unavailable when the storefront was constructed**; this includes vinyl and aluminum siding, anodized aluminum, mirrored or tinted glass, artificial stone, and brick veneer.
4. **Choose paint colors based on the buildings historical appearance**. In general do not coat surfaces that have never been painted. For 19th century storefronts, contrasting colors may be appropriate, but avoid too many different colors on a single facade.

Evaluating the Storefront

The important key to a successful rehabilitation of a historic commercial building is planning and selecting treatments that are sensitive to the architectural character of the storefront.

As a first step, it is therefore essential to identify and evaluate the existing storefront's construction materials; architectural features; and the relationship of those features to the upper stories. This evaluation will permit a better understanding of the storefront's role in, and significance to, the overall design of the building. A second and equally important step in planning the rehabilitation work is a careful examination of the storefront's physical conditions



Storefronts of the 1940s, 50s, and 60s were frequently installed by attaching studs or a metal grid over an early front and applying new covering materials. Photo: Bob Dunn.

to determine the extent and nature of rehabilitation work needed. In most cases, this examination is best undertaken by a qualified professional.

The following questions should be taken into consideration in this two-part evaluation:

Construction Materials, Features, and Design Relationships

Storefront's Construction Materials: What are the construction materials? Wood? Metal? Brick or other masonry? A combination?

Storefront's Architectural Features: What are the various architectural features comprising the storefront and how are they arranged in relationship to each other?

Supporting Columns/Piers

What do the columns or piers supporting the storefront look like? Are they heavy or light in appearance? Are they flush with the windows or do they protrude? Are they all structural elements or are some columns decorative?

Display Windows and Transoms

Are the display windows and transoms single panes of glass or are they subdivided? Are they flush with the

facade or are they recessed? What is the proportion of area between the display windows and transom? Are there window openings in the base panels to allow natural light into the basement?

Entrances

Are the entrances centered? Are they recessed? Is one entrance more prominent than the others? How is the primary retail entrance differentiated from other entrances? Is there evidence that new entrances have been added or have some been relocated? Are the doors original or are they later replacements?

Decorative Elements

Are there any surviving decorative elements such as molded cornices, column capitals, fascia boards, brackets, signs, awnings or canopies? Is there a beltcourse, cornice, or fascia board between the first and second floor? Are some elements older than others indicating changes over time?

Storefront's Relationship to Upper Stories: Is there a difference in materials between the storefront and upper stories? Were the storefront and floors above it created as an overall design or were they very different and unrelated to each other?

It is also worthwhile to study the neighboring commercial buildings and their distinctive characteristics to look for similarities (canopies, lighting, signs) as well as differences. This can help determine whether the storefront in question is significant and unique in its own right and/or whether it is significant as part of an overall commercial streetscape.

Physical Condition

Mild Deterioration

Do the surface materials need repair? Is paint flaking? Are metal components rusting? Do joints need recaulking where materials meet glass windows? Mild deterioration generally requires only maintenance level treatments.

Moderate Deterioration

Can rotted or rusted or broken sections of material be replaced with new material to match the old? Can solid material (such as Carrara glass) from a non-conspicuous location be used on the historic facade to repair damaged elements? Do stone or brick components need repointing? Is the storefront watertight with good flashing connections? Are there leaky gutters or air conditioner units which drip condensation on the storefront? Is caulking needed? Moderate deterioration generally requires patching or splicing of the existing elements with new pieces to match the deteriorated element.



By evaluating the components of a storefront as well as their existing condition, a successful rehabilitation is more likely. Photo: HABS collection, NPS.

Severe Deterioration

Have existing facing materials deteriorated beyond repair through vandalism, settlement, or water penetration? Is there a loss of structural integrity? Is the material rusted through, rotted, buckling, completely missing? Are structural lintels sagging? Are support columns settled or out of alignment? Severe deterioration generally requires replacement of deteriorated elements as part of the overall rehabilitation.

In evaluating whether the existing storefront is worthy of preservation, recognize that good design can exist in any period; a storefront added in 1930 may have greater architectural merit than what is replaced. In commercial historic districts, it is often the diversity of styles and detailing that contribute to the character; removing a storefront dating from 1910 simply because other buildings in the district have been restored to their 1860s appearance may not be the best preservation approach. If the storefront design is a good example of its period and if it has gained significance over time, it should be retained as part of the historical evolution of the building (this architectural distinctiveness could also be an economic asset as it may attract attention to the building).

Deciding a Course of Action

The evaluation of the storefront's architectural features and physical condition will help determine the best course of action in the actual rehabilitation work. The following recommendations, adapted from the Secretary of the Interior's "Standards for Rehabilitation" and the accompanying interpretive guidelines, are designed to ensure that the historic commercial character of the building is retained in the rehabilitation process.

If the original or significant storefront exists, repair and retain the historic features using recommended treatments (see following sections on rehabilitating metal, wood and masonry storefronts as well as the guidelines for rehabilitating existing historic storefronts).

If the original or significant storefront no longer exists or is too deteriorated to save, undertake a contemporary design which is compatible with the rest of the building in scale, design, materials, color and texture; or undertake an accurate restoration based on historical research and physical evidence (see section on "Replacement Storefronts"). Where an original or significant storefront no longer exists and no evidence exists to document its early appearance, it is generally preferable to undertake a contemporary design that retains the commercial "flavor" of the building. The new storefront design should not draw attention away from the historic building with its detailing but rather should respect the existing historic character of the overall building.

A new design that copies traditional details or features from neighboring buildings or other structures of the period may give the building a historical appearance which blends in with its neighbors but which never, in fact, existed. For this reason, use of conjectural designs, even if based on similar buildings elsewhere in the neighborhood or the availability of different architectural elements from other buildings or structures, is generally not recommended.

Rehabilitating Metal Storefronts

Rehabilitating metal storefronts can be a complex and time-consuming task. Before steps are taken to analyze or treat deteriorated storefronts, it is necessary to know which metal is involved, because each has unique properties and distinct preservation treatments. Storefronts were fabricated using a variety of metals, including cast iron, bronze, copper, tin, galvanized sheet iron, cast zinc, and stainless steel. Determining metallic composition can be a difficult process especially if components are encrusted with paint. Original architect's specifications (sometimes available from permit offices, town halls, or records of the original owner) can be important clues in this regard and should be checked if at all possible.

Iron—a magnetic, gray-white malleable metal, readily susceptible to oxidation. Cast iron, most commonly found in storefronts, is shaped by molds and can withstand great compressive loads. Rolled sheet iron, sometimes galvanized with zinc, also was used in store-front construction. Stainless steel began to appear in storefronts after 1930.

Zinc—a medium-hard, bluish-white metal, widely used as a protective coating for iron and steel. It is softer than iron and is nonmagnetic.

Copper—a nonmagnetic, corrosion-resistant, malleable metal, initially reddish-brown but when exposed to the atmosphere turns brown to black to green.

Bronze and brass—nonmagnetic, abrasive-resistant alloys combining copper with varying amounts of zinc, lead, or tin. These copper alloys, more commonly found in office buildings or large department stores, range in color from lemon yellow to golden brown to green depending on their composition and are well suited for casting.

Aluminum—a lightweight, nonmagnetic metal commonly found on storefronts dating from the 1920s and 30s. Its brightness and resistance to corrosion has made it a popular storefront material in the 20th century.

Repair and Replacement of Metal

Simply because single components of a storefront need repair or replacement should not be justification for replacing an entire storefront. Deteriorated metal architectural elements can be repaired by a variety of means, although the nature of the repair will depend on the extent of the deterioration, the type of metal and its location, and the overall cost of such repairs. Patches can be used to mend, cover or fill a deteriorated area. Such patches should be a close match to the original material to prevent galvanic corrosion. Splicing—replacement of a small section with new material—should be undertaken on structural members only when temporary bracing has been constructed to carry the load. Reinforcing—or bracing the damaged element with additional new metal material—can relieve fatigue or overloading in some situations.

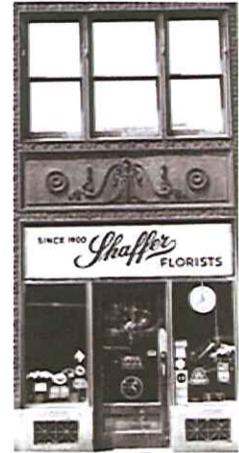
If metal components have deteriorated to a point where they have actually failed (or are missing), replacement is the only reasonable course of action. If the components are significant to the overall design of the storefront, they should be carefully removed and substituted with components that match the original in material, size and detailing.

Before going to the expense of reproducing the original, it may be useful to check salvage yards for compatible components. Missing parts of cast iron storefronts can be replaced by new cast iron members that are reproductions of the original. New wooden patterns, however, usually need to be made if the members are large. This procedure tends to be expensive (it is usually impossible to use existing iron components as patterns to cast large elements because cast iron shrinks 1/5 inch per foot as it cools). In some situations, less expensive substitute materials such as aluminum, wood, plastics, and fiberglass, painted to match the metal, can be used without compromising the architectural character of the resource.

Cleaning and Painting

Cast iron storefronts are usually encrusted with layers of paint which need to be removed to restore crispness to the details. Where paint buildup and rust are not severe problems, handscraping and wire-brushing are viable cleaning methods. While it is necessary to remove all rust before repainting, it is not necessary to remove all paint. For situations involving extensive paint buildup and corrosion, mechanical methods such as low-pressure gentle dry grit blasting (80-100 psi) can be effective and economical, providing a good surface for paint. Masonry and wood surfaces adjacent to the cleaning area, however, should be protected to avoid inadvertent damage from the blasting. It will be necessary to recaulk and putty the heads of screws and bolts after grit blasting to prevent moisture from entering the joints. Cleaned areas should be painted immediately after cleaning with a rust-inhibiting primer to prevent new corrosion. Before any cleaning is undertaken, local codes should be checked to ensure compliance with environmental safety requirements.

Storefronts utilizing softer metals (lead, tin), sheet metals (sheet copper), and plated metals (tin andterneplate) should not be cleaned mechanically (grit blasting) because their plating or finish can be easily abraded and damaged. It is usually preferable to clean these softer metals with a chemical (acid pickling or phosphate dipping) method. Once the surface of the metal has been cleaned of all corrosion, grease, and dirt, a rustinhibiting primer coat should be applied. Finish coats



This finely detailed bronze storefront is typical of many constructed during the 1920s. The original grilles, spandrel panel and windows are all intact. Photo: NPS files.

especially formulated for metals, consisting of lacquers, varnishes, enamels or special coatings, can be applied once the primer has dried. Primer and finish coats should be selected for chemical compatibility with the particular metal in question.

Bronze storefronts, common to large commercial office buildings and major department stores of the 20th century, can be cleaned by a variety of methods; since all cleaning removes some surface metal and patina, it should be undertaken only with good reason (such as the need to remove encrusted salts, bird droppings or dirt). Excessive cleaning can remove the texture and finish of the metal. Since this patina can protect the bronze from further corrosion, it should be retained if possible. If it is desirable to remove the patina to restore the original surface of the bronze, several cleaning methods can be used: chemical compounds including rottenstone and oil, whiting and ammonia, or precipitated chalk and ammonia, can be rubbed onto bronze surfaces with a soft, clean cloth with little or no damage. A number of commercial cleaning companies successfully use a combination of 5% oxalic acid solution together with finely ground India pumice powder. Fine glass-bead blasting (or peening) and crushed walnut shell blasting also can be acceptable mechanical methods if carried out in controlled circumstances under low (80-100 psi) pressure. Care should be taken to protect any adjacent wood or masonry from the blasting.

The proper cleaning of metal storefronts should not be considered a "do-it-yourself" project. The nature and condition of the material should be assessed by a competent professional, and the work accomplished by a company specializing in such work.

Rehabilitating Wooden Storefronts

The key to the successful rehabilitation of wooden storefronts is a careful evaluation of existing physical conditions. Moisture, vandalism, insect attack, and lack of maintenance can all contribute to the deterioration of wooden storefronts.



Rather than replace an entire wooden storefront, a new wooden component can be pieced-in, as seen in this column base. Photo: NPS files.

Paint failure should not be mistakenly interpreted as a sign that the wood is in poor condition and therefore irreparable. Wood is frequently in sound physical condition beneath unsightly paint. An ice pick or awl may be used to test wood for soundness—decayed wood that is jabbed will lift up in short irregular pieces; sound wood will separate in long fibrous splinters.

Repair and Replacement of Wood

Storefronts showing signs of physical deterioration can often be repaired using simple methods. Partially decayed wood can be patched, built up, chemically treated or consolidated and then painted to achieve a sound condition, good appearance, and greatly extended life.

To repair wood showing signs of rot, it is advisable to dry the wood; carefully apply a fungicide such as pentachlorophenol (a highly toxic substance) to all decayed areas; then treat with 2 or 3 applications of boiled linseed oil (24 hours between applications).

Afterward, fill cracks and holes with putty; caulk the joints between the various wooden members; and finally prime and paint the surface.

Partially decayed wood may also be strengthened and stabilized by consolidation, using semirigid epoxies which saturate porous decayed wood and then harden. The consolidated wood can then be filled with a semirigid epoxy patching compound, sanded and painted. More information on epoxies can be found in the publication "Epoxies for Wood Repairs in Historic Buildings," cited in the bibliography.

Where components of wood storefronts are so badly deteriorated that they cannot be stabilized, it is possible to replace the deteriorated parts with new pieces. These techniques all require skill and some expense, but are recommended in cases where decorative elements, such as brackets or pilasters, are involved. In some cases, missing edges can be filled and rebuilt using wood putty or epoxy compounds. When the epoxy cures, it can be sanded smooth and painted to achieve a durable and waterproof repair.

Repainting of Wood

Wooden storefronts were historically painted to deter the harmful effects of weathering (moisture, ultraviolet rays from the sun, wind, etc.) as well as to define and accent architectural features. Repainting exterior woodwork is thus an inexpensive way to provide continued protection from weathering and to give a fresh appearance to the storefront.

Before repainting, however, a careful inspection of all painted wood surfaces needs to be conducted in order to determine the extent of surface preparation necessary, that is, whether the existing layers of paint have deteriorated to the point that they will need to be partially or totally removed prior to applying the new paint.

As a general rule, removing paint from historic exterior woodwork should be avoided unless absolutely essential. Once conditions warranting removal have been identified, however, paint can be removed to the next sound layer using the gentlest method possible, then the woodwork repainted. For example, such conditions as mildewing, excessive chalking, or staining (from the oxidization of rusting nails or metal anchorage devices) generally require only thorough surface cleaning prior to repainting. Intercoat peeling, solvent blistering, and wrinkling require removal of the affected layer using mild abrasive methods such as hand scraping and sanding. In all of these cases of limited paint deterioration, after proper surface preparation the exterior woodwork may be given one or more coats of a high quality exterior oil finish paint.

On the other hand, if painted wood surfaces display continuous patterns of deep cracks or if they are extensively blistering and peeling so that bare wood is visible, the old paint should be completely removed before repainting. (It should be emphasized that because peeling to bare wood—the most common type of paint problem—is most often caused by excess interior or exterior moisture that collects behind the paint film, the first step in treating peeling is to locate and remove the source or sources of moisture. If this is not done, the new paint will simply peel off.)

There are several acceptable methods for total paint removal, depending on the particular wooden element involved. They include such thermal devices as an electric heat plate with scraper for flat surfaces such as siding, window sills, and doors or an electric hot-air gun with profiled scraper for solid decorative elements such as gingerbread or molding. Chemical methods play a more limited, supplemental role in removing paint from historic exterior woodwork; for example, caustic or solvent-base strippers may be used to remove paint from window muntins because thermal devices can easily break the glass. Detachable wooden elements such as exterior shutters, balusters and columns, can probably best be stripped by means of immersion in commercial dip tanks because other methods are too laborious. Care must be taken in rinsing all chemical residue off the wood prior to painting or the new paint will not adhere.

Finally, if the exterior woodwork has been stripped to bare wood, priming should take place within 48 hours (unless the wood is wet, in which case it should be permitted to dry before painting). Application of a high quality oil type exterior primer will provide a surface over which either an oil or latex top coat can be successfully used.

Rehabilitating Masonry Storefronts

Some storefronts are constructed of brick or stone, and like their metal and wooden counterparts, also may have been subjected to physical damage or alterations over time. Although mortar may have disintegrated, inappropriate surface coatings applied, and openings reduced or blocked up, careful rehabilitation will help restore the visual and physical integrity of the masonry storefront.

Repair and Replacement of Masonry

If obvious signs of deterioration—disintegrating mortar, spalling bricks or stone—are present, the causes (ground moisture, leaky downspouts, etc.) should be identified and corrected. Some repointing may be necessary on the masonry surface, but should be limited to areas in which so much mortar is missing that water accumulates in the mortar joints, causing further deterioration. New mortar should duplicate the composition, color, texture, and hardness, as well as the joint size and profile of the original. Badly spalling bricks may have to be replaced. Deteriorated stone may be replaced in kind, or with a matching substitute material; in some cases where not visually prominent, it may be covered with stucco, possibly scored to resemble blocks of stone.

Cleaning Masonry

Inappropriate cleaning techniques can be a major source of damage to historic masonry buildings. Historic masonry should be cleaned only when necessary to halt deterioration or to remove graffiti and stains, and always with the gentlest means

possible, such as water and a mild detergent using natural bristle brushes, and/or a non-harmful chemical solution, both followed by a low-pressure water rinse.

It is important to remember that many mid-19th century brick buildings were painted immediately or soon after construction to protect poor quality brick or to imitate stone. Some historic masonry buildings not originally painted were painted at a later date to hide alterations or repairs, or to solve recurring maintenance or moisture problems. Thus, whether for reasons of historical tradition or practicality, it may be preferable to retain existing paint. If it is readily apparent that paint is not historic and is a later, perhaps unsightly or inappropriate treatment, removal may be attempted, but only if this can be carried out without damaging the historic masonry. Generally, paint removal from historic masonry may be accomplished successfully only with the use of specially formulated chemical paint removers. No abrasive techniques, such as wet or dry sandblasting should be considered. If nonhistoric paint cannot be removed without using abrasive methods, it is best to leave the masonry painted, although repainting in a compatible color may help visually.

Removing unsightly mastic from masonry presents a similarly serious problem. Its removal by mechanical means may result in abrading the masonry, and chemical and heat methods may prove ineffective, although solvents like acetone will aid in softening the hardened mastic. If the mastic has become brittle, a flat chisel may be used to pop it off; but this technique, if not undertaken with care, may result in damaging the masonry. And even if total removal is possible, the mastic may have permanently stained the masonry. Replacement of these masonry sections marred by mastic application may be one option in limited situations; individual pieces of stone or bricks that have been damaged by inappropriate alterations may be cut out and replaced with new pieces that duplicate the original. However, since an exact match will be nearly impossible to achieve, it may be necessary to paint the repaired masonry in order to create a harmonious facade. Replacement of a large area with new materials may not be acceptable as it may give the building a new, nonhistoric appearance inappropriate to the building style and period.

Designing Replacement Storefronts

Where an architecturally or historically significant storefront no longer exists or is too deteriorated to save, a new front should be designed which is compatible with the size, scale, color, material, and character of the building. Such a design should be undertaken based on a thorough understanding of the building's architecture and, where appropriate, the surrounding streetscape. For example, just because upper floor windows are arched is not sufficient justification for designing arched openings for the new storefront. The new design should "read" as a storefront; filling in the space with brick or similar solid material is inappropriate for historic buildings. Similarly the creation of an arcade or other new design element, which alters the architectural and historic character of the building and its relationship with the street, should be avoided. The guidelines on page 8 can assist in developing replacement storefront designs that respect the historic character of the building yet meet current economic and code requirements.



This photograph shows the impact of preserving historic storefronts. The one on the right has been totally obscured by a "modern" front added in the 1950s. Photo: NPS files.

Guidelines for Designing Replacement Storefronts

1. **Scale:** Respect the scale and proportion of the existing building in the new storefront design.
2. **Materials:** Select construction materials that are appropriate to the storefronts; wood, cast iron, and glass are usually more appropriate replacement materials than masonry which tends to give a massive appearance.
3. **Cornice:** Respect the horizontal separation between the storefront and the upper stories. A cornice or fascia board traditionally helped contain the store's sign.
4. **Frame:** Maintain the historic planar relationship of the storefront to the facade of the building and the streetscape (if appropriate). Most storefront frames are generally composed of horizontal and vertical elements.

5. **Entrances:** Differentiate the primary retail entrance from the secondary access to upper floors. In order to meet current code requirements, out-swinging doors generally must be recessed. Entrances should be placed where there were entrances historically, especially when echoed by architectural detailing (a pediment or projecting bay) on the upper stories.
6. **Windows:** The storefront generally should be as transparent as possible. Use of glass in doors, transoms, and display areas allows for visibility into and out of the store.
7. **Secondary Design Elements:** Keep the treatment of secondary design elements such as graphics and awnings as simple as possible in order to avoid visual clutter to the building and its streetscape.

A restoration program requires thorough documentation of the historic development of the building prior to initiating work. If a restoration of the original storefront is contemplated, old photographs and prints, as well as physical evidence, should be used in determining the form and details of the original. Because storefronts are particularly susceptible to alteration in response to changing marketing techniques, it is worthwhile to find visual documentation from a variety of periods to have a clear understanding of the evolution of the storefront. Removal of later additions that contribute to the character of the building should not be undertaken.

Other Considerations

Pigmented Structural Glass

The rehabilitation of pigmented structural glass storefronts, common in the 1930's, is a delicate and often frustrating task, due to the fragility and scarcity of the material. Typically the glass was installed against masonry walls with asphaltic mastic and a system of metal shelf angles bolted to the walls on three-foot centers. Joints between the panels were filled with cork tape or an elastic joint cement to cushion movement and prevent moisture infiltration.

The decision to repair or replace damaged glass panels should be made on a case-by-case basis. In some instances, the damage may be so minor or the likelihood of finding replacement glass so small, that repairing, reanchoring and/or stabilizing the damaged glass panel may be the only prudent choice. If the panel is totally destroyed or missing, it may be possible to replace with glass salvaged from a demolition; or a substitute material, such as "spandrel glass," which approximates the appearance of the original. Although pigmented structural glass is no longer readily available, occasionally long-established glass "jobbers" will have a limited supply to repair historic storefronts.

Awnings

Where based on historic precedent, consider the use of canvas awnings on historic storefronts. Awnings can help shelter passersby, reduce glare, and conserve energy by controlling the amount of sunlight hitting the store window, although buildings with northern exposures will seldom functionally require them. Today's canvas awnings have an average life expectancy of between 4 and 7 years. In many cases awnings can disguise, in an inexpensive manner, later inappropriate alterations and can provide both additional color and a strong store identification. Fixed aluminum awnings and awnings simulating mansard roofs and umbrellas are generally inappropriate for older commercial buildings. If awnings are added, choose those that are made from soft canvas or vinyl materials rather than wood or metal; be certain that they are installed without damaging the building or visually impairing distinctive architectural features and can be operable for maximum energy conservation effect.

Signs



Try to locate old photographs or prints to determine what alterations have been made to the storefront and when they were undertaken. Awnings were common elements of storefronts at the turn of the century. Photo: NPS files.

Signs were an important aspect of 19th and early 20th century storefronts and today play an important role in defining the character of a business district. In examining historic streetscape photographs, one is struck by the number of signs—in windows, over doors, painted on exterior walls, and hanging over (and sometimes across) the street. While this confusion was part of the character of 19th century cities and towns, today's approach toward signs in historic districts tends to be much more conservative. Removal of some signs can have a dramatic effect in improving the visual appearance of a building; these include modern backlit fluorescent signs, large applied signs with distinctive corporate logos, and those signs attached to a building in such a way as to obscure significant architectural detailing. For this reason, their removal is encouraged in the process of rehabilitation. If new signs are designed, they should be of a size and style compatible with the historic building and should not cover or obscure significant architectural detailing or features. For many 19th century buildings, it was common to mount signs on the lintel above the first story. Another common approach, especially at the turn of the century, was to paint signs directly on the inside of the display windows. Frequently this was done in gold leaf. New hanging signs may be appropriate for historic commercial buildings, if they are of a scale and design compatible with the historic buildings. Retention of signs and advertising painted on historic walls, if of historic or artistic interest (especially where they provide evidence of early or original occupants), is encouraged.

Paint Color

Paint analysis can reveal the storefront's historic paint colors and may be worth undertaking if a careful restoration is desired. If not, the paint color should be, at a minimum, appropriate to the style and setting of the building. This also means that if the building is in a historic district, the color selection should complement the building in question as well as other buildings in the block. In general, color schemes for wall and major decorative trim or details should be kept simple; in most cases the color or colors chosen for a storefront should be used on other painted exterior detailing (windows, shutter, cornice, etc.) to unify upper and lower portions of the facade.

Windows

Class windows are generally the most prominent features in historic storefronts, and care should be taken to ensure that they are properly maintained. For smaller paned windows with wooden frames, deteriorated putty should be removed manually, taking care not to damage wood along the rabbet. To reglaze, a bead of linseed oil-based putty should be laid around the perimeter of the rabbet; the glass pane pressed into place; glazing points inserted to hold the pane; and a final seal of putty beveled around the edge of the glass. For metal framed windows, glazing compound and special glazing clips are used to secure the glass; a final seal of glazing compound then is often applied. If the glass needs replacing, the new glass should match the original in size, color and reflective qualities. Mirrored or tinted glass are generally inappropriate replacements for historic storefronts. The replacement of cracked or missing glass in large windows should be undertaken by professional glaziers.

Code Requirements

Alterations to a storefront called for by public safety, handicapped access, and fire codes can be difficult design problems in historic buildings. Negotiations can be undertaken with appropriate officials to ensure that all applicable codes are being met while maintaining the historic character of the original construction materials and features. If, for instance, doors opening inward must be changed, rather than replace them with new doors, it may be possible to reverse the hinges and stops so that they will swing outward.

Summary and References

A key to the successful rehabilitation of historic commercial buildings is the sensitive treatment of the first floor itself. Wherever possible, significant storefronts (be they original or later alterations), including windows, sash, doors, transoms, signs and decorative features, should be repaired in order to retain the historic character of the building. Where original or early storefronts no longer exist or are too deteriorated to save, the commercial character of the building should nonetheless be preserved—either through an accurate restoration based on historic research and physical evidence or a contemporary design which is compatible with the scale, design, materials, color and texture of the historic building. The sensitive rehabilitation of historic storefronts will not only enhance the architectural character of the overall building but will contribute to rejuvenating neighborhoods or business districts as well.

Acknowledgements

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

September 1982

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PRESERVATION BRIEFS

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Michael J. Auer

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Terra cotta wheel with Studebaker banner, 1926. Lakewood, Ohio. Photo: Frank Wrenick.

"Signs" refers to a great number of verbal, symbolic or figural markers. Posters, billboards, graffiti and traffic signals, corporate logos, flags, decals and bumper stickers, insignia on baseball caps and tee shirts: all of these are "signs." Buildings themselves can be signs, as structures shaped like hot dogs, coffee pots or Chippendale highboys attest. The signs encountered each day are seemingly countless, for language itself is largely symbolic. This Brief, however, will limit its discussion of "signs" to lettered or symbolic messages affixed to historic buildings or associated with them.

Signs are everywhere. And everywhere they play an important role in human activity. They identify. They direct and decorate. They promote, inform, and advertise. Signs are essentially social. They name a human activity, and often identify who is doing it. Signs allow the owner to communicate with the reader, and the people inside a building to communicate with those outside of it.

Signs speak of the people who run the businesses, shops, and firms. Signs are signatures. They reflect the owner's tastes and personality. They often reflect the ethnic makeup of a neighborhood and its character, as well as the social and business activities carried out there. By giving concrete details about daily life in a former era, historic signs allow the past to speak to the present in ways that buildings by themselves do not. And multiple surviving historic signs on the same building can indicate several periods in its

history or use. In this respect, signs are like archeological layers that reveal different periods of human occupancy and use.

Historic signs give continuity to public spaces, becoming part of the community memory. They sometimes become landmarks in themselves, almost without regard for the building to which they are attached, or the property on which they stand. Furthermore, in an age of uniform franchise signs and generic plastic "box" signs, historic signs often attract by their individuality: by a clever detail, a daring use of color and motion, or a reference to particular people, shops, or events.

Yet historic signs pose problems for those who would save them. Buildings change uses. Businesses undergo change in ownership. New ownership or use normally brings change in signs. Signs are typically part of a business owner's sales strategy, and may be changed to reflect evolving business practices or to project a new image.

Signs also change to reflect trends in architecture and technology: witness the Art Deco and Depression Modern lettering popular in the 1920s and 1930s, and the use of neon in the 1940s and 1950s.

The cultural significance of signs combined with their often transitory nature makes the preservation of historic signs fraught with questions, problems, and paradoxes. If the common practice in every period has been to change signs with regularity, when and how should historic signs be kept? If the business is changing hands, how can historic signs be reused? The subject is an important one, and offers opportunities to save elements that convey the texture of daily life from the past.

This Brief will attempt to answer some of the preservation questions raised by historic signs. It will discuss historic sign practices, and show examples of how historic signs have been preserved even when the business has changed hands or the building itself has been converted to a new use.

Historic Sign Types and Practices

Pre-Nineteenth Century

American sign practices originated largely in Europe. The earliest commercial signs included symbols of the merchant's goods or tradesman's craft. Emblems were mounted on poles, suspended from buildings, or painted on hanging wooden boards. Such symbolic signs were necessary in a society where few could read, although verbal signs were not entirely unknown. A sheep signified a tailor, a tankard a tavern.

The red and white striped pole signifying the barbershop, and the three gold balls outside the pawnshop are two such emblems that can occasionally be seen today. (The barber's sign survives from an era when barbers were also surgeons; the emblem suggests bloody bandages associated with the craft. The pawnbroker's sign is a sign of a sign: it derives from the coat of arms of the Medici banking family.)

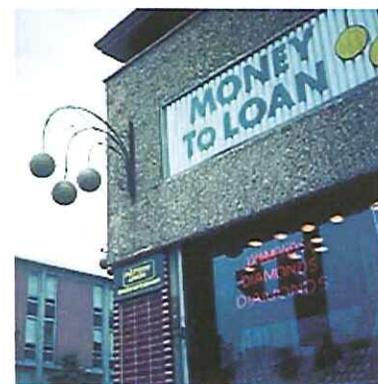
Flat signs with lettering mounted flush against the building gradually replaced hanging, symbolic signs. The suspended signs posed safety hazards, and creaked when they swayed in the wind: "The creaking signs not only kept the citizens awake at night, but they knocked them off their horses, and occasionally fell on them too." The result, in England, was a law in 1762 banning large projecting signs. In 1797 all projecting signs were forbidden, although some establishments, notably "public houses," retained the hanging sign tradition."⁽¹⁾

By the end of the eighteenth century, the hanging sign had declined in popularity. Flat or flush-mounted signs, on the other hand, had become standard. Like symbolic signs, however, the tradition of projecting signs has survived into the present.

Nineteenth Century Signs and Sign Practices



Neon first appeared in signs in the 1920s, and reached its height of popularity in the 1940s. Photo: Peter Phillips.



Once commonplace, the three balls symbolizing the pawnbroker are now rare. Photo: NPS files.

Surviving nineteenth-century photographs depict a great variety of signs. The list of signs discussed here is by no means exhaustive.

Fascia signs, placed on the fascia or horizontal band between the storefront and the second floor, were among the most common. The fascia is often called the "signboard," and as the word implies, provided a perfect place for a sign—then as now. The narrowness of the fascia imposed strict limits on the sign maker, however, and such signs usually gave little more than the name of the business and perhaps a street number.

Similar to fascia signs were signs between the levels of windows across the upper facade. Such signs were mounted on horizontal boards or painted on the building. Signs of this type tended to use several "lines" of text, the name of business and short description, for example. The message, reading from top to bottom, sometimes covered several stories of the building. Other **painted signs** presented figures, products, or scenes. Such signs were typically more vertical than horizontal in emphasis. Whether such painted signs featured text or images, they became major features of the building, as their makers intended them to be. The building itself often became a backdrop for the sign.

Signs in the form of **plaques, shields, and ovals** were used on many nineteenth-century buildings. Such signs had the advantage of being easily replaced as tenants came and went. They also easily incorporated images as well as lettering.

Hanging or projecting signs, both lettered and symbolic, were also common in the nineteenth century, although less so than previously. Projecting signs were often paired with another at a 45-degree angle for increased visibility. Occasionally a sign would stretch out from the building across the sidewalk, supported by a post at the street.

Goldleaf signs, and signs painted or etched on glass in windows, doors and transoms were quite common.

Porcelain enamel signs were also very popular in the latter half of the nineteenth century and into the mid-twentieth century. Signs carved from stone or wood also appeared frequently, especially on institutional buildings. Painted shutters and even window shades provided additional advertising space.

Posters found their way into display windows when they weren't pasted onto the building.

Sidewalk signs or "sandwich boards" offered another chance to catch the eye of any passerby not watching the graphics overhead.

Nineteenth-century tenants looking for additional advertising space found it in unexpected places. They used the entrance steps to mount signs in a variety of ways: Handrails, risers, skirts, and balusters sported signs that gave businesses on upper levels a chance to attract notice.

Awnings offered other opportunities for keeping a name before the public. The fringe or skirt of the awning, as well as the panel at the side were the usual places for a name or street number. Flags, particularly hung from the upper floors, and banners, sometimes stretching across the sidewalk, also appeared on buildings.

Rooftop signs appeared with greater frequency in the second half of the nineteenth century than previously. Earlier rooftop signs tended to be relatively simple—often merely larger versions of the horizontal signs typically found on lower levels. Late in the century the signs became more ornate as well as more numerous. These later rooftop signs were typically found on hotels, theaters, banks and other large buildings.

The sign types described here were not used in isolation. Window and awning signs attracted sidewalk pedestrians and people in the street. Upper level signs reached viewers at greater distances. If signs were numerous, however, they were nonetheless usually small in scale.

As the century wore on, signs increased in size and scale. Wall signs several stories high were not uncommon in the second half of the century. This development reflects changes in urban life as the century headed to its close. Cities were experiencing rapid population growth. Buildings became bigger and taller. Elevated trains and electric trolleys increased the



Objects associated with a business continue to be used as signs. Photo: NPS files.

pace of city life. And when it comes to signs, speed alters scale. The faster people travel, the bigger a sign has to be before they can see it.

Twentieth Century Signs and Sign Practices

The advent of the twentieth century approximately coincided with the coming of electricity, which gave signs light and, later, movement. Illuminated signs were not unknown before electricity. An advertisement printed about 1700 mentioned a night time sign lit by candles, and in 1840 the legendary showman P.T. Barnum built a huge sign illuminated by gas.² But electricity was safer and cheaper than candles, kerosene and gas. Its widespread use gave signs a prominence they retain today: illuminated signs dominate the streets at night.



In the 1930s and 1940s, signs built into storefronts became popular. This example is from Guthrie, Oklahoma. Photo: NPS files.

Electricity permitted signs to be illuminated by light shining onto them, but the real revolution occurred when lightbulbs were used to form the images and words on signs. Lightbulbs flashing on and off made new demands on the attention of passersby. Lightbulbs blinking in sequence could also simulate movement. Add this property to the mix, and a dramatic transformation of American streets resulted.

Moving signs were not unknown prior to the advent of electricity, for wind-driven signs had made their appearance in the nineteenth century. But electricity gave signs an unparalleled range of motion. This movement added yet another element to the life of the street.

Neon is another great twentieth-century contribution to the signmaker's art. "Neon," coined from the Greek word for "new," is a "new gas." It has the useful property of glowing when an electric charge passes through it. (Argon, krypton, xenon and helium share this property. Only neon and argon, however, are typically used in commercial

signs.) Encased in glass tubes shaped into letters or symbols, neon offered signmakers an opportunity to mold light into an infinite variety of shapes, colors, and images. Combined with an electric timer, the neon tubing could present images moving in succession.

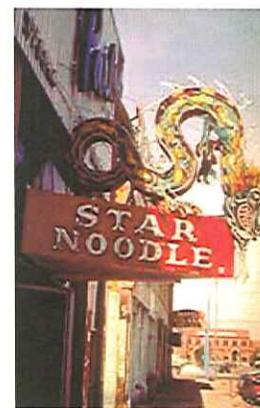
Neon first appeared in signs in the 1920s, and reached its height of popularity in the 1940s. The first documented neon commercial sign in the United States was at a Packard Motor Car dealership in Los Angeles in 1923.³ After a period of decline, it underwent a renaissance, beginning in the 1970s. Artists experimented with neon as a conscious art-form, and several notable architects further helped in its revival.⁴ Renewed interest in this colorful medium also sparked interest in preserving historic neon signs.

Along with such developments as the coming of electricity and then neon, stylistic movements influenced twentieth-century signs. In particular, Art Deco and Streamlined Moderne affected not just buildings, but their signs as well.

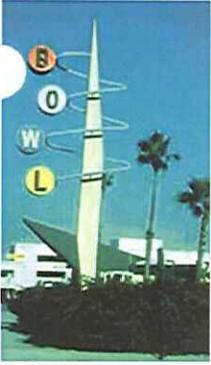
Architects working in these styles often integrated signs and buildings into a unified design. This was particularly true of storefronts built using pigmented structural glass, commonly known as "Carrara glass," and porcelain enamel on steel panels. These materials allowed words and images to be etched into the glass or enamel, or to be constructed in different colors and patterns as part of an overall design for the building. Such storefronts were popular from the 1920s into the 1940s.

As the century advanced, new styles took hold. The late 1950s brought signs with fins, starbursts, and other images reflecting a new fascination with outer space.

In the decades after World War II signs were also transformed by a group of materials now known generically as "plastic." Plastic had several advantages over wood, metal and other traditional sign materials. As the name indicates, "plastic" can take almost any shape. It can also take almost any color. Plastic is



This Ogden, Utah, sign is a superb example of neon. Photo: NPS files.



In the late 1950s and early 1960s, the country turned its attention to outer space, as in this example in Long Beach, California. Photo: Peter Phillips.

translucent. Lit from behind, it appears to glow. It is relatively durable. Above all, it is inexpensive, and can be mass produced. Plastic quickly became the dominant sign material.

Another profound influence on signs in this period stemmed from business trends rather than from technological breakthroughs or design movements: the rise of chain stores and franchises. National firms replaced many local businesses. Standard corporate signs went up; local trademarks came down. The rise of mass culture, of which the national chain is but one expression, has meant the rise of standardization, and the elimination of regional differences and local character.

The decline of gold-leafing and other traditional sign techniques contributed to these trends. Mass-produced signs have replaced local signs that differed from owner to owner and from signmaker to signmaker. The result is not just sameness, but impersonality as well: It is becoming rarer, for example, to find owners' names on signs. Whether the trend toward sameness can successfully be resisted is yet to be seen. (Some crafts, such as gold-leafing and porcelain enameling, for example, have experienced a revival of sorts.) But the preservation of historic signs is one way to ensure that at least some of these expressions of local history continue to enliven our streets.

Sign Regulation

Historic commercial areas have customarily been a riot of signs. Yet if clutter has ample precedent, so do efforts to control it. Early attempts to regulate signs in this country include those of professional associations of advertisers, such as the International Bill Posters Organization of North America, founded in St. Louis in 1872.⁵

However, early efforts by municipalities to enact sign regulations met with disfavor in the courts, which traditionally opposed any regulatory effort based on aesthetic concerns. Early successes in the legal arena, such as the 1911 case, *St. Louis Gunning Advertising Company v. City of St. Louis*, were realized when proponents of sign controls argued that signs and billboards endangered public health and safety.

Yet gradually courts found merit in the regulation of private property for aesthetic reasons. In 1954 the U.S. Supreme Court handed down the landmark decision, *Berman v. Parker*, in which the court declared: "It is within the power of the legislature to determine that the community should be beautiful as well as healthy, spacious as well as clean, well balanced as well as carefully patrolled."⁶

With the blessing of the courts, communities across the nation have enacted sign controls to reduce "urban blight." And where historic buildings are concerned, the growth of local review commissions has added to the momentum for controls in historic districts.

Typically, sign controls regulate the number, size and type of signs. In some cases, moving or projecting signs are prohibited. Often such ordinances also regulate sign placement—owners are told to line up their signs with others on the block, for example. Materials, likewise, are prescribed: wood is encouraged, plastic discouraged or forbidden altogether. Sign controls often specify lighting sources: indirect illumination (light shining onto the sign) is often required instead of neon tubing, bare lightbulbs, or "backlighting," used in most plastic signs. Some ordinances forbid lighting completely. (Neon, especially, is still held in disfavor in some areas.) Finally, ordinances sometimes require signs to be "compatible" in color and other design qualities with the facade of the building and the overall appearance of the street.

Existing signs frequently do not meet requirements set forth in sign controls. They are too big, for example, or project too far from the building. Typically, sign ordinances permit such "nonconforming" existing signs to remain, but only for a specified period, after which they must be removed. If they need repair before then, or if the business changes owners, they must likewise be removed.



This fading sign was painted in Baltimore in 1931 or 1932. It survives from the campaign to enact the 21st amendment to the United States Constitution, which repealed prohibition. Photo: NPS files.

Sign controls offer communities the chance to reduce visual blight. They can also assist in producing both a new visibility and a new viability for historic commercial districts. Yet sign ordinances are not without problems. Sign controls satisfy contemporary ideas of "good taste." But "bad taste" has ample historic precedent. And in any case, tastes change. What is tasteful today may be dated tomorrow. Sign controls can impose a uniformity that falsifies history. Most historic districts contain buildings constructed over a long period of time, by different owners for different purposes; the buildings reflect different architectural styles and personal tastes. By requiring a standard sign "image" in such matters as size, material, typeface and other qualities, sign controls can mute the diversity of historic districts. Such controls can also sacrifice signs of some age and distinction that have not yet come back into fashion.⁷ Neon serves as an instructive example in this regard: once "in," then "out," then "in" again. Unfortunately, a great number of notable signs were lost because sign controls were drafted in many communities when neon was "out." Increasingly, however, communities are enacting ordinances that recognize older and historic signs and permit them to be kept. The National Park Service encourages this trend.

Sign as Icon

Signs often become so important to a community that they are valued long after their role as commercial markers has ceased. They become landmarks, loved because they have been visible at certain street corners—or from many vantage points across the city—for a long time. Such signs are valued for their familiarity, their beauty, their humor, their size, or even their grotesqueness. In these cases, signs transcend their conventional role as vehicles of information, as identifiers of something else. When signs reach this stage, they accumulate rich layers of meaning. They no longer merely advertise, but are valued in and of themselves. They become icons.

Preserving Historic Signs

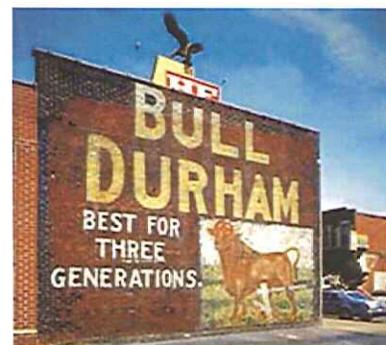
Historic signs can contribute to the character of buildings and districts. They can also be valued in themselves, quite apart from the buildings to which they may be attached. However, any program to preserve historic signs must recognize the challenges they present. These challenges are not for the most part technical. Sign preservation is more likely to involve aesthetic concerns and to generate community debate. Added to these concerns are several community goals that often appear to conflict: retaining diverse elements from the past, encouraging artistic expression in new signs, zoning for aesthetic concerns, and reconciling business requirements with preservation.

Preserving historic signs is not always easy. But the intrinsic merit of many signs, as well as their contribution to the overall character of a place, make the effort worthwhile. Observing the guidelines given below can help preserve both business and history.

Retaining Historic Signs

Retain historic signs whenever possible, particularly when they are:

- associated with historic figures, events or places.
- significant as evidence of the history of the product, business or service advertised.
- significant as reflecting the history of the building or the development of the historic district. A sign may be the only indicator of a building's historic use.
- characteristic of a specific historic period, such as gold leaf on glass, neon, or stainless steel lettering.
- integral to the building's design or physical fabric, as when a sign is part of a storefront made of Carrara glass or enamel panels, or when the name of the historic firm or the date are rendered in stone, metal or tile. In such cases, removal can harm the integrity of a historic property's design, or cause significant damage to its materials.
- outstanding examples of the signmaker's art, whether because of their excellent craftsmanship, use of materials, or design.



Signs for Bull Durham Tobacco once covered walls all over the country. Photo: Jack E. Boucher, HABS, NPS.

- local landmarks, that is, signs recognized as popular focal points in a community.
- elements important in defining the character of a district, such as marquees in a theater district.

Maintaining and Repairing Historic Signs

Maintenance of historic signs is essential for their long-term preservation. Sign maintenance involves periodic inspections for evidence of damage and deterioration. Lightbulbs may need replacement. Screws and bolts may be weakened, or missing altogether. Dirt and other debris may be accumulating, introduced by birds or insects, and should be cleaned out. Water may be collecting in or on sign cabinets, threatening electrical connections. The source of water penetration should be identified and sealed. Most of these minor repairs are routine maintenance measures, and do not call for special expertise. All repairs, however, require caution. For example, electricity should be turned off when working around electric signs.

More extensive repairs should be undertaken by professionals. The sign industry is a large and active one. Sign designers, fabricators and skilled craftsmen are located throughout the country. Once in danger of being lost altogether, gold leaf on glass and porcelain enamel are undergoing revivals, and the art of bending neon tubes is now widely practiced. Finding help from qualified sources should not be difficult. Before contracting for work on historic signs, however, owners should check references, and view other projects completed by the same company.

Major repairs may require removal of the sign to a workshop. Since signs are sometimes damaged while the building is undergoing repair, work on the building should be scheduled while the sign is in the shop. (If the sign remains in place while work on the building is in progress, the sign should be protected.)

Repair techniques for specific sign materials are discussed below (see "Repairing Historic Sign Materials"). The overall goal in repairs such as supplying missing letters, replacing broken neon tubing, or splicing in new members for deteriorated sections is to restore a sign that is otherwise whole. Recognize, however, that the apparent age of historic signs is one of their major features; do not "over restore" signs so that all evidence of their age is lost, even though the appearance and form may be recaptured.

Reusing Historic Signs

If a building or business has changed hands, historic signs associated with former enterprises in the building should be reused if possible by:

- keeping the historic sign—unaltered. This is often possible even when the new business is of a different nature from the old. Preferably, the old sign can be left in its historic location; sometimes, however, it may be necessary to move the sign elsewhere on the building to accommodate a new one. Conversely, it may be necessary to relocate new signs to avoid hiding or overwhelming historic ones, or to redesign proposed new signs so that the old ones may remain. (The legitimate advertising needs of current tenants, however, must be recognized.) Keeping the old sign is often a good marketing strategy. It can exploit the recognition value of the old name and play upon the public's fondness for the old sign. The advertising value of an old sign can be immense. This is especially true when the sign is a community landmark.
- relocating the sign to the interior, such as in the lobby or above the bar in a restaurant. This option is less preferable than keeping the sign outside the building, but it does preserve the sign, and leaves open the possibility of putting it back in its historic location.
- modifying the sign for use with the new business. This may not be possible without destroying essential features, but in some cases it can be done by changing details only. In other respects, the sign may be perfectly serviceable as is.

If none of these options is possible, the sign could be donated to a local museum, preservation organization or other group.

Repairing Historic Sign Materials

Porcelain Enamel

Porcelain enamel is among the most durable of materials used in signs.⁵ Made of glass bonded onto metal (usually steel) at high temperatures, it keeps both its high gloss and its colors for decades. Since the surface of the sign is essentially glass, porcelain enamel is virtually maintenance free; dirt can be washed off with soap and water and other glass cleaners.

Porcelain enamel signs can be damaged by direct blows from stones and other sharp objects. If both the enamel surface and the undercoat are scratched, the metal surface can rust at the impact site. Because the bond between glass and metal is so strong, however, the rust does not "travel" behind the glass, and the rust is normally confined to localized areas. The sign edges can also rust if they were never enamelled. To treat the problem, clean the rust off carefully, and touchup the area with cold enamel (a type of epoxy used mostly in jewelry), or with enamel paints.

Dents in porcelain enamel signs should be left alone. Attempting to hammer them out risks further damage.

Goldleaf or Gilding

Goldleaf or gilding is both elegant and durable. These properties made it among the most popular sign materials in the nineteenth and early twentieth centuries. Surface-gilded signs (for example, gilded raised letters or symbols found on the exterior) typically last about 40 years. Damage to these signs occurs from weather and abrasion. Damage to gilded signs on glass normally occurs when the protective coating applied over the gilding is removed by harsh cleaning chemicals or scratched by scrub brushes. The sign can then flake upon subsequent cleanings.

Historic gilded signs can be repaired, typically by regilding damaged areas. An oil size is painted on the surface. The gold leaf is applied when the surface has become sufficiently "tacky." Similarly, historic "reverse on glass" goldleaf signs can be repaired—by experts. A sample of the flaking sign is first taken to determine its composition. Reverse on glass signs use goldleaf ranging from 12 to 23 karats. The gold is alloyed with copper and silver in varying amounts for differences in color. (Surface gilding—on raised letters, picture frames and statehouse domes—uses 23 karat gold. Pure gold, 24 karat, is too soft to use in such applications.) The damaged portions of the sign are then regilded in the same manner as they were done historically: the inside surface of the glass is coated with a gelatin; gold leaves about three inches square are then spread over the area. The new letter or design is then drawn in reverse on the new leaf, and coated with a backing paint (normally a chrome yellow). With the new design thus sealed, the rest of the leaf is removed. The sign is then sealed with a clear, water-resistant varnish.

Gilded signs, both surface and reverse on glass, can be cleaned gently with soap and water, using a soft cloth. Additionally, for glass signs, the varnish backing should be replaced every seven years at the latest.

Neon

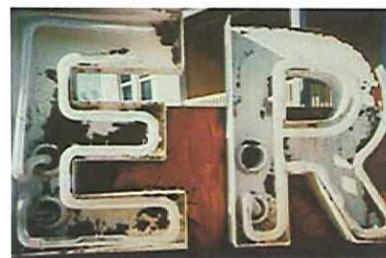
Neon signs can last 50 years, although 20-25 years is more typical. When a neon sign fails, it is not because the gas has "failed," but because the system surrounding it has broken down. The glass tubes have been broken, for example, thus letting the gas escape, or the electrodes or transformers have failed. If the tube is broken, a new one must be made by a highly skilled "glass bender." After the hot glass tube has been shaped, it must undergo "purification" before being refilled with gas.



Workers prepare the "metal cans" from a sign for re-mounting. Photo: Larry Kanter.

The glass and the metal electrode at the end of the tube are heated in turns. As these elements become hot, surface impurities burn off into the tube. The resulting vapor is then removed through "evacuation"—the process of creating a vacuum. Only then is the "neon" gas (neon or mercury-argon) added. Neon gives red light, mercury-argon produces blue. Other colors are produced by using colored glass and any of dozens of phosphor coatings inside the tube. Green, for example, can be produced by using mercury-argon in yellow glass. Since color is so important in neon signs, it is vital to determine the original color or colors. A neon studio can accomplish this using a number of specialized techniques.

A failing transformer can cause the neon sign to flicker intensely, and may have to be replaced. Flickering



These tubes in this amusement park's sign were broken and the surrounding "metal cans" needed work also. See below. Photo: Stan Fowler.

neon can also indicate a problem with the gas pressure inside the tube. The gas may be at too high or too low a pressure. If so, the gas must be repumped.

Repairs to neon signs also include repairs to the surrounding components of the sign. The "metal cans" that often serve as backdrops to the tubing may need cleaning or, in case of rust, scraping and repainting.

As with gilded signs, repair of neon signs is not a matter for amateurs.



Neon fabricators are installing the new tubing in the repaired and remounted cans. Photo: Larry Kanter.

New Signs and Historic Buildings

Preserving old signs is one thing. Making new ones is another. Closely related to the preservation of historic signs on historic buildings is the subject of new signs for historic buildings. Determining what new signs are appropriate for historic buildings, however, involves a major paradox: Historic sign practices were not always "sympathetic" to buildings. They were often unsympathetic to the building, or frankly contemptuous of it. Repeating some historic practices, therefore, would definitely not be recommended.

Yet many efforts to control signage lead to bland sameness. For this reason the National Park Service discourages the adoption of local guidelines that are too restrictive, and that effectively dictate uniform signs within commercial districts. Instead, it encourages communities to promote diversity in signs—their sizes, types, colors, lighting, lettering and other qualities. It also encourages business owners to choose signs that reflect their own tastes, values, and personalities. At the same time, tenant sign practices can be stricter than sign ordinances. The National Park Service therefore encourages businesses to fit their sign programs to the building.

The following points should be considered when designing and constructing new signs for historic buildings:

- signs should be viewed as part of an overall graphics system for the building. They do not have to do all the "work" by themselves. The building's form, name and outstanding features, both decorative and functional, also support the advertising function of a sign. Signs should work with the building, rather than against it.
- new signs should respect the size, scale and design of the historic building. Often features or details of the building will suggest a motif for new signs.
- sign placement is important: new signs should not obscure significant features of the historic building. (Signs above a storefront should fit within the historic signboard, for example.)
- new signs should also respect neighboring buildings. They should not shadow or overpower adjacent structures.
- sign materials should be compatible with those of the historic building. Materials characteristic of the building's period and style, used in contemporary designs, can form effective new signs.
- new signs should be attached to the building carefully, both to prevent damage to historic fabric, and to ensure the safety of pedestrians. Fittings should penetrate mortar joints rather than brick, for example, and signloads should be properly calculated and distributed.



This hanging pig is delightful, even without its neon. Holes show where tubing was attached. It has been a local landmark in Baltimore's Fells Point neighborhood for over 60 years. Photo: NPS files.

Summary and References

Historic signs once allowed buyers and sellers to communicate quickly, using images that were the medium of daily life.

Surviving historic signs have not lost their ability to speak. But their message has changed. By communicating names, addresses, prices, products, images and other fragments of daily life, they also bring the past to life.

With halting steps I paced the streets, and passed the sign of "The Crossed Harpoons" —but it looked too expensive and jolly there. . . . Moving on, I at last came to a dim sort of light not far from the docks, and heard a forlorn creaking in the air; and looking up, saw a swinging sign over the door with a white painting upon it, faintly representing a tall straight jet of misty spray, and these words underneath — "The Spouter Inn: —Peter Coffin."

The creaking wooden sign in *Moby Dick* identifies public lodging. But it also does a great deal more than that. It projects an image. It sets a mood and defines a place. The ability to convey commercial and symbolic messages is a property of all signs, not just those in novels.

Every sign hanging outside a door, standing on a roof, extending over a storefront, or marching across a wall transmits messages from the sign maker to the sign reader. Mixed in with names, addresses, business hours and products are images, personalities, values and beliefs.

NOTES

1. Bill Evans and Andrew Lawson, *Shopfronts*. New York: Van Nostrand Reinhold Co., 1981, p. 109, 114.
2. Charles L.H. Wagner, *The Story of Signs: An Outline History of the Sign Arts from Earliest Recorded Times to the Present "Atomic Age"*. Boston: Arthur MacGibbon, 1954, p. 37.
3. Rudi Stern, *Let There Be Neon*. New York: Harry N. Abrams, Inc. 1979, p. 19.
4. Robert Venturi, Denise Scott Brown, and Steven Izenour, *Learning from Las Vegas*. Rev. ed. Cambridge, MA: MIT Press, 1977.
5. George H. Kramer, "Preserving Historic Signs in the Commercial Landscape: The Impact of Regulation." (Unpublished Masters Thesis: University of Oregon, 1989), p. 15. This section on sign regulation is heavily indebted to this work. See especially Chapter 2, History of Sign Regulation and Chapter 3, Mechanics of Sign Regulation, pp. 7-60.
6. *Berman v. Parker* involved the condemnation of an older building for an urban renewal project. The decision "ironically would prove to be a major spur to a new wave of local preservation laws...." Christopher J. Duerksen, ed. *A Handbook on Historic Preservation Law*. Washington, D.C.: The Conservation Foundation and The National Center for Preservation Law, 1983, p. 7.
7. A balanced approach to sign controls is offered by Peter H. Phillips, "Sign Controls for Historic Signs," PAS Memo, November 1988. (Published by American Planning Association, Washington, D.C.).
8. See John Tymoski, "Porcelain Enamel: The Sign Industry's Most Durable Material," *Signs of the Times*, December 1990, pp. 6671. For goldleaf, see October 1984 and November 1990 special issues of *Signs of the Times*. An excellent short "course" in neon evaluation is offered in *Neon: The Good, the Bad, and the Ugly*, by Paul R. Davis, Identity, Spring 1991, pp. 5659.

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

October 1991

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Technical Preservation Services

National Park Service
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PRESERVATION BRIEFS

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Making Historic Properties Accessible

Thomas C. Jester and Sharon C. Park, AIA

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Accessible historic building.
Photo: NPS files.

Historically, most buildings and landscapes were not designed to be readily accessible for people with disabilities. In recent years, however, emphasis has been placed on preserving historically significant properties, and on making these properties—and the activities within them—more accessible to people with disabilities. With the passage of the Americans with Disabilities Act in 1990, access to properties open to the public is now a civil right.



A significant entrance may be difficult to modify. Although a special challenge, sensitive changes can almost always be made to provide access while preserving

This Preservation Brief introduces the complex issue of providing accessibility at historic properties, and underscores the need to balance accessibility and historic preservation. It provides guidance on making historic properties accessible while preserving their historic character; the Brief also provides examples to show that independent physical accessibility at historic properties can be achieved with careful planning, consultation, and sensitive design. While the Brief focuses primarily on making buildings and their sites accessible, it also includes a section on historic landscapes. The Brief will assist historic property owners, design professionals, and administrators in evaluating their historic properties so that the highest level of accessibility can be provided while minimizing changes to historic materials and features. Because many projects encompassing accessibility work are complex, it is advisable to consult with experts in the fields of historic preservation and accessibility before proceeding with permanent physical changes to historic properties.

the unique historic character. Photo: NPS files.

Modifications to historic properties to increase accessibility may be as simple as a small, inexpensive ramp to overcome one entrance step, or may involve changes to exterior and interior features. The Brief does not provide a detailed explanation of local or State

accessibility laws as they vary from jurisdiction to jurisdiction. A concise explanation of several federal accessibility laws is included below.

Planning Accessibility Modifications

Historic properties are distinguished by features, materials, spaces, and spatial relationships that contribute to their historic character. Often these elements, such as steep terrain, monumental steps, narrow or heavy doors, decorative ornamental hardware, and narrow pathways and corridors, pose barriers to persons with disabilities, particularly to wheelchair users.

A three-step approach is recommended to identify and implement accessibility modifications that will protect the integrity and historic character of historic properties:

1. Review the historical significance of the property and identify character-defining features;
2. Assess the property's existing and required level of accessibility; and
3. Evaluate accessibility options within a preservation context.

1. Review the Historical Significance

If the property has been designated as historic (properties that are listed in, or eligible for listing in the National Register of Historic Places, or designated under State or local law), the property's nomination file should be reviewed to learn about its significance. Local preservation commissions and State Historic Preservation Offices can usually provide copies of the nomination file and are also resources for additional information and assistance. Review of the written documentation should always be supplemented with a physical investigation to identify which character defining features and spaces must be protected whenever any changes are anticipated. If the level of documentation for a property's significance is limited, it may be necessary to have a preservation professional identify specific historic features, materials, and spaces that should be protected.

For most historic properties, the construction materials, the form and style of the property, the principal elevations, the major architectural or landscape features, and the principal public spaces constitute some of the elements that should be preserved. Every effort should be made to minimize damage to the materials and features that convey a property's historical significance when making modifications for accessibility. Very small or highly significant properties that have never been altered may be extremely difficult to modify.

Secondary spaces and finishes and features that may be less important to the historic character should also be identified; these may generally be altered without jeopardizing the historical significance of a property. Nonsignificant spaces, secondary pathways, later additions, previously altered areas, utilitarian spaces, and service areas can usually be modified without threatening or destroying a property's historical significance.

2. Assess the Property's Existing and Required Level of Accessibility

A building survey or assessment will provide a thorough evaluation of a property's accessibility. Most surveys identify accessibility barriers in the following areas: building and site entrances; surface textures, widths and slopes of walkways; parking; grade changes; size, weight and configuration of doorways; interior corridors and path of travel restrictions; elevators; and public toilets and amenities. Simple audits can be completed by property owners using readily available checklists (See Further Reading). Accessibility specialists can be hired to assess barriers in more complex properties, especially those with multiple buildings, steep terrain, or interpretive programs. Persons with disabilities can be particularly helpful in assessing specific barriers.



This accessibility ramp is compatible with the historic building in scale and materials. Photo: William Smith.

All applicable accessibility requirements—local codes, State codes and federal laws—should be reviewed carefully before undertaking any accessibility modification. Since many States and localities have their own accessibility regulations and codes (each with their own requirements for dimensions and technical requirements), owners should use the most stringent accessibility requirements when implementing modifications. The Americans with Disability Act Accessibility Guidelines (ADAAG) is the document that should be consulted when complying with the Americans with Disabilities Act (ADA) requirements.

3. Identify and Evaluate Accessibility Options within a Preservation Context

Once a property's significant materials and features have been identified, and existing and required levels of accessibility have been established, solutions can be developed. Solutions should provide the greatest amount of accessibility without threatening or destroying those materials and features that make a property significant. Modifications may usually be phased over time as funds are available, and interim solutions can be considered until more permanent solutions are implemented. A team comprised of persons with disabilities, accessibility and historic preservation professionals, and building inspectors should be consulted as accessibility solutions are developed.

Modifications to improve accessibility should generally be based on the following priorities:

1. Making the main or a prominent public entrance and primary public spaces accessible, including a path to the entrance;
2. Providing access to goods, services, and programs;
3. Providing accessible restroom facilities; and,
4. Creating access to amenities and secondary spaces.



The ramp's scale and materials are inconsistent with the historic character of the building. Photo: NPS files.

All proposed changes should be evaluated for conformance with the Secretary of the Interior's "Standards for the Treatment of Historic Properties," which were created for property owners to guide preservation work. These Standards stress the importance of retaining and protecting the materials and features that convey a property's historical significance. Thus, when new features are incorporated for accessibility, historic materials and features should be retained whenever possible. Accessibility modifications should be in scale with the historic property, visually compatible, and, whenever possible, reversible. Reversible means that if the new feature were removed at a later date, the essential form and integrity of the property would be unimpaired. The design of new features should also be differentiated from the design of the historic property so that the evolution of the property is evident.

In general, when historic properties are altered, they should be made as accessible as possible. However, if an owner or a project team believes that certain modifications would threaten or destroy the significance of the property, the State Historic Preservation Officer should be consulted to determine whether or not any special accessibility provisions may be used. Special accessibility provisions for historic properties will vary depending on the applicable accessibility requirements.

In some cases, programmatic access may be the only option for extremely small or unaltered historic properties, such as a two-story house museum with no internal elevator. Programmatic access for historic properties refers to alternative methods of providing services, information, and experiences when physical access cannot be provided. It may mean offering an audio-visual program showing an inaccessible upper floor of a historic house museum, providing interpretive panels from a vista at an inaccessible terraced garden, or creating a tactile model of a historic monument for people with visual impairments.

Accessibility Solutions

The goal in selecting appropriate solutions for specific historic properties is to provide a high level of accessibility without compromising significant features or the overall character of the property. The following sections describe accessibility solutions and offer guidance on specific historic property components, namely the building site, entrances, interiors,

landscapes, amenities, and new additions. Several solutions are discussed in each section, referencing dimensions and technical requirements from the ADA's accessibility guidelines, ADAAG. State and local requirements, however, may differ from the ADA requirements. Before making any modification owners should be aware of all applicable accessibility requirements.

The Building Site

An accessible route from a parking lot, sidewalk, and public street to the entrance of a historic building or facility is essential. An accessible route, to the maximum extent possible, should be the circulation route used by the general public. Critical elements of accessible routes are their widths, slopes, cross slopes, and surface texture. Each of these route elements must be appropriately designed so that the route can be used by everyone, including people with disabilities.



The significant building site is now accessible to people with disabilities (note steps in front of ramp). Photo: NPS files.

The distance between the arrival and destination points should also be as short as possible. Sites containing designed landscapes should be carefully evaluated before making accessibility modifications. Historic landscapes are described in greater detail below.

Providing Convenient Parking

If parking is provided, it should be as convenient as possible for people with disabilities. Specially designated parking can often be created to improve accessibility. Modifications to parking configurations and pathways should not alter significant landscape features.

Creating an Accessible Route

The route or path through a site to a historic building's entrance should be wide enough, generally at least 3 feet (91 cm), to accommodate visitors with disabilities and must be appropriately graded with a stable, firm, and slip-resistant surface. Existing paths should be modified to meet these requirements whenever possible as long as doing so would not threaten or destroy significant materials and features.

Existing surfaces can often be stabilized by providing a new base and resetting the paving materials, or by modifying the path surface. In some situations it may be appropriate to create a new path through an inaccessible area. At large properties, it may be possible to regrade a slope to less than 1:20 (5%), or to introduce one or more carefully planned ramps. Clear directional signs should mark the path from arrival to destination.

Entrances



The historic threshold was made accessible with a 1/2" wood bevel. Photo: NPS files.

Whenever possible, access to historic buildings should be through a primary public entrance. In historic buildings, if this cannot be achieved without permanent damage to character-defining features, at least one entrance used by the public should be made accessible. If the accessible entrance is not the primary public entrance, directional signs should direct visitors to the accessible entrance. A rear or service entrance should be avoided as the only mean of entering a building.

Creating an accessible entrance usually involves overcoming a change in elevation. Steps, landings, doors, and thresholds, all part of the entrance, often pose barriers for persons with disabilities. To preserve the integrity of these features, a number of solutions are available to increase accessibility. Typical solutions include regrading, incorporating ramps, installing wheelchair lifts, creating new entrances, and modifying doors, hardware, and thresholds.

Regrading an Entrance

In some cases, when the entrance steps and landscape features are not highly significant, it may be possible to regrade to provide a smooth entrance into a building. If the existing steps are historic masonry, they should be buried, whenever possible, and not removed.

Incorporating Ramps

Permanent ramps are perhaps the most common means to make an entrance accessible. As a new feature, ramps should be carefully designed and appropriately located to preserve a property's historic character.

Ramps should be located at public entrances used by everyone whenever possible, preferably where there is minimal change in grade. Ramps should also be located to minimize the loss of historic features at the connection points—porch railings, steps, and windows—and should preserve the overall historic setting and character of the property. Larger buildings may have below grade areas that can accommodate a ramp down to an entrance. Below grade entrances can be considered if the ramp leads to a publicly used interior, such as an auditorium, or if the building is serviced by a public elevator. Ramps can often be incorporated behind historic features, such as cheek-walls or railings, to minimize the visual effect.



A new elevator entrance was provided next to the stairs to provide universal access to the services inside. Photo: Courtesy, GSA.

The steepest allowable slope for a ramp is usually 1:12 (8%), but gentler slopes should be used whenever possible to accommodate people with limited strength. Greater changes in elevation require larger and longer ramps to meet accessibility scoping provisions and may require an intermediate landing. Most codes allow a slightly steeper ramp for historic buildings to overcome one step.

Ramps can be faced with a variety of materials, including wood, brick, and stone. Often the type and quality of the materials determines how compatible a ramp design will be with a historic property. Unpainted pressure-treated wood should not be used to construct ramps because it usually appears temporary and is not visually compatible with most historic properties.

Railings should be simple in design, distinguishable from other historic features, and should extend one foot beyond the sloped area.

Ramp landings must be large enough for wheelchair users, usually at least 5 feet by 5 feet (152.5 cm by 152.5 cm), and the top landing must be at the level of the door threshold. It may be possible to reset steps by creating a ramp to accommodate minor level changes and to meet the threshold without significantly altering a property's historic character. If a building's existing landing is not wide or deep enough to accommodate a ramp, it may be necessary to modify the entry to create a wider landing. Long ramps, such as switchbacks, require intermediate landings, and all ramps should be detailed with an appropriate edge and railing for wheelchair users and visually impaired individuals.

Temporary or portable ramps are usually constructed of light-weight materials and, thus, are rarely safe or visually compatible with historic properties. Moreover, portable ramps are often stored until needed and, therefore, do not meet accessibility requirements for independent access. Temporary and portable ramps, however, may be an acceptable interim solution to improve accessibility until a permanent solution can be implemented.

Installing Wheelchair Lifts

Platform lifts and inclined stair lifts, both of which accommodate only one person, can be used to overcome changes of elevation ranging from three to 10 feet (.9 m-3 m) in height. However, many States have restrictions on the use of wheelchair lifts, so all applicable codes should be reviewed carefully before installing one. Inclined stair lifts, which carry a wheelchair on a platform up a flight of stairs, may be employed selectively. They tend to be visually intrusive, although they are relatively reversible. Platform lifts can be used when there is inadequate space for a ramp. However, such lifts should be installed in unobtrusive locations and under cover to minimize maintenance if at all possible. A similar, but more expensive platform lift has a retracting railing that lowers into the ground, minimizing the visual effect to historic properties. Mechanical lifts have drawbacks at historic properties with high public visitation because their capacity is limited, they sometimes cannot be operated independently, and they require frequent maintenance.

Considering a New Entrance

When it is not possible to modify an existing entrance, it may be possible to develop a new entrance by creating an entirely new opening in an appropriate location, or by using a secondary window for an opening. This solution should only be considered after exhausting all possibilities for modifying existing entrances.

Retrofitting Doors

Historic doors generally should not be replaced, nor should door frames on the primary elevation be widened, as this may alter an important feature of a historic design. However, if a building's historic doors have been removed, there may be greater latitude in designing a compatible new entrance. Most accessibility standards require at least a 32" (82 cm) clear opening with manageable door opening pressures. The most desirable preservation solution to improve accessibility is retaining historic doors and upgrading the door pressure with one of several devices. Automatic door openers (operated by push buttons, mats, or electronic eyes) and power-assisted door openers can eliminate or reduce door pressures that are accessibility barriers, and make single or double-leaf doors fully operational.

Adapting Door Hardware

If a door opening is within an inch or two of meeting the 32" (81 cm) clear opening requirement, it may be possible to replace the standard hinges with off-set hinges to increase the size of the door opening as much as 1 1/8" (3.8 cm). Historic hardware can be retained in place, or adapted with the addition of an automatic opener, of which there are several types. Door hardware can also be retrofitted to reduce door pressures. For example, friction hinges can be retrofitted with ball-bearing inserts, and door closers can be rethreaded to reduce the door pressure.

Altering Door Thresholds

A door threshold that exceeds the allowable height, generally 1/2" (1.3 cm), can be altered or removed with one that meets applicable accessibility requirements. If the threshold is deemed to be significant, a bevel can be added on each side to reduce its height. Another solution is to replace the threshold with one that meets applicable accessibility requirements and is visually compatible with the historic entrance.



This door handle has been retrofitted to meet ADA requirements. Photo: NPS files.

Easily Achievable Accessibility Options

Many accessibility solutions can be implemented easily and inexpensively without destroying the significance of historic properties. While it may not be possible to undertake all of the modifications listed below, each change will improve accessibility.

Sites and Entrances

- Creating a designated parking space.
- Installing ramps.
- Making curb cuts.

Interiors

- Repositioning shelves.
- Rearranging tables, displays, and furniture.
- Repositioning telephones.
- Adding raised markings on elevator control buttons.
- Installing flashing alarm lights.
- Installing offset hinges to widen doorways.
- Installing or adding accessible door hardware.
- Adding an accessible water fountain, or providing a paper cup dispenser at an inaccessible water fountain.

Restrooms

- Installing grab bars in toilet stalls.
- Rearranging toilet partitions to increase maneuvering space.

- Insulating lavatory pipes under sinks to prevent burns.
- Installing a higher toilet seat.
- Installing a full-length bathroom mirror.
- Repositioning the paper towel dispenser.



A retractable lift for this historic building foyer was created using "like" materials. Photo: NPS files.

Moving Through Historic Interiors

Persons with disabilities should have independent access to all public areas and facilities inside historic buildings. The extent to which a historic interior can be modified depends on the significance of its materials, plan, spaces, features, and finishes. Primary spaces are often more difficult to modify without changing their character. Secondary spaces may generally be changed without compromising a building's historic character. Signs should clearly mark the route to accessible restrooms, telephones, and other accessible areas.

Installing Ramps and Wheelchair Lifts

If space permits, ramps and wheelchair lifts can also be used to increase accessibility inside buildings. However, some States and localities restrict interior uses of wheelchair lifts for life-safety reasons. Care should be taken to install these new features where they can be readily accessed. Ramps and wheelchair lifts are described below.

Upgrading Elevators

Elevators are an efficient means of providing accessibility between floors. Some buildings have existing historic elevators that are not adequately accessible for persons with disabilities because of their size, location, or detailing, but they may also contribute to the historical significance of a building. Significant historic elevators can usually be upgraded to improve accessibility. Control panels can be modified with a "wand" on a cord to make the control panel accessible, and timing devices can usually be adjusted.

Retrofitting Door Knobs

Historic door knobs and other hardware may be difficult to grip and turn. In recent years, lever-handles have been developed to replace door knobs. Other lever-handle devices can be added to existing hardware. If it is not possible or appropriate to retrofit existing door knobs, doors can be left open during operating hours (unless doing so would violate life safety codes), and power-assisted door openers can be installed. It may only be necessary to retrofit specific doorknobs to create an accessible path of travel and accessible restrooms.

Modifying Interior Stairs

Stairs are the primary barriers for many people with disabilities. However, there are some ways to modify stairs to assist people who are able to navigate them. It may be appropriate to add hand railings if none exist. Railings should be 1 ½" (3.8 cm) in diameter and return to the wall so straps and bags do not catch. Color-contrasting, slip-resistant strips will help people with visual impairments. Finally, beveled or closed risers are recommended unless the stairs are highly significant, because open risers catch feet.

Building Amenities

Some amenities in historic buildings, such as restrooms, seating, telephones, drinking fountains, counters, may contribute to a building's historic character. They will often require modification to improve their use by persons with disabilities. In many cases, supplementing existing amenities, rather than changing or removing them, will increase access and minimize changes to historic features and materials.

Upgrading Restrooms

Restrooms may have historic fixtures such as sinks, urinals, or marble partitions that can be retained in the process of making modifications. For example, larger restrooms can sometimes be reconfigured by relocating or combining partitions to create an accessible toilet stall. Other changes to consider are adding grab bars around toilets, covering hot water pipes under sinks with insulation to prevent burns, and providing a sink, mirror, and paper dispenser at a height suitable for wheelchair users. A unisex restroom may be created if it is technically infeasible to create two fully accessible restrooms, or

if doing so would threaten or destroy the significance of the building. It is important to remember that restroom fixtures, such as sinks, urinals, and partitions, may be historic, and therefore, should be preserved whenever possible.

Modifying Other Amenities

Other amenities inside historic buildings may require modification. Seating in a theater, for example, can be made accessible by removing some seats in several areas. New seating that is accessible can also be added at the end of existing rows, either with or without a level floor surface. Readily removable seats may be installed in wheelchair spaces when the spaces are not required to accommodate wheelchair users. Historic water fountains can be retained and new, two-tiered fountains installed if space permits. If public telephones are provided, it may be necessary to install at least a Text Telephone (TT), also known as a Telecommunication Device for the Deaf (TDD). Historic service counters commonly found in banks, theaters, and hotels generally should not be altered. It is preferable to add an accessible counter on the end of a historic counter if feasible. Modified or new counters should not exceed 36" (91.5 cm) in height.

Considering a New Addition as an Accessibility Solution

Many new additions are constructed specifically to incorporate modern amenities such as elevators, restrooms, fire stairs, and new mechanical equipment. These new additions often create opportunities to incorporate access for people with disabilities. It may be possible, for example, to create an accessible entrance, path to public levels via a ramp, lift, or elevator. However, a new addition has the potential to change a historic property's appearance and destroy significant building and landscape features. Thus, all new additions should be compatible with the size, scale, and proportions of historic features and materials that characterize a property.

New additions should be carefully located to minimize connection points with the historic building, such that if the addition were to be removed in the future, the essential form and integrity of the building would remain intact. On the other hand, new additions should also be conveniently located near parking that is connected to an accessible route for people with disabilities. As new additions are incorporated, care should be taken to protect significant landscape features and archeological resources. Finally, the design for any new addition should be differentiated from the historic design so that the property's evolution over time is clear. New additions frequently make it possible to increase accessibility, while simultaneously reducing the level of change to historic features, materials, and spaces.

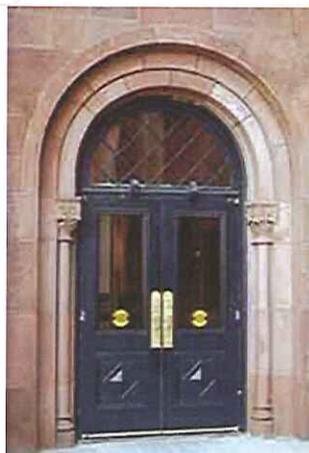
Making Historic Landscapes Accessible

To successfully incorporate access into historic landscapes, the planning process is similar to that of other historic properties. Careful research and inventory should be undertaken to determine which materials and features convey the landscape's historical significance. As part of this evaluation, those features that are character-defining (topographical variation, vegetation, circulation, structures, furnishings, objects) should be identified. Historic finishes, details, and materials that also contribute to a landscape's significance should also be documented and evaluated prior to determining an approach to landscape accessibility. For example, aspects of the pedestrian circulation system that need to be understood include walk width, aggregate size, pavement pattern, texture, relief, and joint details. The context of the walk should be understood including its edges and surrounding area. Modifications to surface textures or widths of pathways can often be made with minimal effect on significant landscape features.

Additionally, areas of secondary importance such as altered paths should be identified—especially those where the accessibility modifications will not destroy a landscape's significance. By identifying those features that are contributing or non-contributing, a sympathetic circulation experience can then be developed.

After assessing a landscape's integrity, accessibility solutions can be considered. Full access throughout a historic landscape may not always be possible. Generally, it is easier to provide accessibility to larger, more open sites where there is a greater variety of public experiences. However, when a landscape is uniformly steep, it may only be possible to make discrete portions of a historic landscape accessible, and viewers may only be able to experience the landscape from selected vantage points along a prescribed pedestrian or vehicular access route. When defining such a route, the interpretive value of the user experience should be considered; in other words, does the route provide physical or visual access to those areas that are critical to understand the meaning of the landscape?

Federal Accessibility Laws



The automatic door to this museum building is a practical solution for universal entry. Photo: NPS files.

Today, few building owners are exempt from providing accessibility for people with disabilities. Before making any accessibility modification, it is imperative to determine which laws and codes are applicable. In addition to local and State accessibility codes, the following federal accessibility laws are currently in effect:

Architectural Barriers Act (1968)

The Architectural Barriers Act stipulates that all buildings designed, constructed, and altered by the Federal Government, or with federal assistance, must be accessible. Changes made to federal buildings must meet the Uniform Federal Accessibility Standards (UFAS). Special provisions are included in UFAS for historic buildings that would be threatened or destroyed by meeting full accessibility requirements.

Rehabilitation Act (1973)

The Rehabilitation Act requires recipients of federal financial assistance to make their programs and activities accessible to everyone. Recipients are allowed to make their properties accessible by altering their building, by moving programs and activities to accessible spaces, or by making other accommodations.

Americans with Disabilities Act (1990)

Historic properties are not exempt from the Americans with Disabilities Act (ADA) requirements. To the greatest extent possible, historic buildings must be as accessible as non-historic buildings. However, it may not be possible for some historic properties to meet the general accessibility requirements.

Under Title II of the ADA, State and local governments must remove accessibility barriers either by shifting services and programs to accessible buildings, or by making alterations to existing buildings. For instance, a licensing office may be moved from a second floor to an accessible first floor space, or if this is not feasible, a mail service might be provided. However, State and local government facilities that have historic preservation as their main purpose—State-owned historic museums, historic State capitols that offer tours—must give priority to physical accessibility.

Under Title III of the ADA, owners of "public accommodations" (theaters, restaurants, retail shops, private museums) must make "readily achievable" changes; that is, changes that can be easily accomplished without much expense. This might mean installing a ramp, creating accessible parking, adding grab bars in bathrooms, or modifying door hardware. The requirement to remove barriers when it is "readily achievable" is an ongoing responsibility. When alterations, including restoration and rehabilitation work, are made, specific accessibility requirements are triggered.

Recognizing the national interest in preserving historic properties, Congress established alternative requirements for properties that cannot be made accessible without "threatening or destroying" their significance. A consultation process is outlined in the ADA's Accessibility Guidelines for owners of historic properties who believe that making specific accessibility modifications would "threaten or destroy" the significance of their property. In these situations, after consulting with persons with disabilities and disability organizations, building owners should contact the State Historic Preservation Officer (SHPO) to determine if the special accessibility provisions for historic properties may be used. Further, if it is determined in consultation with the SHPO that compliance with the minimum requirements would also "threaten or destroy" the significance of the property, alternative methods of access, such as home delivery and audio-visual programs, may be used.

Summary and References

Historic properties are irreplaceable and require special care to ensure their preservation for future generations. With the passage of the Americans with Disabilities Act, access to historic properties open to the public is a now civil right, and owners of historic properties must evaluate existing buildings and determine how they can be made more accessible. It is a challenge to evaluate properties thoroughly, to identify the applicable accessibility requirements, to explore alternatives and

to implement solutions that provide independent access and are consistent with accepted historic preservation standards. Solutions for accessibility should not destroy a property's significant materials, features and spaces, but should increase accessibility as much as possible. Most historic buildings are not exempt from providing accessibility, and with careful planning, historic properties can be made more accessible, so that all citizens can enjoy our Nation's diverse heritage.

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

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PRESERVATION BRIEFS

47 Maintaining the Exterior of Small and Medium Size Historic Buildings

Sharon C. Park, FAIA

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

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

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

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

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

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

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

Getting Started

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

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

Monitoring, inspections, and maintenance should all be undertaken with safety in mind. Besides normal safety procedures, it is important to be cognizant of health issues more commonly encountered with older buildings,



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

such as lead-based paint, asbestos, and bird droppings, and to know when it is necessary to seek professional services (see [debar](#)).

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

Cautions During Maintenance Work

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

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

Cyclical Maintenance Checklist (Figure 2)

Cyclic Building Inspection Checklist: Horse Stable

Inspection date: 04/24/05

Building Feature	Material(s)	Condition Description	Maintenance Action Required	Work Done
ROOF:				
Covering	Clay tile	Two slipped tiles	Reattach tiles	5/4/05
	Painted metal standing seam	Slight corrosion; blistering paint on metal roof section	Sand and repaint area that is peeling	6/8/05
Flashing	Painted metal	Flashing in good condition	N/A	N/A
Gutters/Downspouts		Gutter sagging; downspouts OK		5/4/05

	6" half round galvanized metal		Realign gutter and put on new hanger strap	
			Flush out downspouts	5/5/05
Chimneys	No masonry chimney	N/A	N/A	N/A
Attachments/Penetrations	Metal vent stack and weathervane	Vent stack hood has some peeling paint; vane OK	Sand and repaint vent stack	6/8/05

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

Maintenance Plan, Schedules and Inspection

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

The first time a property owner or manager establishes a maintenance plan or program, it is advisable to have help from a preservation architect, preservation consultant, and/or experienced contractor. Written procedures should outline step-by-step approaches that are custom-tailored to a building. No matter how small the property, every historic site should have a written guide for maintenance that can be as simple as:

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

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

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

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

Maintenance costs can be controlled, in part, through careful planning, identification of the amount of labor required, and thoughtful scheduling of work. Maintenance schedules should take into account daily and seasonal activities of the property

in order to maximize the uninterrupted time necessary to complete the work. Institutions generally need to budget annually between 2 and 4 percent of the replacement value of the building to underwrite the expense of full building maintenance.² Use of trained volunteers to undertake maintenance can help reduce costs.

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

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

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

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

INSPECTION FREQUENCY CHART

Feature	Minimum Inspection Frequency	Season
Roof	Annually	Spring or fall; every 5 years by roofer
Chimneys	Annually	Fall, prior to heating season; every 5 years by mason
Roof Drainage	6 months; more frequently as needed	Before and after wet season, during heavy rain
Exterior Walls and Porches	Annually	Spring, prior to summer/fall painting season
Windows	Annually	Spring, prior to summer/fall painting season
Foundation and Grade	Annually	Spring or during wet season
Building Perimeter	Annually	Winter, after leaves have dropped off trees
Entryways	Annually; heavily used entries may merit greater frequency	Spring, prior to summer/fall painting season
Doors	6 months; heavily used entry doors may merit greater frequency	Spring and fall; prior to heating/cooling seasons
Attic	4 months, or after a major storm	Before, during and after wet season
Basement/Crawlspace	4 months, or after a major storm	Before, during and after rain season

Building Components

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

Roofs/Chimneys

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

Inspection

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

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

Maintenance

- Remove leaves and other debris from gutters and downspouts. Utilize a ladder with a brace device, if necessary, to keep the ladder from crushing the gutter. Use a garden hose to flush out troughs and downspouts. Patch or repair holes in gutters using products such as fiberglass tape and epoxy adhesive in metal gutters. Avoid asphalt compounds since acidic material can cause further deterioration of metal gutters.
- Correct misaligned gutters and adjust, if necessary, so that water flows to drains and does not pond. If gutter edges sag, consider inserting wooden wedges between the fascia board and the back of the gutter to add support. Seal leaking seams or pinholes in gutters and elbows.
- Broom sweep branch or leaf debris away from shingles, valleys, and crickets, particularly around chimneys and dormers.



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

- Where mechanical equipment is mounted on flat or low-sloped roofs, ensure that access for maintenance can be provided without damaging the roof. Clean out trapped leaves and debris from around equipment base and consider adding a protective walkway for access.



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

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

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

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

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



Figure 5. The use of a sealant to close an exposed joint is not always an effective long-term solution. Where this decorative wood element connects to the slate roof, the sealant has failed within a short time and a proper metal

recommendations. Prepare the surface prior to application to obtain good adhesion with the prime coat. Apply both a prime coat and a topcoat for good bonding and coverage; select primer and topcoat products from the same manufacturer.

flashing collar is being fitted instead. Photo: Bryan Blundell.

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



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

Exterior Walls

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

Inspections

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

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

Maintenance

- Trim tree branches away from walls. Remove ivy and tendrils of climbing plants by first cutting at the base of the vine to allow tendrils to die back, and later using a plastic scraper to dislodge debris and an appropriate digging tool to dislodge and remove root systems. Be cautious if using a

commercial chemical to accelerate root decay; follow safety directions and avoid contact of chemicals with workers and wall materials.

- Wash exterior wall surfaces if dirt or other deposits are causing damage or hiding deterioration; extend scheduled times for cleaning for cosmetic purposes to reduce frequency (Figure 9). When cleaning, use the gentlest means possible; start with natural bristle brushes and water and only add a mild phosphate-free detergent if necessary. Use non-abrasive cleaning methods and low-pressure water from a garden hose. For most building materials, such as wood and brick, avoid abrasive methods such as mechanical scrapers and high-pressure water or air and such additives as sand, natural soda, ice crystals, or rubber products. All abrasives remove some portion of the surface and power-washing drives excessive moisture into wall materials and even into wall cavities and interior walls. If using a mild detergent, two people are recommended, one to brush and one to prewet and rinse. When graffiti or stains are present, consult a preservation specialist who may use poultices or mild chemicals to remove the stain. If the entire building needs cleaning other than described above, consult a specialist.

- Repoint masonry in areas where mortar is loose or where masonry units have settled. Resolve cause of cracks or failure before resetting units and repointing. Rake out joints by hand, generally avoiding rotary saws or drills, to a depth of 2 ½ times the width of the joint (or until sound mortar is encountered), to make sure that fresh mortar will not pop out. Repointing mortar should be lime-rich and formulated to be slightly weaker than the masonry units and to match the historic mortar



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



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

in color, width, appearance, and tooling. Off-the-shelf pre-mixed cement mortars are not appropriate for most historic buildings. Avoid use of joint sealants in place of mortar on vertical masonry wall surfaces, as they are not breathable and can lead to moisture-related damage of the adjacent masonry (Figure 10).

- Correct areas that trap unwanted moisture. Damaged bricks or stone units can sometimes be removed, turned around, and reset, or replaced with salvaged units. When using traditional or contemporary materials for patching wood, masonry, metal, or other materials, ensure that the materials are compatible with the substrate; evaluate strength, vapor permeability, and thermal expansion, as well as appearance.
- When patching is required, select a compatible patch material. Prepare substrate and install patch material according to manufacturer's recommendations; respect existing joints. Small or shallow surface defects may not require patching; large or deep surface defects may be better addressed by installation of a dutchman unit than by patching.

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

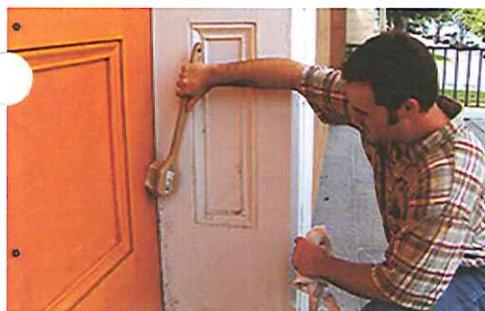


Figure 9. To help extend a repainting cycle, dirt and spider webs should be removed before permanent staining occurs. In this case, a natural bristle brush and a soft damp cloth are being used to remove insect debris and refresh the surface appearance.

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

Prepare, prime, and spot paint areas needing repainting. Remember that preparation is the key to a successful long lasting paint job. Ensure beforehand the compatibility of new and existing paints to avoid premature paint failure. Remove loose paint to a sound substrate; sand or gently rough surface if needed for a good paint bond; wipe clean; and repaint with appropriate primer and topcoats. Follow manufacturer's recommendations for application of coatings, including temperature parameters for paint application. Use top quality coating materials. Generally paint when sun is not

shining directly onto surfaces to be painted.

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

Openings

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

Inspection

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

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

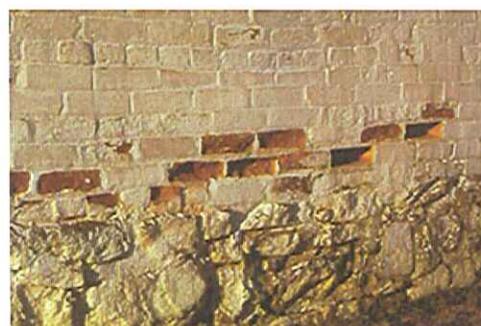


Figure 10. Repointing of masonry should usually be approached as repair rather than maintenance work in part because of the need for a skilled mason familiar with historic mortar. In this case, a moisture condition was not corrected and the use of a waterproof coating and off-the-shelf Portland cement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

- window well debris accumulation, heavy bird droppings, and termite and carpenter ant damage.

Maintenance

- Replace broken or missing glass as soon as possible; in some cases cracked glass may be repaired using specialty glues. For historic crown glass and early cylinder glass, a conservation approach should be considered to repair limited cracks. Where panes with a distinct appearance are missing, specialty glass should be obtained to match, with sufficient inventory kept for future needs. Avoid using mechanical devices to remove old putty and match historic putty bevels or details when undertaking work.
- Reputty window glazing where putty is deteriorated or missing. Take care in removing putty so as not to crack or break old glass or damage muntins and sash frames. Re-glaze with either traditionally formulated oil putties or modern synthetic ones, making sure to properly bed the glass and secure with glazing points (Figure 11).
- Clean window glass, door glazing, storefronts, transom prism lights, garage doors, and storm panels using a mild vinegar and water mixture or a non-alkaline commercial window cleaner. Be cautious with compounds that contain ammonia as they may stain brass or bronze hardware elements if not totally removed. When using a squeegee blade or sponge, wipe wet corners with a soft dry cloth. Avoid high-pressure washes.
- Clean handles, locks and similar hardware with a soft, damp cloth. Use mineral spirits or commercial cleaners very sparingly, as repeated use may remove original finishes. Most metal cleaners include ammonia that can streak and stain metal, so it is important to remove all cleaning residue. Polished hardware subject to tarnishing or oxidation, particularly doorknobs, often benefits from a thin coat of paste wax (carnauba), hand buffed to remove extra residue. Avoid lacquer finishes for high use areas, as they require more extensive maintenance. Patinated finishes should not be cleaned with any chemicals, since the subtle aged appearance contributes to the building's character.
- Remove and clean hardware before painting doors and windows; reinstall after the paint has dried.
- Tighten screws in doorframes and lubricate door hinges, awning hardware, garage door mechanisms, window sash chains, and pulleys using a graphite or silicone type lubricant.
- Check weather stripping on doors and windows and adjust or replace as necessary. Use a durable type of weather stripping, such as spring metal or high quality synthetic material, avoiding common brush and bulb or pile weather stripping that require more frequent replacement.
- Adjust steel casement windows as needed for proper alignment and tight fit. Avoid additional weather stripping as this may lead to further misalignment, creating pathways for air and water infiltration.
- Check window sills for proper drainage. Fill cracks in wood sills with a wood filler or epoxy. Follow manufacturer's instructions for preparation and installation. Do not cover over a wood sill with metal panning, as it may trap moisture and promote decay.
- Repair, prime, and repaint windows, doors, frames, and sills when needed. Clean out putty debris and paint chips from windows using a wet paper towel and dispose of debris prior to repair or repainting. Take appropriate additional precautions when removing lead-based paint. Sand and prepare surfaces and use material-specific patching compounds to fill any holes or areas collecting moisture (Figure 12). Avoid leaving exposed wood unpainted for any length of time, as light will degrade the wood surface and lead to premature failure of subsequent paint applications. Immediately prime steel sash after paint is removed and the substrate prepared for repainting.
- Adjust wood sash that bind when operated. Apply beeswax, paraffin, or similar material to tracks or sash runs for ease of movement. If sash are loose, replace worn parting beads. Sash runs traditionally were unpainted between the stop and parting bead; removing subsequent paint applications will often help improve sash operation.



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

- Correct perimeter cracks around windows and doors to prevent water and air infiltration. Use traditional material or modern sealants as appropriate. If fillers such as lead wool have been used, new wool can be inserted with a thin blade tool, taking care to avoid damage to adjacent trim. Reduce excess air infiltration around windows by repairing and lubricating sash locks so that windows close tightly.
- Remove debris beneath window air conditioning units and ensure that water from units does not drain onto sills or wall surfaces below (Figure 13). Removal of air conditioning units when not in season is recommended.
- Adjust storm panels and clean weep holes; check that weep holes at the bottom of the panels are open so water will not be trapped on the sill. Exterior applied storm windows are best attached using screws and not tightly adhered with sealant. Use of sealant makes storm units difficult to remove for maintenance and can contribute to moisture entrapment if weep holes become clogged.
- Remove weakened or loose shutters and store for later repair. Consider adding a zinc or painted metal top to shutters as a protective cap to cover the wood's exposed end grain. This will extend the life of the shutters.



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



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

Contracting Maintenance and Repair Work

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

1. Become familiar with work done on similar historic properties in your area so that you can obtain names of possible preservation contractors.
2. Be as specific as possible in defining the scope of work you expect to undertake.
3. Ask potential contractors for multiple references (three to five) and visit previous work sites. Contact the building owner or manager and ask how the job proceeded; if the same work crew was retained from start to finish; if the workers were of a consistent skill level; whether the project was completed in a reasonable time; and whether the person would use the contractor again.

4. Be familiar with the preservation context of the work to be undertaken. Use the written procedures in your maintenance plan to help define the scope of work in accordance with preservation standards and guidelines. Always request that the gentlest method possible be used. Use a preservation consultant if necessary to ensure that the work is performed in an appropriate manner.
5. Request in the contract proposal a detailed cost estimate that clearly defines the work to be executed, establishes the precautions that will be used to protect adjoining materials, and lists specific qualified subcontractors, if any, to be used.
6. Insure that the contractor has all necessary business licenses and carries worker compensation.

Projections

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

Inspection

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

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

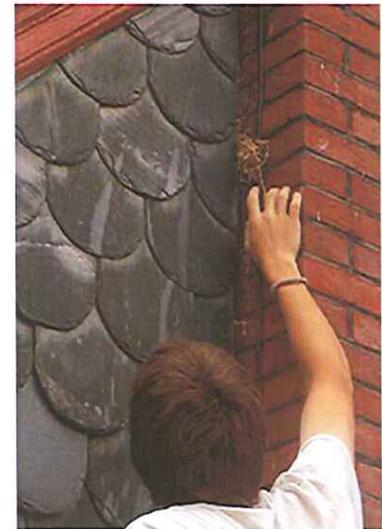


Figure 14. When inspecting connections between projections and the main building, look for areas where birds, bees and pests may enter or nest. Birds have been nesting in this porch roof and the area is being cleaned of their debris. Where an opening exists, it may be necessary to cover it with a trim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

Maintenance

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

devices, ensure that cover plates are properly sealed. Prime and paint metal elements as needed.

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



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

Foundations and Perimeter Grades

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

Inspection

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

- depressions or grade sloping toward the foundation; standing water after a storm;
- material deterioration at or near the foundation, including loss of mortar in masonry, rotting wood clapboards, or settlement cracks in the lower sections of wall;
- evidence of animal or pest infestation;
- vegetation growing close to the foundation, including trees, shrubs and planting beds;

- evidence of moisture damage from lawn and garden in-ground sprinkler systems;
- evidence of moss or mold from damp conditions or poorly situated downspout splash blocks (Figure 16); and
- blocked downspout drainage boots or clogged areaway grates.

Maintenance

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



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

Sealants and Caulks

Using sealants and caulks has become a familiar part of exterior maintenance today. As the use of precision joinery and certain traditional materials to render joints more weathertight has waned in recent years, caulks and more often elastomeric sealants are used to seal cracks and joints to keep out moisture and reduce air infiltration. Where

cracks and failing joints are indicators of a serious problem, sealants and caulks may be used as a temporary measure. In some cases they may actually exacerbate the existing problem, such as by trapping moisture in adjacent masonry, and lead to more costly repairs.

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

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

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

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

Summary and References

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

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

Historic house journals, maintenance guides for older buildings, preservation consultants, and preservation maintenance firms can assist with writing

appropriate procedures for specific properties. Priorities should be

established for intervening when unexpected damage occurs such as from broken water pipes or high winds. Worker safety should always be paramount. When work is beyond the capabilities of in-house personnel and must be contracted, special



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

efforts should be made to ensure that a contractor is both experienced in working with historic buildings and utilizes appropriate preservation treatments.

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

Endnotes

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Acknowledgements

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June 2007

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