The Brownstone Guide

Maintenance & Repair Facts for Historic Property Owners

New York Landmarks Conservancy
Technical Services Center

Contents

Acknowledgements

The Brownstone Guide is more a consumer's handbook than a technical manual. Rather than a source of step-by-step instructions for repair materials and techniques, the *Guide* is designed to help owners of historic properties understand the character of sandstone and the basic causes of its decay. In addition, it provides an introduction to the various methods and materials for sandstone repair and restoration. With this background, building owners can make more informed choices about maintaining and repairing historic brownstone.

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Brownstone as a Building Material

"Brownstone" is the common name for a variety of brown, red, and pink sandstone widely used as building materials from the mid-1800s until the early-1900s. In fact, it was so common that the word became synonymous with "row house."

Brownstone is found in buildings as early as the 1600s, but it truly emerged as a dominant American building material in the mid-1800s, when popular taste in literature, art, and architecture embraced a romantic return to nature. Its rich, earth-toned color and variety of surface textures expressed this ideal perfectly. To nineteenth-century builders, the softness of brownstone was an ideal quality. The material lent itself perfectly to the rapid carving of moldings, brackets, consoles, bas-relief, pediments, architraves, enframements, and many other architectural devices that decorated roughhouses of this period.

During the period of its greatest use, brownstone was central to the look and feel of American architecture. It is found not only in row houses and individual residences, but also in religious, industrial, commercial, and public buildings. Brownstone use was most common in the Northeast, close to the principal quarries.

Brownstone used in nineteenth-century New York City came from quarries in:

- Connecticut: Portland, East Haven
- New Jersey: Newark, Belleville, and Little Falls
- Massachusetts: East Longmeadow
- Pennsylvania: Hummelstown
- New York: Medina
- Michigan
- Scotland

Almost as soon as sandstone became prominent as a building material, it became known for its tendency to decay. Unfortunately, its layered composition and high porosity means that brownstone deteriorates easily. It is especially susceptible to the action of water, salts, freeze-thaw cycling, air pollutants, and similar factors. In the Northeast, the local climate consisting of wet winters with daily temperature fluctuations has proven to be particularly hard on the material. Consequently, brownstone presents significant maintenance and repair problems for many owners of historic brownstone buildings.

Brownstone homes, like these Harlem row houses, were built by the thousand throughout the Northeast in the late-nineteenth century.

The relative softness of brownstone lends itself to decorative carvings and building ornamentation.

Inspecting the Condition of Brownstone

Brownstone has two basic characteristics that determine its appearance and performance in buildings:

- Composition: Sandstone is made up of grains of sand and other minerals held together by natural cementing agents.

- Structure: The minerals that form the stone were deposited into layers, or strata, by water and wind over many centuries. Within the stone, natural areas of weakness, called bedding planes, occur where each layer comes into contact with the next.

All brownstone is not created equal, however. Some is much harder and more durable than others. Stone from the same quarry can have very different properties, depending on the specific location where it was quarried.

In the early days, quarries sorted and graded brownstone, saving the good quality, dense material for architectural use. This stone was carved, or dressed, into lintels, doorways, and blocks. Beautifully preserved brownstone lintels, quoins, and other details can be seen in such grand buildings as St. Paul's Chapel in lower Manhattan. The less desirable brownstone was given over to uses such as road and rail embankments or other projects where large, rough blocks were needed and the fineness or thinness of the stone did not matter.

Beginning in the late 1860s, however, a construction boom in New York and other eastern cities created mile upon mile of new row houses. Often, the less desirable material was pressed into architectural service and sliced into thin veneer or carved into elaborate façade features.

Before embarking on any repairs, the condition of the stone should be surveyed, identifying the symptoms and possible causes of deterioration. Observations regarding the color, pattern, texture, and surface tooling of the brownstone, as well as previous repairs, can be very helpful to a conservator, architect, or contractor. Building owners can do some of this initial investigation, allowing them to better describe the condition of their building:

Color: Is the stone brown or another color? Has more than one color of stone been used?

Pattern: Are there swirls, bands, or veins of color within the individual stones?

Texture: Is the stone surface hard or crumbly, sharp or weathered?

Surface Tooling: Is the stone carved, rock-faced, or smooth? Are there other tooling marks or decorative surface patterns? Is any part damaged or missing?

Previous Repairs: Are there old patches applied to the masonry? Has the entire surface of the façade been patched or refaced some time in the past? Is the stone painted? Are past stucco repairs showing signs of blistering, loosening, or detachment?

Protection and Maintenance Strategies

Building owners and stewards can avoid many problems commonly associated with brownstone through proper maintenance. A regular maintenance program can remedy water infiltration and slow the rate of decay. Deteriorating stone often can be protected, and repair and replacement costs can be reduced.

A responsible building owner can carry out most of the following basic maintenance procedures at a very low cost:

Clear Gutters Regularly: Clearing gutters and leaders of debris at least twice a year allows them to drain properly.

Maintain Roof: Repair leaks in the roof and drainage systems immediately. They can act as a funnel for water, causing severe and costly damage to the façade.

Remove Vegetation: Vegetation, such as ivy, on or immediately adjacent to stone walls traps moisture and prevents the walls from thoroughly drying out.

Fill Open Joints: Caulking open joints prevents moisture infiltration around windows, doors, and along horizontal lines in projections, such as window lintels or parapet walls. Use high quality polysulfide, butyl rubber, or acrylic latex caulk.

Maintain Flashing: Metal flashings protect ledges, lintels, ornamentation, and other projections that collect and absorb water. Use non-corrosive, non-staining sheet metal, such as lead or lead-coated copper, to seal the top surfaces and to bridge the small, open gaps between the elements.

Repoint as Necessary: Crumbling, loose, or missing mortar joints should be repointed by a qualified mason. The repointing mortar must be softer and more porous than the stone. Hard mortar with too high a cement content can accelerate brownstone deterioration.

Clean Carefully: Improper cleaning can cause more damage in minutes than years of weathering. Cleaning is only necessary to protect brownstone from pollutants or excess dirt build-up. Use a professional mason to handle the cleaning, and ask to see a sample of their work. A gentle water wash or water and non-ionic detergent wash should be the first cleaning methods attempted. Do not use harsh chemicals or abrasive methods, such as sand- or water-blasting.

Causes of Brownstone Deterioration

Brownstone, like other sandstones, consists essentially of grains of sand that have been consolidated by the pressure of overlying sediments and the presence of a cementing matrix, or binder, between the grains. Many of the brownstones used in New York are composed mainly of quartz and feldspar, bound by clays and iron oxides. In some cases, silica or calcite are also present in the binder.

Most brownstone deterioration is caused by the failure of its cementing matrix. As the mortar joints between the stones deteriorate, water finds its way into the interior bedding planes of the stones. Hard freezes cause expansion of the trapped water within the tiny crevices of the stone, destroying the stone's solidity from within. The recrystallization of salts from deicing compounds or mortars also plays a role in deterioration.

The most common forms of deterioration are:

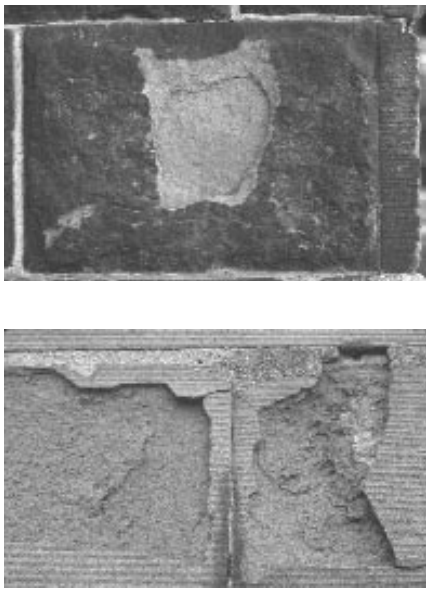
Exfoliation: Separation and failure of stone along its sedimentary bedding planes. Exfoliation causes the most dramatic failure when a stone unit is "face-bedded," with its bedding planes set parallel to the finished face of the stone. "Blind exfoliation" describes bedding layers that have separated but are still loosely attached, causing the finished surface to sound hollow. Exfoliation is caused by the failure of weakly cemented layers in a stone unit.

Severely exfoliating brownstone can be both unattractive and detrimental to the building.

Contour scaling: Failure of a thin surface layer of the stone parallel to the worked surface of the stone, rather than along its bedding planes. "Crust formation," "blistering," and "surface induration" are terms used for similar deterioration. Contour scaling occurs when acid-soluble binders dissolve and form a brittle crust at the surface of the stone. This is most likely to occur in areas of frequent wet-dry cycling, such as windowsills and copings.

Disaggregation: Loss of cohesion between sand grains as the binder deteriorates. Disaggregation at the surface of a stone can result in slow erosion of the surface and softening of tooling. Areas beneath surface crusts are also often disaggregated. Disaggregation often occurs in sheltered areas where moisture from other sources evaporates, in some cases from salt recrystallization.

Deterioration varies dramatically for the different types of brownstone that were available in the nineteenth century. The severity of exposure of the stone and its orientation in the wall both significantly affect how the brownstone deteriorates. The more carving on a façade, the more surface area of the stone is exposed to the elements. These factors can create an enduring challenge to the concerned building owner.



Contour scaling (top) and disaggregation (bottom) are two commonly found forms of brownstone deterioration.

Composite Repairs

Composite repair, the application of a tinted mortar-like patch to the surface of a deteriorated stone or portion of a stone, is one of the most common techniques utilized to repair deteriorated brownstone surfaces. Composite repairs are appropriate where small areas of mechanical damage have occurred or where the entire face of a unit has exfoliated. Composite repairs last longer in locations that do not have heavy exposure to rain. Composites applied to windowsills and wall copings often fail prematurely, due to water infiltration and disaggregation of the stone beneath the repair. In areas where direct wetting of the patch is not a problem, such as sheltered vertical wall surfaces, composites may be very durable. Satisfactory adhesion of a composite repair requires removal of all deteriorated stone down to solid material. The sound stone is then scarified or roughened to provide some mechanical anchorage for the composite patch. For large repairs, rods and wire armatures are sometimes added to provide additional support and to assure that the patch does not separate from the substrate. The rods can be made of fiberglass, nylon, or stainless steel. A durable composite repair must be at least 3/4" thick.

Due to the difficulty of exact color matching, composites applied to the full face of a deteriorated stone unit are the most successful visually. Usually, it is preferable to apply composite repairs separately to individual stone units, stopping the edge of the repair at the mortar joint that separates the unit from adjacent stones.

Since the 1930s, many brownstone contractors have completely covered the façades of small buildings with tinted stuccos. When an entire façade is heavily deteriorated or when a façade has been refaced once before, this approach may be appropriate. Refacing is most successful when they faithfully replicate window hoods, door surrounds, and other trim elements. Complete refacing should be avoided, however, when significant sections of original brownstone are intact and may be retained.

Materials The proper repair mixture consists of a combination of a binder, aggregate, pigments,



Years of weathering caused the brownstone details to deteriorate (left), but careful composite repairs (center) restore it to its original glory (right)

admixtures, and water. Most masons have their own preferred composite patching system, and in general, it makes sense to use the system with which your mason is most familiar.

The most common repair mixture is a stucco-like mix consisting of Portland cement and lime binder, crushed stone-sand aggregate, and small amounts of dry oxide pigments. The ingredients are combined dry and then mixed with water, often with a small amount of acrylic latex admixture. The dry mixture is usually prepared on site, but may also be prepared off site in a more controlled setting and brought to the site in pails or bags.

One important point to remember: gray Portland cement should not be used for composite sandstone patches. It is more difficult to color and work, shrinks more in curing, and may cause staining.

In addition to the traditional cement-lime-sand patching mix, many companies market their own proprietary patching systems. Among the more common proprietary mixes available today are those sold under the Edison and Jahn names. Proprietary mixes have a number of advantages, including uniformity of material, a proven track record, and technical assistance from the manufacturer. Many manufacturers will supply a premixed, color-matched product to which water is added at the site. It is important to ensure that the masons are properly trained in the use and application of proprietary mixes when using or specifying such mixes. Many proprietary mixes are not applied in the same manner as traditional cement-lime-sand mixes, and, like any repair, will fail if improperly installed.

Color Matching Color matching is one of the most crucial aspects of creating a successful composite patch and should be based on a careful examination of the existing stone. The contractor or an architectural conservator who specializes in masonry can do the color matching. Manufacturers of proprietary mixes can provide a custom color match based on a sample of the stone being repaired. Samples of proprietary mixes should be prepared in accordance with manufacturer's instructions.

If the stone is to be cleaned, the repair material must match color of the cleaned stone. If the stone's color and dirt or stains give it a varied appearance, select the color that blends best. Repairs in more than one color may be needed if the color variations are great. Often, sandstone buildings are part of a group of similar façades, constructed at the same time and of the same sandstone. When repairing entire façades in such buildings, it is important to use a color mixture compatible with the neighboring buildings.

Surface Finishing Even with proper color matching, a repair will look dead and artificial – like sand sealed up in colored cement – unless the character of the surface mineral grains closely resembles that of natural sandstone. Commonly, this is achieved with acid-etching or rubbing stones to remove the thin outer film of pigmented cement binder and expose the shape, size, color and distribution of the aggregate grains at the surface of the repair. Patches can also be stippled with a sponge or dry-troweled to create surface effects. Tool marks and patterns can be matched to those on the original stone.

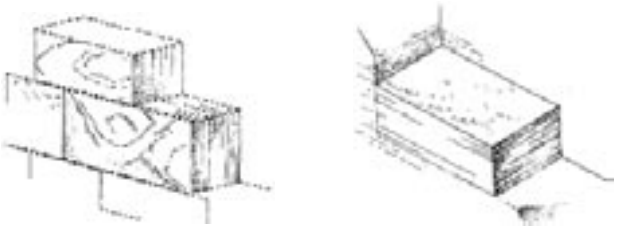
Historic Accuracy A successful composite patch, whether a small repair or replacement of an entire façade, should be indistinguishable from the original stone. Mortar joints in the new repair should replicate the historic profile. Repairs should not extend continuously between separate blocks of stone, because continuous patches can crack and fail if the individual stones behind them move.

Where possible, photographs and measured drawings or sketches should be used to recreate carved decoration. For row houses that are part of a uniform development, one can often find surviving decoration on adjacent buildings. Decorations found on neighboring buildings may serve as the model for new composite patches or may be used to create molds for cast stone ornamentation. Historic photographs should be consulted to ensure that architectural features that appear on a neighboring building are historically appropriate on the building being restored.

Alternative Repair Methods

In addition to composite repair, there are other techniques that can be used to repair deteriorated brownstone masonry.

Unit Replacement In some cases, the most durable and most visually successful "repair" for deteriorated brownstone is replacement. While replacement of entire brownstone façades is rare, replacement of portions of façades and of individual stone units is quite common. Unit replacement is an appropriate approach with severely deteriorated stone, especially at corners, buttresses, and projecting bays. Heavily exposed features prone to deterioration, such as stoops and stairways, are also often replaced. Damaged elements can be replaced with either natural stone or cast stone.



Brownstone can be laid with its natural bedding planes oriented vertically, called face bedding (left), or horizontally, called quarry bedding (right).

NATURAL STONE For simply tooled units of wall masonry, natural stone is often the most appropriate choice. Generally natural stone will be more expensive, but is usually a better match for surrounding masonry. Finding a stone that matches the color of the original stone is extremely important. Salvaged stone, taken from buildings that have been demolished, is often available and the simplest choice for smaller projects. For new brownstone, quarries are currently active in Connecticut, Michigan, and Canada's maritime provinces. For larger projects, imported stone resembling some brownstone in the Northeast is available through American suppliers from Germany, Scotland, and England. Whenever possible, brownstone should be laid with its natural bedding planes oriented horizontally ("quarry-bedded").

CAST STONE Cast stone, which is precast concrete tinted and finished to resemble brownstone, can be a durable and economical material for replacement of stair treads, balustrades, and molded ornamentation. Color and texture are important considerations in the use of cast stone. A mixture of cement, sand, and coarse aggregate, most of its color comes from the use of a tinted cementitious matrix. As the matrix weathers, more of the sand and aggregate are exposed. If these are lighter than the matrix, the cast stone will fade and no longer match the adjacent stone. The use of crushed brownstone or other brown aggregates assures a closer and more durable color match.

After cast stone has been molded, it is common for the fabricator to lightly sandblast or acid etch the surface to remove a portion of the cement on the surface and expose the aggregate. Stainless steel reinforcement should be considered for pieces that serve a structural function or that may crack in handling. Keeping the cast stone moist during curing assures proper hydration of the cement in the concrete. Design and fabrication of cast stone is complicated enough that the services of an architect

or engineer may be desired, depending on the size of the project.

Dutchman Repairs A "dutchman" repair may be used with exposed damaged stone where a composite repair is infeasible or unlikely to last. A stone dutchman is a piece of stone set into a larger stone to replace a damaged or missing section. In highly visible locations and in areas subject to frequent wetting, a dutchman will generally be more durable and more successful visually than a composite repair. Although sometimes used for severely damaged brownstone, dutchmen, adhered with pins and adhesives, are used more frequently with granites and marbles. "Full face" dutchman may be used for brownstone repair when the face of a unit is deteriorated to a significant depth and the stone surface must be durable. A dutchman might be used, for instance, where an exposed repair overhangs an entry or sidewalk, and the failure of a composite would be hazardous.

Retooling If the decayed surface of the stone is too shallow for a durable composite repair and the depth of deterioration does not warrant unit replacement or a dutchman, retooling may be considered. Reworking the decayed surface of an individual stone and retooling the stone is most successful where the original surface of the stone is roughly tooled and the plane of the façade is not extremely important. Smooth honed and finely tooled surfaces, as well as rock facing, are more difficult to retool successfully. Retooling that does not match the original tooling of the stone is not advisable.

Consolidation In recent years a number of products have been developed to "consolidate" or strengthen deteriorated stone. These liquid preservatives can play a limited role in some brownstone restoration projects.

YES Consolidants may be appropriate where a stone surface is slowly eroding or where original tooling or carving is still present, but threatened.

NO Consolidants cannot re-adhere separated surface layers or repair severe damage.

Numerous factors must be considered before consolidation is undertaken, including soundness of substrate, type of consolidant, depth of consolidant penetration, methods of and numbers of applications, and color change. An architectural conservator should be consulted to guide any proposed consolidation effort.

Inappropriate Repair Methods

Many historic brownstone buildings in New York City have been repaired, restored, or remodeled at least once. In some cases, these old rehabilitations have become historic in their own right. Often they are a testament to the layering of history typical of old, urban centers. If your brownstone is in an historic district, you must check with your local landmarks board or commission before embarking on a restoration plan. Depending on the age and quality of the remodeling, it may be seen as significant feature.

Many brownstone owners today need to address the failures of old repairs. Old patches often fade over time, resulting in a patchwork appearance to the building. Old stucco or cement may start to come loose, and some areas may blister and detach from the substrate. Sometimes, these failures occur as a result of natural aging, but sometimes they are caused by inappropriate repair methods or installation.

Inappropriate Mortars Repointing with a mortar that is too hard or impermeable will damage brownstone. Impermeable mortars force water, which enters the masonry through joints and cracks, to collect in, and evaporate through, the stone itself rather than through the mortar joints. Moisture trapped in the masonry often damages the stone through salt crystallization or frost damage. In extreme cases, the masonry will spall completely, leaving protruding mortar. Similarly, composite patches that are too vapor impermeable will result in deterioration of the natural stone. Pointing mortars should be sacrificial to the surrounding stone or brick, and owners should expect to repoint their building from time to time.

Cementitious Coatings Tinted cementitious coatings are available under a variety of trade names and are one of the most common repair methods to avoid. Unlike composite repairs, which are generally applied only to deteriorated stone, brush-on cementitious coatings are often indiscriminately applied to entire façades of sound and deteriorated stone. These coatings tend to hinder vapor transmission through the stone surface and hold water inside the stone, eventually causing it to disaggregate. In areas of severe water infiltration, near roofs or parapets, coatings such as these may lead to frost damage. While they may match stone coloration when they are initially applied, cementitious coatings tend to fade and may be highly disfiguring. They are also difficult to remove without damaging the surface of the stone.

Painting Painting brownstone is generally not recommended. Even paints that are vapor permeable may retard the passage of moisture and cause the underlying stone to deteriorate. This is especially true where cracks or open joints allow water to enter the masonry. A thick paint buildup may lead to future damage by trapping moisture in the stone behind it. Painting will not preserve decayed stone, since paint will adhere only to sound material.

Inappropriate repair methods, such as painting (top) and cementitious coatings (bottom), tend to trap moisture and mask underlying brownstone deterioration.

Repainting of sound stone that has already been painted is an option if paint removal is likely to cause damage or if it would expose old, non-matching repairs. If painting is appropriate, use oil-based paint over previously painted stone and latex paint on exposed stone.

Waterproofing Waterproofing and water repellent coatings tend to trap moisture and migrating soluble salts. This may cause loss of stone surface through freezing or salt recrystallization. These coatings may also alter the color and reflective qualities of the stone. They also require regular and frequent reapplication, making this an expensive option for homeowners.

Harsh Cleaning Sandblasting, high-pressure water blasting, and other abrasive cleaning or paint removal techniques damage stone and should never be used.

The Future of Brownstone Preservation

A rich heritage of architectural brownstone has survived to the present day in the neighborhoods of New York City. These buildings and homes have endured despite adverse structural, mineralogical, and environmental conditions.

Restoration of brownstone façades has grown into an industry. Natural stone supplies are more easily available today than in years past, and repair methods are advancing rapidly. A trip to many brownstone blocks in warm weather will show one or more houses in the process of being repaired.

Brownstone restoration can be a complex process for building owners, but if they are prepared with a practical understanding of sandstone and its problems, they can continue to preserve this legacy for future generations.

Further Reading

The following is a selective list of books and articles of use to the homeowner. Emphasis has been placed on general works and information particularly helpful to the novice, as well as more recent articles not cited elsewhere.

General Building Maintenance and Restoration Guides

Carosino, Catherine, et al, editors. *Historic Masonry Deterioration and Repair Techniques: An Annotated Bibliography.* Washington, D.C.: Preservation Assistance Division, National Park Service, United States Department of the Interior. 1993.

Fisher, Charles E. and Hugh C. Miller, editors. *Caring for Your Historic House*. New York: Henry N. Abrams, Inc. 1998.

Foulks, William G., editor. *Historic Building Façades: The Manual for Maintenance and Rehabilitation*. New York: John Wiley & Sons, Inc. 1997.

Friedman, Donald. *The Investigation of Buildings: A Guide for Architects, Engineers, and Owners.* New York: W. W. Norton & Company, Inc. 2000.

McKee, Harley. *Introduction to Early American Masonry: Stone, Brick, Mortar and Plaster*. Washington, D. C.: National Trust for Historic Preservation. 1973.

Weaver, Martin with Frank G. Matero. *Conserving Buildings: Guide to Techniques and Materials*. New York: John Wiley & Sons, Inc. 1993.

Preservation Briefs

The National Park Service has published over 40 Preservation Briefs on a range of subjects related to the repair and maintenance of historic buildings. Many of these briefs are now online at http://www2.cr.nps.gov/tps/briefs/presbhom.htm.

Conservancy Publications

In addition to *The Brownstone Guide*, the Conservancy offers other helpful publications to the public:

• *Historic Building Facades: The Manual for Maintenance and Rehabilitation* covers inspection, maintenance, and repair of historic facades made of brownstone, limestone, brick, terra cotta, cast iron, and wood. $29.95

• *Repairing Old and Historic Windows* is a complete guide to window deterioration, maintenance, replacement, and repair for homeowners and professionals. $24.95

• *Managing Repair & Restoration Projects: A Congregation's How-to Guide* is a step-by-step guidebook that explains the basics of project planning, management, and supervision to laypeople and clergy. $20.000

• *Inspecting and Maintaining Religious Properties* is a practical guide for building caretakers and professionals with chapters on the building envelope (roofs, walls, and drainage systems), structural systems, mechanical systems, energy cost-saving measures, and cyclical maintenance. $15.00

For more information or a publications order form, call 212-995-5260 or visit www.nylandmarks.org

The New York Landmarks Conservancy is proud to announce that 2003 marks our 30th anniversary. Since 1973, the Conservancy has advocated for preservation of New York's unique architectural heritage in Washington, Albany, and at City Hall. In addition, it is the only preservation organization in New York City – and one of the few in the country – with the financial and technical resources to back up advocacy with assistance.

In thirty years, we have awarded nearly $22 million in loans and grants, accompanied by countless hours of pro-bono technical advice, to owners of historic homes, businesses, schools, houses of worship, theaters, cultural institutions, and community centers. In turn, we help revitalize neighborhoods and shape the future of our great City.

The Conservancy's **Technical Services Center** is nationally recognized for its expertise in addressing building problems. Its staff answer questions from hundreds of owners each year and help them find and manage qualified architects, craftspeople, contractors, and other consultants. The Center's publications offer detailed, practical guidance on the preservation of specific building types, materials, and features. For answers and referrals, call the Preservation Hotline at 212-995-5260.

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