Bellows Falls

Work Book

Bellows Falls Work Book

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CREDITS

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Foreword

15 May 1983

Dear Reader:

The BELLOWS FALLS WORKBOOK represents an important publication in the continuing revitalization of Rockingham and downtown Bellows Falls. Bellows Falls' unique natural beauty and historic buildings are irreplaceable assets which have long been overlooked and underutilized, and are only now being used to their fullest potential. Much, however, remains to be done. By pointing out these assets and by suggesting ways to better take advantage of their potential, the WORKBOOK will go a long way in helping the community to help itself.

Over the past several years, the Town of Rockingham has undertaken a number of projects aimed at significantly improving the quality of life in both the Town as a whole and the Village in particular. Many of these were begun during the Bi-Centennial. Others, such as the renovation of the former Rockingham Hotel into commercial retail space and housing for the elderly, or the restoration and redevelopment of the Centennial Block into a commercial arcade, were joint ventures involving both government and private funds. Even today, efforts continue with the replacement of the Arch Bridge and the construction of the New England Power Company's Fish Ladder. Based on these experiences, I believe that the WORKBOOK will now become an essential tool and guide in helping the community to shape its future while preserving its past.

One of the real benefits of the WORKBOOK is its identification of realistic goals for improvement. Many of them involve nothing more than simple maintenance, something which is all too easily overlooked, and ignored. Others, of a more long term nature, are recommendations which will require additional planning and public input. Whichever the case, the projects which have been identified are consistent with the Town's long term goals for its revitalization and future development, and will have a lasting and worthwhile impact.

The achievement of the goals and recommendations presented in the WORKBOOK will require both public and private efforts. To date, the Town has played an invaluable role as a catalyst in initiating and, in some cases, completing projects. We now look to the private sector to continue their work with us in these joint efforts toward revitalization.

I believe, on behalf of the Board of Selectmen, that this WORKBOOK will serve the community well in its continuing efforts to improve and prosper.

Sincerely yours,

John Cook, Chairman
Rockingham Board of Selectmen

Introduction

The *BELLOWS FALLS WORKBOOK* is the third volume of the Bellows Falls Town-Scape Project. It is not, as some might think, a revised edition of either the original 1975 BELLOWS FALLS TOWN-SCAPE REPORT or the project's second volume, ROCKINGHAM TOWN-SCAPE II, published in 1978. Instead, the *BELLOWS FALLS WORKBOOK* is a companion volume to those earlier publications, with a much more specific purpose. Because it is a companion volume, it is important to keep in mind that the material included in the TOWN-SCAPE REPORT and TOWN-SCAPE II has not been re-written for inclusion here, and that in order to more fully understand some of the present recommendations, a review of those earlier publications may be necessary, if not advisable. Whenever necessary, the TOWN-SCAPE REPORT will be referred to in order to avoid any unnecessary confusion.

PURPOSE

The prime purpose of the *BELLOWS FALLS WORKBOOK* is identical to that of the original BELLOWS FALLS TOWN-SCAPE REPORT - to preserve and enhance the architectural character of Bellows Falls while providing a framework for continued economic revitalization and for the maintenance of the downtown as a viable commercial center. As stated in the TOWN-SCAPE REPORT, the goals are to enhance the downtown's pedestrian character, to strengthen an already strong awareness of the downtown's importance as an invaluable historic and economic resource, and to preserve the charm and character of the downtown's unique architectural environment.

It is hoped that the *BELLOWS FALLS WORKBOOK* will rekindle an interest in the goals and recommendations presented in the original BELLOWS FALLS TOWN-SCAPE REPORT and TOWN-SCAPE II, and reassert the necessity of promoting, on a continuing basis, the economic well being of the Bellows Falls central business district through the physical improvement of its unique historic character. It is hoped that the *WORKBOOK* will create a new sense of awareness in the potential of the downtown, and remind people that if the downtown is going to remain competitive, the community must continue to remain involved.

The present volume, however, goes one step further than its predecessors. Instead of presenting a vague set of general guidelines or suggesting a broad range of possible improvements which property owners might, or might not, undertake to upgrade the quality of their buildings, the *WORKBOOK* makes specific recommendations for improvement which are tailored to meet not only the requirements of building preservation but also the realities of the pocketbook.

Pleasant surroundings and shopper convenience are as necessary to good business as adequate parking, personal service and reasonable prices. By improving the existing quality of buildings, signing, sidewalks, parking, circulation, landscaping and open spaces - in general, those ingredients that are essential to the success and prosperity of a modern shopping center, Bellows Falls' central business district can be made a better place to shop and work. Bellows Falls already possesses most of the ingredients which make any modern shopping center successful. It also possesses one ingredient which most modern shopping centers lack - good architecture.

Bellows Falls' historic buildings and historic environments are an invaluable and irreplaceable resource which should be used to their best advantage. They are both a symbol and identity that are uniquely Bellows Falls'. They are, in fact, the central business district's own best advertising.

The central business district can learn a lot from the success of the modern shopping center. Uniform store hours and cooperative advertising, not to mention visual appeal, are only part of the formula. By cooperating with, not against, each other, merchants and building owners within the downtown can learn to compete more effectively, and to their best advantage. By supporting revitalization and necessary municipal improvements, and by improving and maintaining the quality of individual buildings, Bellows Falls can ensure the continued vitality of the central business district for years to come.

It is a matter of pride.

STUDY AREA

The study area for the *BELLOWS FALLS WORKBOOK* includes The Square and all of the streets which radiate out from it - Rockingham Street to and including the *I.G.A.*, Canal Street to and including the *Exner Block*, Bridge Street to its intersection with Depot Street, and Westminster Street to its intersection with Church Street. Special emphasis has been placed on recommendations for redeveloping the site of the former *Star Hotel*. This is particularly appropriate since this site has the potential for being transformed into a unique asset directly within the downtown commercial district, an asset not typically found in villages of comparable size and economic status.

ORGANIZATION

The *BELLOWS FALLS WORKBOOK* is the end product of a much larger preservation study undertaken by the Rockingham Planning and Development Office for the betterment of the Bellows Falls central business district. That study included five separate, yet integrated, parts. PART ONE involved the development of a preservation plan for the central business district. Included in the plan was the development of specific recommendations for the overall maintenance of individual buildings, with a particular emphasis placed on improving the appearance of the building's facade. While many of the recommendations in this section deal with what should be the obvious, and unavoidable, maintenance problems of any building owner, other recommendations are based on long-term and short-term goals, and are tailored, accordingly, to a more gradual renovation strategy.

PART ONE also included the development of specific recommendations for improving parking and pedestrian amenities. Here, an emphasis was placed on providing more easily accessible and conveniently located short-term, high turn-over shopper parking, and on up-grading the downtown's sidewalks to make them safer and more appealing to the potential shopper.

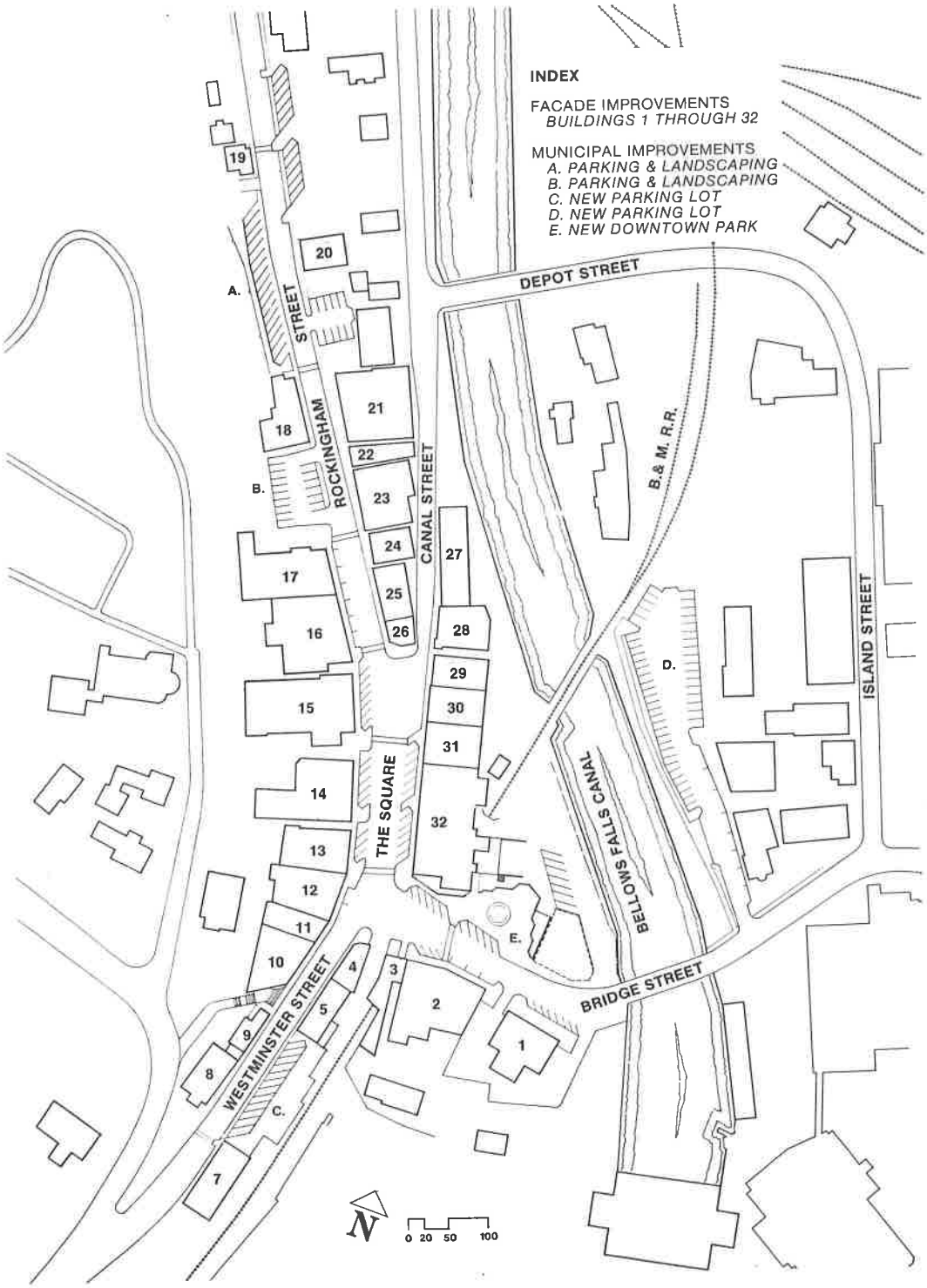
In contrast, PART TWO involved the selection of seven buildings within the central business district for more intensive study, and the development of more drastic recommendations for improvement. The buildings selected are in need of major renovation to either restore their original architectural integrity, or to visually integrate their present exterior appearance more successfully with the downtown's overall historic character. Detailed working drawings and construction specifications were completed for these buildings in the hope that each will undergo a substantial face-lift in the immediate future. The buildings selected are the *Elks Block*, the *Elks Block Annex*, the *Aubuchon Hardware* buildings, the *Bellows Falls Chamber of Commerce* building, *Sam's Army &Navy Dep't. Store*, the *American Legion* building, and the *Emporium Block*.

PART THREE involved the development of a new signing ordinance specifically designed to preserve and enhance the character of the central business district's historic buildings. PART FOUR involved the design of a new park to be constructed on the site of the former *Star Hotel;* and PART FIVE the development of a self-guiding walking tour of the downtown's historic sites and other points of natural and historic interest.

The *BELLOWS FALLS WORKBOOK* contains PARTS ONE, FOUR and FIVE. PART THREE is also included, but not in the form of a signing ordinance. The new signing ordinance was written for publication in the Rockingham Zoning By-Laws and, once adopted, will be found there. Instead, a series of signing guidelines has been written for inclusion here. PART TWO is not included. As stated above, this section of the study involved the development of a complete set of working drawings and construction specifications for seven buildings located within downtown Bellows Falls. Copies of the drawings and specifications are available either from the Rockingham Community Development Agency or from the project consultant.

ADDITIONAL INFORMATION

Also included in the *WORKBOOK* are the *Secretary of the U.S. Department of the Interior's "Standards for the Rehabilitation of Historic Buildings"* and a series of *Preservation Briefs* on specific restoration techniques published by the National Park Service. Only ten *Briefs* are included here (*Brief No. 5* on historic adobe is not included). As new *Briefs* dealing with specific topics on restoration techniques are published, copies will be available from the Vermont Division for Historic Preservation in Montpelier.



Base Map: Buildings and Improvements

Facade Recommendations

The recommendations outlined below are intended as general guidelines for improving the overall appearance of individual buildings within the study area. Most of the buildings are in relatively good condition and suffer only from minor alterations which are not in keeping with their architectural character. Consequently, the recommendations are aimed at improving the little details which, taken individually, are not necessarily significant but, taken together, can have a significant visual impact. For most merchants and building owners, a logical first step would be a concerted program of scrubbing down and painting up. Dirty buildings should be cleaned. Clapboards and trim should be repainted.

The recommendations are organized on a building by building basis, in a clockwise direction around The Square and down and back the four streets which radiate out from it. Starting with the U.S. Post Office, Bldg. No. 1, the last building is the Andrew's Inn, thirty-two numbers later.

Each building is identified by a photograph and is classified as to functional use, date and type of construction, and architectural style. A special category describes those characteristics which contribute to the overall quality of the street-scape as well as those features which distinguish the building architecturally.

For the most part, the recommendations are limited to a written description and are in the nature of general maintenance. For those buildings where a more comprehensive design change is suggested, the written recommendation is accompanied by a line illustration. When compared to the photograph of the building directly above, the illustration gives a clear indication of the changes being suggested.

It is important to keep in mind that the recommendations for each building are based on their existing use. Should that use change, for whatever reason, before the recommendations are carried out, the suggested improvements might prove to be imcompatible, or inappropriate. It should also be kept in mind that many of the recommendations included in this present volume will require plans and specifications in order to be completed. The line illustrations are not intended for use as working drawings. They are intended only as a visual suggestion.

Recommendations for specific paint colors are also not included. Color selection is, unavoidably, a matter of personal choice. If in doubt about a possible color scheme, consult with a knowledgeable architect or a reputable paint dealer before making a final color selection.

STOREFRONTS

Most of the storefronts in downtown Bellows Falls represent examples of nineteenth and early twentieth century design which are in large part responsible for the downtown's unique urban-like character. There are, of course, a number of exceptions. Several storefronts, such as *Aubuchon Hardware,* were remodeleda number of years ago in an effort to either modernize or project a particular company image. The results, unfortunately, are not in keeping with and, consequently, not as asset to the image of the downtown.

Several storefronts, such as the *Corner Pharmacy,* have undergone recent renovations and restorations which have attempted, for the most part successfully, to restore a certain degree of nineteenth century scale and detailing back into the building's overall design. Others, such as *Walker Insurance,* have taken that enthusiasm a step too far and have superimposed "colonial" style details on a Victorian facade, where they do not belong.

In order to avoid this kind of mistake in the future, it is recommended that, except for those examples such as *Aubuchon Hardware* and the *Elks* which are in obvious need of restoration, existing downtown storefronts be kept and improved only as necessary. They are the character of the downtown. To lose them through needless change would be to lose that character, and in so doing, to change the unique image that is Bellows Falls.

One amazing characteristic of the downtown is the number of early twentieth century bronze storefronts which survive on many of the buildings. While most of these are second generation replacements on older Victorian buildings, several, such as the *J.J. Newbury Co.* storefront or the storefronts on the *Andrew's Inn,* are original installations. Whether original or second generation, these bronze storefronts are a prominent feature of the downtown and should be preserved. They also display a quality of construction and materials which a modern anodized aluminum replacement would be hard put to match.

A.J. Hind's Dep't. Store storefront. This original 1930's storefront is constructed out of bronze and plate glass. The design includes all of those features now typically included in any modern storefront design - a recessed entrance to protect shoppers from the weather and pedestrians on the sidewalk from swinging doors, and lots of plate glass for display. The original stone panels below the display windows have to be covered over with ribbed sheet metal and the transom windows above by the sign.

A concern which is undoubtedly on the minds of many business and building owners is the heat loss they are experiencing through their single thickness plate glass display windows. Fortunately this problem can be solved without having to resort to replacing the entire window system. Retrofit, or "add-a-pane", glazing systems are available from a number of manufacturers where an extra layer of glass is added to the inside of an existing window. The extra layer is mounted so as to create a dead air space in between and, consequently, results in the creation of an R-value equal to that of replacement insulated glass. Sales pressure to the contrary, retrofit glazing is effective and should be used to upgrade the R-value of existing bronze storefront display windows whenever possible.

REPLACEMENT STANDARDS

If a storefront must be replaced, either because a retrofit glazing system cannot be used or because the existing storefront is beyond repair and there is no other alternative, the guidelines outlined below should be followed as closely as possible to insure that the new storefront will be in keeping with not only the architecture of the building but the character of the downtown as a whole as well.

1. The original storefront layout and design should be duplicated as closely as possible. In no instance should the storefront be made to look older than it actually is, or should "colonial"style details be used on a Victorian building. If modern materials are introduced, they must be used with extreme care so as not to violate the original design of the building's facade.

2. The glass area of the display windows should not be cut down either in width or in height. Storefronts were designed with high ceilings and tall windows for two very good reasons - so as to be in scale with the overall design and proportions of the rest of the building's facade, and thereby provide a strong visual base on which to support the floors above, and to let in lots of natural light. Cutting them down almost always results in a new storefront design which is neither in scale nor in keeping with the rest of the building.

3. On brick buildings, the new door and window frames should be made up out of aluminum which is anodized, not bright. On wood frame buildings, the new door and window frames should, preferably, be made out of wood, but anodized is acceptable.

4. If a new skirt has to be installed below the display windows between the windows and the sidewalk, it should be faced with cut panels of either structural slate or granite, not brick. The slate and granite are also available as imitation stone which is generally less expensive yet still in keeping with the character of the building if a natural color is selected.

STORM WINDOWS

In accordance with modern standards and practices regarding the installation of moisture and thermal barriers, all new storm windows should be installed on the inside face of the window, not the outside. To increase the efficiency of an existing barrier, existing storm windows should be relocated to the inside face of the window if they are presently installed on the outside. If they cannot be reinstalled on the inside without moderate alteration, they should be replaced with new units.

ENERGY AUDITS

Energy audits have been completed for almost all of the buildings within the study area. In order to gain a better picture of the needs required to upgrade each building to a minimum standard of energy conservation and architectural maintenance, these audits should be reviewed in conjunction with the recommendations outlined in this *WORKBOOK*. It is important to keep in mind that improvements in energy efficiency should, in no way, detract from the architectural integrity or character of the building. Energy audit recommendations have been designed to be compatible with the requirements of historic preservation and to complement, rather than juxtapose, preservation goals.

RESTORATION STANDARDS AND TECHNIQUES

Additional information regarding appropriate procedures for restoring a building and for applying specific restoration techniques can be found in the *Secretary of the U.S. Department of Interior's "Standards for the Rehabilitation of Historic Buildings"* and a series of *Preservation Briefs* published by the National Park Service. The *Standards* and those *Briefs* currently available have been reproduced and included in the Appendix of this workbook.

The Buildings

FACADE IMPROVEMENTS - Building No. 1

U.S. POST OFFICE
7 Bridge Street

BUILDING USE
Post Office

DATE(S)
19301931

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Colonial Revival

Contributing Characteristics

Rare example of building type and architectural style. Maintains facade line and building scale along street. Acts as focal point marking gateway into The Square when approaching from east along Bridge Street, and as terminal focal point at end of bridge when approaching The Square from across Bellows Falls Canal.

Distinguishing Features:
mixture of Classical details common to Colonial Revival style.

Comments

This is the only example of this particular style of architecture in Vermont. The building should be preserved without major lateration to the facade, details or fenestration.

FACADE IMPROVEMENTS - Building No. 2

AUBUCHON BUILDING
59 The Square

BUILDING USE
Commercial/Apartment

DATE(S)
1887 & 1892

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Italianate Revival

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street. Defines and encloses south side of The Square, and acts as focal point when approaching The Square from Rockingham Street.

Distinguishing Features:
one (partially) original storefront; granite window sills and lintels; roof cornice with decorative brickwork on three story section; wood roof cornice with dentils on four story section.

TOP: Historic View.
CENTER: Existing Condition.
BOTTOM: Recommended Improvements.

Recommendations

This building is in an excellent state of overall maintenance. The storefront portion of the facade should be restored in order to bring the appearance of the building back into harmony with the historic architectural character of the rest of The Square.

- Repoint brick wherever necessary, particularly at points where water, ice and snow can accumulate, or where there is water run-off down building face. Repointing should match existing in joint profile and mortar color.
- Remove paint from stone window sills and lintels.
- Recaulk second, third and fourth floor windows at point where frames abut masonry.
- Clean, scrape and prime, as necessary, upper floor windows and roof cornice in preparation for painting.
- Repaint in color scheme more appropriate to character of building:
    1. Two tone color scheme for cornice.
    2. Trim color for windows.
- Scrape and prime brick as necessary, and repaint.
- Remove *Aubuchon Hardware* and *Snowflake Wash-Dry* overhanging signs and do not replace.
- SHORT-TERM: Remove shutters on *Dexter's* storefront, and repaint storefront in more neutral earth-tone color. Remove *Ladies'-Men's Clothing* sign on storefront and replace with new lettering which is compatible with *Dexter's* lettering and is mounted directly on storefront sign panel.
- LONG TERM: Restore storefronts as shown in illustration. Restoration will involve partial remodeling of existing Dexter's storefront and complete remodeling of *Aubuchon Hardware* and *Snowflake Wash-Dry* storefronts.
- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions, and, for overhanging signs, type of bracket used for mounting from wall.
- Storefront signing should be located on building facade as shown in illustration.

A complete set of working drawings and construction specifications has been prepared for the renovation of the facade of this building and is available from the Community Development Agency at the Rockingham Town Hall.

FACADE IMPROVEMENTS - Building No. 3

CHAMBER OF COMMERCE
55-57 The Square

BUILDING USE
Commercial/Office

DATE(S)
Circa 1860

CONSTRUCTION
Wood Frame

BUILDING STYLE
Italianate Revival

Contributing Characteristics

Maintains facade line and building scale along street. Defines south side of The Square and helps to act as terminal focal point when approaching The Square from Rockingham Street.

Wood frame, clapboard construction helps break monotony of C.B.D.'s predominantly brick character. One of few surviving clapboarded buildings in C.B.D.

TOP: Historic view.
CENTER: Existing Condition.
BOTTOM: Recommended Improvements.

Recommendations

This building is in need of major structural stabilization.

- Stabilization work will include: replacement of deteriorated framing; repair and/or replacement of deteriorated siding, window and door casings and sills, window sash, and miscellaneous trim; and repair of roof cornice, jets and flashing. Framing below grade, to height of 2 feet above grade, should be replaced with pressure treated wood.
- Deteriorated sash should be replaced with new which matches existing in size and number of panes.

- Install new storm window units on interior face of first and second floor windows, and insulate walls, floors and ceilings wherever necessary.
- Remodel facade as shown in illustration.

- Storefront signing should be located on building facade as shown in illustration.

- Clean, scrape and prime building exterior, as necessary, in preparation for painting.
- Repaint in color scheme appropriate to character of building:

    1. Body color for clapboards.
    2. Trim color.
    3. Accent color for window sash and entry doors.

A complete set of working drawings and construction specifications has been prepared for the renovation of the facade of this building and is available from the Community Development Agency at the Rockingham Town Hall.

FACADE IMPROVEMENTS - Building No. 4

CORNER PHARMACY
51 The Square

BUILDING USE
Commercial/Office

DATE(S)
1875

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Italianate Revival

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street, helps to define corner of intersection by providing visual anchor, and acts as terminal focal point on The Square when approaching from either Rockingham or Canal streets.

Distinguishing Features:
original cast iron storefronts; granite window sills and lintels; roof cornice with decorative and corbelled brickwork.

Recommendations

This building is in an excellent state of overall maintenance and should be preserved without major alteration to either the building facade or the storefront.

This building has been recently renovated. The remodeling of the storefront is an excellent example of a sympathetic restoration which utilizes historic architectural features in combination with new building components.

- Repair windows facing Mill Street and third floor windows facing The Square and Westminster Street as necessary, replacing broken or deteriorated woodwork with new which matches existing in profile and dimension.
- Deteriorated sash should be replaced with new which matches existing in size and number of panes.
- Install new storm window units on interior face of Mill Street and third floor windows.

- Install smooth plywood panel, recessed back 4 inches from face of brick and trimmed to match windows, in door opening on second floor facing Mill Street.

- Repoint brick wherever necessary, particularly at points where water, ice and snow can accummulate, or where there is water run-off down building face. Repointing should match existing in joint profile and mortar color.

- Clean brick on Mill Street, and fill holes left when fire escape was removed, coloring mortar to match either existing joint mortar or brick color, as appropriate.
- Repoint corner facing The Square and Westminster Street directly above storefront entrance.

- Clean, scrape and prime woodwork, as necessary, in preparation for painting, and repaint, wherever necessary, to match existing color.

FACADE IMPROVEMENTS - Building No. 5

CRAY BLOCK
6-16 Westminster Street

BUILDING USE
Commercial/Office/Apartment

DATE(S)
Circa 1925 & 1935

CONSTRUCTION
Wood Frame/Brick Veneer

BUILDING STYLE
1930's Commercial

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street.

Distinguishing Features:
original storefronts with wood entry doors; multi-section second and third floor windows with combination of double-hung sash and glass block; decorative brickwork in cornice.

Recommendations

This building is in a good state of overall maintenance and should be preserved without major alteration to either the building facade or the storefronts.

This building may be in need of structural stabilization along east elevation facing tracks of Boston & Maine Railroad. Stabilization work might include: repair and reinforcement of foundation; replacement of deteriorated framing; repair of deteriorated clapboard siding, window casings and sash, and miscellaneous trim; and repair of roof cornice, jets and flashing.

- Repoint brick wherever necessary, particularly at points where water, ice and snow can accummulate, or where there is water run-off down building face.
- Repoint brickwork between sidewalk and storefront display windows 100%.
- Repointing should match existing in joint profile and mortar color.

- Repair upper floor windows as necessary, replacing broken or deteriorated woodwork with new which matches existing in profile and dimension.
- Deteriorated sash should be replaced with new which matches existing in size and number of panes.
- Replace broken and missing glass in upper floor windows with new.
- Recaulk all window and door frames at joint between wood and masonry.

- Repair roof cornice as necessary.
- Repair entry doors as necessary and refinish natural.

- Clean, scrape and prime all woodwork in preparation for painting, and repaint.

- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions, and, for overhanging signs, type of bracket used for mounting from wall.

FACADE IMPROVEMENTS - Building No. 6

BOWLING ALLEY BLOCK
18-30 Westminster Street

BUILDING USE
Commercial/Office/Apartment

DATE(S)
Circa 1925 & 1935

CONSTRUCTION
Wood Frame/Brick Veneer

BUILDING STYLE
1930's Commercial

Contributing Characteristics

Example of building type and architectural style. Maintains facade line and building scale along street.

Distinguishing Features:
original storefronts; decorative brickwork in band below third floor windows.

Comments

This building has been vacant for a number of years. Due to an apparent absence of general maintenance, a high level of vibration from passing trains, and uneven settling on its hillside location, the building appears to lack sufficient structural integrity to warrant renovation. The building should be demolished and the site used to better advantage.

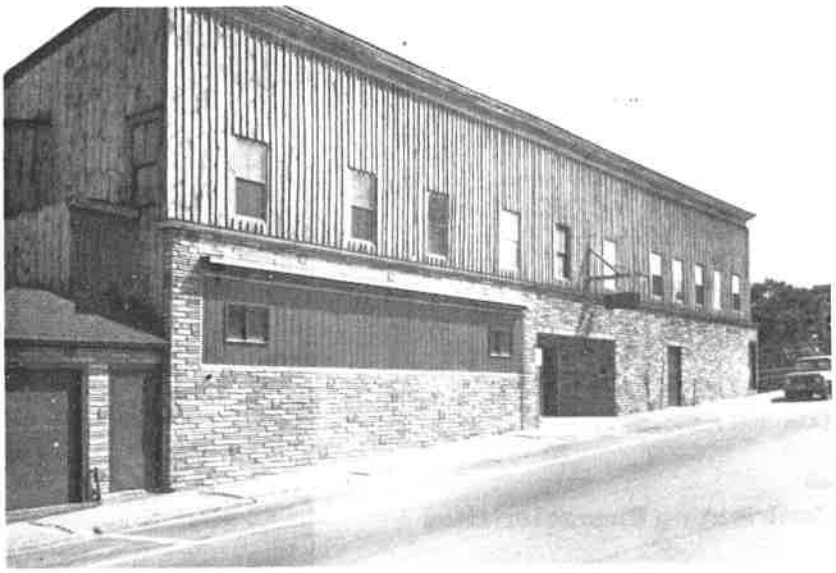
FACADE IMPROVEMENTS - Building No. 7

DOC'S PLACE
46 Westminster Street

BUILDING USE
Commercial/Apartment

DATE(S)
Circa 1900

CONSTRUCTION
Wood Frame



Contributing Characteristics

Maintains facade line and building scale along street.

Recommendations

- Stain rough cut board-and-batten siding more compatible earth-tone color.
- LONG TERM: Remove rough cut board-and-batten siding, and replace with clapboards and traditional trim around windows and at corners.

FACADE IMPROVEMENTS - Building No. 8

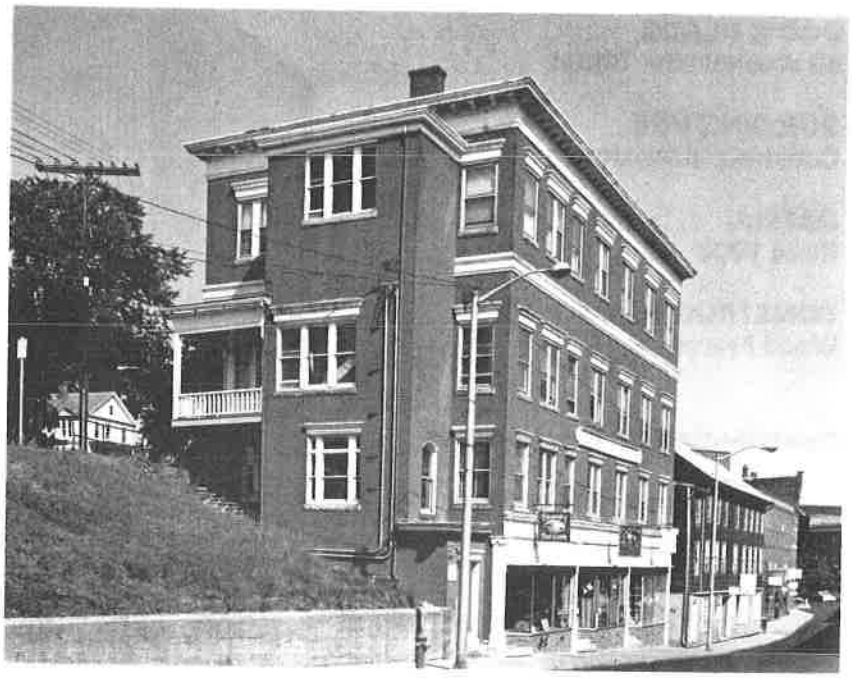
EDWARD ARMS BLOCK
29-35 Westminster Street

BUILDING USE
Commercial/Office/Apartment

DATE(S)
1890 & 1910

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Colonial Revival



Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street. Acts as focal point marking gateway into The Square when approaching C.B.D. from south along Westminster Street.

Distinguishing Features:
original bronze storefronts enframed by fluted cast iron Ionic pilasters supporting full Classic entablature, and detailed with paneled sign bands and wood entry doors, side lights and transoms; upper story entrance porches detailed with turned posts and dentilated cornices; granite window sills and decorative stamped sheet metal window lintel entablatures; stamped sheet metal modillion roof cornice with frieze.

TOP: Overall Building.
BOTTOM: Storefronts.

Recommendations

This building is in an excellent state of overall maintenance and should be preserved without major alteration to either the building facade or the storefronts.

- Repoint brick wherever necessary, particularly at points such as sills, lintels, decorative ledges and cornices where water, ice and snow can accummulate, or where there is water run-off down building face.
- Repointing should match existing in joint profile and mortar color.

- Complete window replacement program with windows of identical manufacture to new replacement units.
- Recaulk all window and door frames at joint between wood and masonry.

- Repair storefront entry doors and surrounding woodwork as necessary. Transoms above entry doors should be repaired and made more easily operable. Latch hardware should be refurbished and preserved.
- Repair entrance porches on School Street facade as necessary.
- All broken or deteriorated woodwork should be replaced with new which matches existing in profile and dimension.

- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions, and, for overhanging signs, type of bracket used for mounting from wall.
- Remove existing overhanging signs and replace with new signs of more appropriate design.
- Storefront signing should be located in existing sign panels as shown in illustration.
- Refurbish *Edward Arms Block* sign on Westminster Street facade, and repaint in complementary two tone color scheme with gold-leaf lettering.

- Clean, scrape and prime, with wood or metal primer as appropriate, all architectural trim in preparation for painting.
- Repaint in color scheme more appropriate to character of building:
  1. Window color.
  2. Two tone color scheme for trim and storefronts.
  3. Complementary background color for storefront sign panels.
  4. Accent color for upper floor entry doors.
  5. Refinish storefront entry doors natural.

- SHORT TERM: Paint brick veneer below storefront display windows to match brick on rest of building.

- LONG TERM: Remove brick veneer below storefront display windows and replace with new slate panels.
- Repaint brick.

FACADE IMPROVEMENTS - Building No. 9

JIM'S ARCADE
21 Westminster Street

BUILDING USE
Commercial/Apartment

DATE(S)
Circa 1840

CONSTRUCTION
Wood Frame

BUILDING STYLE
Greek Revival

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street. When approaching from The Square, north gable end acts as focal point on street to mark location of The Stairs.

Oldest commercial building in C.B.D. Wood frame construction helps break monotony of C.B.D.'s predominantly brick character.

Distinguishing Features:
pedimented gable and second floor oriel bay window on north end.

TOP: Historic View.
CENTER: Existing Condition.
BOTTOM: Recommended Improvements.

Recommendations

This building is the oldest commercial building in the central business district and should be preserved without major alteration to the building facade.

- Remove shed, dormer window, and collection of attachments on School Street elevation, and restore roof, roof cornice, siding, sindows and doors to match rest of building.
- Grade between building, Church Street and The Stairs should be changed, as necessary, to insure proper drainage.

- Repair upper floor windows as necessary
- Deteriorated sash should be replaced with new which matches existing in size and number of panes.
- Uncover windows on School Street elevation and repair as necessary.
- Install new storm window units, wherever necessary, on interior face of second and third floor windows.

- Replace roof and roof flashing. Reinstall existing snow catches, and replace existing gutters and leaders with new.
- Repair roof cornice as necessary.
- All broken or deteriorated woodwork should be replaced with new which matches existing in profile and dimension.

- Install new post under second floor entrance porch on north elevation.

- Clapboard over plywood siding on ground floor and install new storefront cornice as shown in illustration. Remodeling would help to improve early nineteenth century character of building.

- Remove *Jim's Arcade* overhanging sign and replace with new sign of more appropriate design.

- Clean, scrape and prime building exterior in preparation for painting.
- Repaint in color scheme more appropriate to character of building:
    1. Body color for siding.
    2. Trim color.
    3. Accent color for window sash.
    4. Ground floor color.

- LONG TERM: Replace all upper floor windows with new wood, six-over-six, double hung sash window units. New windows should be detailed with 1 by 4 trim.

FACADE IMPROVEMENTS - Building No. 10

STAIRSIDE BUILDING
5-11 Westminster Street

BUILDING USE
Commercial/Office/Apartment

DATE(S)
1932 & 1938

CONSTRUCTION
Wood Frame/Brick Veneer

BUILDING STYLE
1930's Commercial

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street. When approaching from south along street, angled southeast corner of building breaks facade line of street and helps mark location of The Stairs.

Distinguishing Features:
(partially) original storefronts with continuous reinforced concrete lintel; reinforced concrete window sills; decorative brickwork along parapet; terra cotta parapet cap.

TOP: Present View.
BOTTOM: Recommended Improvements.

Recommendations

This building is in an excellent state of overall maintenance and should be preserved without major alteration to either the building facade or the storefronts.

This building is cluttered with an unsightly array of wall mounted and overhanging signs, which, because of their random placement on the building facade and lack of uniform size, do nothing but detract from the overall visual quality of the building as a whole.

- Repoint brick wherever necessary, particularly at points where water, ice and snow can accummulate, or where there is water run-off down building face.
- Replace deteriorated brick along sidewalk with new brick which matches existing in size, color and texture, and repoint repaired area 100%.
- Repointing should match existing in joint profile and mortar color.

- Remodel left-hand storefront, as shown in illustration, but not corner entryway, to match existing design of center and right-hand storefronts.
- Replace broken or missing marble panels beneath storefront display windows with new.
- Replace missing ventilator grills in marble panels.

- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions, and, for overhanging signs, type of bracket used for mounting from wall.
- Remove metal sign band which wraps around corner of building at public stair. Clean and repoint brickwork behind sign band, as necessary.
- Remove all existing wall mounted and overhanging signs and replace with new signs as shown in illustration.

- Clean, scrape and prime all woodwork in preparation for painting, and repaint.

FACADE IMPROVEMENTS - Building No. 11

WALKER INSURANCE AGENCY
49 The Square

BUILDING USE
Commercial/Office

DATE(S)
Circa 1875

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Italianate Revival

Contributing Characteristics

Maintains facade line and building scale along street.

TOP: Historic View.
BOTTOM: Present View.

Recommendations

This building has recently undergone a storefront remodeling which is inappropriate to the historic architectural character of the building and should not be considered as an acceptable example for imitation by others. The "Colonial" style details used in the remodeling are poor excuses for the originals from which they are derived, and, because Vermont was never a colony, have no context within the scope of Vermont's historic architectural development.

Even though the facade of this building maintains the facade line of the buildings on either side, because the new storefront has been recessed back into the facade of the building, the traditional relationship of storefront to sidewalk has been interrupted and the visual continuity of the street disrupted.

- Repair second floor windows as necessary, replacing broken or deteriorated woodwork with new which matches existing in profile and dimension.
- Deteriorated sash should be replaced with new which matches existing in size and number of panes.
- Clean brick and repoint 100%, matching existing joint profile and mortar color.
- Install new storm window units on interior face of windows.
- Clean, scrape and prime second floor windows, caulk and repaint.

FACADE IMPROVEMENTS - Building No. 12

CENTENNIAL ARCADE
37 The Square

BUILDING USE
Commercial/Office

DATE(S)
1877 & 1978

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
High Victorian Italianate

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street. Helps define west side of The Square and acts as terminal focal point when approaching from Bridge Street.

Distinguishing Features:
storefront openings flanked by piers with stone banding supporting continuous storefront cornice; stone window sills and shouldered window lintels; decorative brick bands between window lintel shoulders; roof cornice with decorative and corbelled brickwork and three roof pinnacles.

TOP: Historic View.
BOTTOM: Present View.

Recommendations

This building is an excellent state of overall maintenance and should be preserved without major alteration to the building facade.

This building was renovated in 1979. The remodeling of the storefronts is an excellent example of a sympathetic design solution which blends well with the historic architectural character of the rest of the facade.

- Repoint brick wherever necessary, particularly at points such as sills, lintels, decorative ledges and cornices where water, ice and snow can accumulate, or where there is water run-off down building face.
- Repointing should match existing in joint profile and mortar color.

- Repair two second floor windows above entrance as necessary, replacing deteriorated woodwork with new which matches existing in profile and dimension.
- Deteriorated sash should be replaced with new which matches existing in size and number of panes.

- Replace flashing on *Vermont National Bank* storefront cornice.
- Install new tin cap, which matches existing caps, on right-hand parapet pinnacle.

- Repaint upper floor windows and roof cornice uniform color, and repaint *Vermont National Bank* storefront and *Centennial Arcade* entrance.

- LONG TERM: Restore roof cornice either to match original or to approximate that on Centennial Block.

FACADE IMPROVEMENTS - Building No. 13

CENTENNIAL BLOCK
29 The Square

BUILDING USE
Commercial/Office

DATE(S)
1875 & 1978

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
High Victorian Italianate

Contributing Characteristics

Rare example of building type and architectural style. Maintains facade line and building scale along street. Helps define west side of The Square and acts as terminal focal point when approaching from Bridge Street.

Distinguishing Features:
"remodeled" Georgian Colonial Revival style storefront with broken scroll pediment above entry door, corner piers and dentilated cornice; original upper story entry vestibule and wood doors; stone piers flanking south storefront opening with scrolled Corinthian tops; stone window sills and shouldered window lintels; decorative brick bands between window lintel shoulders; roof cornice with decorative and corbelled brickwork; roof pinnacles and center gable parapet bearing raised stone inscription "Centennial" above semi-circular niche and 1875 date stone.

TOP: Historic View.
BOTTOM: Present View.

Recommendations

This building is in an excellent state of overall maintenance and should be preserved without major alteration to either the building facade or the *Bliss & Lawlor Insurance Agency* storefront.

This building was renovated in 1979. The remodeling of the left-hand storefront, to accommodate a handi-capped entry ramp, has, unfortunately, seriously damaged the visual quality and architectural continuity of the facade along the sidewalk. The problem is that the traditional wall of glass storefront along the sidewalk has been interrupted, and the space in which the ramp is located has been open, directly out onto the sidewalk. A more successful solution would have been to treat the ramp as enclosed interior space and to have masked the ramp from general view behind a storefront, complete with display windows and entry, of identical design to that of the *Vermont National Bank* next door.

- Repoint brick wherever necessary, particularly at points such as sills, decorative ledges and cornices where water, ice and snow can accummulate, or where there is water run-off down building face.
- Repointing should match existing in joint profile and mortar color.

- Repair sheathing and decorative woodwork on *Bliss & Lawlor Insurance Agency* storefront as necessary, replacing broken or deteriorated material with new which matches existing in profile and dimension.
- Replace cornice flashing.

- Clean, scrape and prime *Bliss & Lawlor Agency* storefront in preparation for painting, and repaint to match color scheme of *Vermont National Bank* storefront.

- Restore storefront cornice above handi-capped entry ramp to match that on *Bliss & Lawlor Insurance Agency* storefront.

- Repair woodwork and plaster in recessed center entryway as necessary, and repaint to match color scheme on repainted storefronts.

- Repaint upper floor windows and roof cornice uniform color.

FACADE IMPROVEMENTS - Building No. 14

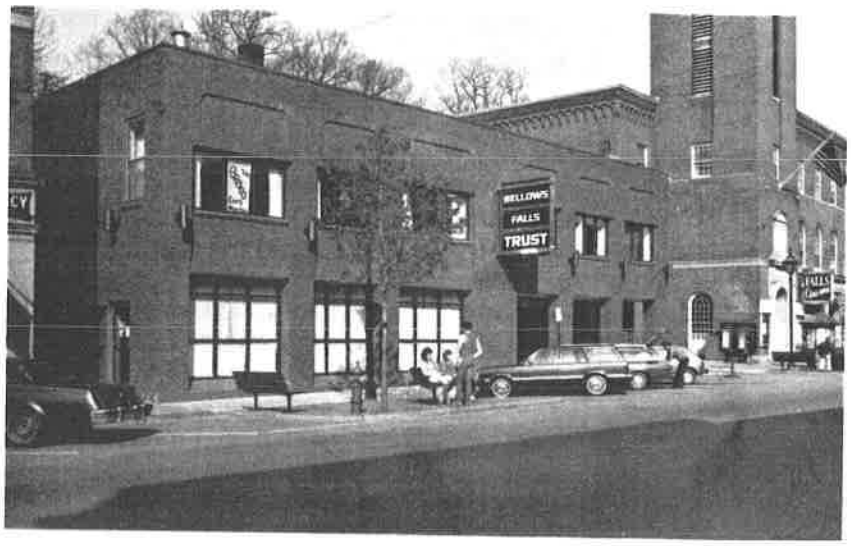
BELLOWS FALLS TRUST CO.
23 The Square

BUILDING USE
Commercial/Office/Meeting Hall

DATE(S)
Circa 1875 & 1979

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Commercial



Contributing Characteristics

Maintains facade line and building scale along street.

Comments

This building was renovated in 1979 and represents a successful attempt at integrating the new with the old. Through the use of materials, overall building scale, the careful proportioning of solid areas to voids, and the selective use of detailing, the building's new facade blends with, but does not intrude upon, the historic character of the surrounding architecture.

Unfortunately, the facades of two historic buildings, facades which, probably, for the same cost, could have been restored, were lost in the process. While this particular renovation is successful, because of the Square's unique historic character and the fact that virtually every building in The Square survives in a relatively unaltered state of preservation, this kind of "remodeling" solution is not recommended. The loss of a valuable historic resource, and the accompanying loss of historic character, should be carefully weighed against any gains which might be made in the areas of physical improvement and image building.

Evolution of the Street-Scape

View of the west side of The Square.
TOP: Circa 1885.
CENTER: Circa 1900.
BOTTOM: 1983.

Each side of The Square has changed dramatically over the years as buildings have been destroyed by fire and replaced or as older buildings have supposedly outlived their usefulness and progress has made it seem beneficial to either remodel or rebuild in order to be more up-to-date. Each time an improvement was made, it was carried out in the style then currently in vogue and using the best possible materials and design. Of primary concern was the preservation of The Square's commercial character and the reenforcement of its identity as the commercial, cultural and political center of Bellows Falls.

In keeping with that character, buildings shared a common facade line along the edge of the street, were of a similar height and scale, and were close set one to the next. Obviously, as can be seen in the photographs, building heights tended to increase as the century progressed. The three center buildings in the top photograph with their gable roofs are a shorter three stories in height than the three story height of the Centennial Block to their left. When the new town hall, on the right side of the center photograph, was built in 1887, the village acquired a proud new symbol and identity. Destroyed in 1925, the present town hall maintained that symbol by incorporating a new clock tower into its design. In a similar vein, when the Bellows Falls Trust Company was remodeled in 1979, scale, detailing, materials and a continuation of the facade line were used in a contemporary design to help preserve and maintain an image and character inherited from the nineteenth century. Hopefully, future change will be as appropriate.

FACADE IMPROVEMENTS - Building No. 15

ROCKINGHAM TOWN HALL
7-15 The Square

BUILDING USE
Town Hall/Cinema/Commercial

DATE(S)
1926

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Colonial Revival

Contributing Characteristics

Excellent example of building type and eclectic architectural style. Maintains facade line and building scale along street, and acts, because of imposing scale and campanile (tower), as dominant focal point of both The Square and village.

Distinguishing Features:
original bronze storefronts; Neo-Renaissance style campanile; Neo-Gothic style arches in parapet; Georgian Colonial Revival style entrance surrounded with keystones archway, pilasters, and broken pediment.

Recommendations

This building is in an excellent state of overall maintenance and should be preserved without major alteration to either the building facade or the storefronts.

- Remove yellow, semi-circular acrylic panels from tops of round arched second floor windows and replace with clear acrylic.

- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions.
- Refurbish existing *Fletcher's* sign located in storefront cornice.
- Remove sign from behind display window in antiques shop and install new sign in cornice above storefront which matches *Fletcher's* sign in basic overall dimensions and style.
- Remove *Fletcher's* overhanging sign and replace with new sign of more appropriate design.

- Refurbish *Falls Cinema* overhanging sign.
- Remove signs above cinema display cases. Clean and refurbish display cases as necessary.

- Reinstall existing air conditioning units above storefront entries so that they do not project out from face of wall, and screen from view behind open grillwork.

- LONG TERM: Remove all existing exterior storm window units and replace with new units mounted on interior face of window.
- Remove existing entry doors and replace with new doors and casing of dark anodized aluminum.

FACADE IMPROVEMENTS - Building No. 16

SAM'S ARMY & NAVY
18 Rockingham Street

BUILDING USE
Commercial

DATE(S)
Circa 1935

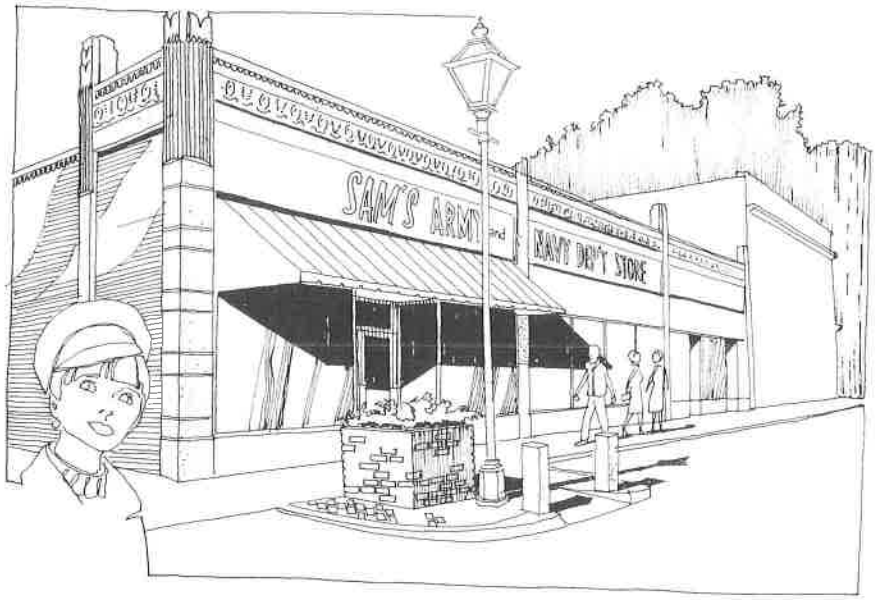
CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Art Deco

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line along street.

Distinguishing Features:
fluted stone piers with pylons on roof parapet; stone roof parapet decorated with stylized Greek anthemion motif.



TOP: Existing Condition.
BOTTOM: Recommended Improvements.

Recommendations

This building is in an excellent state of overall maintenance and should be preserved without major alteration to either the building facade or the storefronts.

- Replace missing stone panels on either side of entrance with new slate panels.

- Recast missing blocks of parapet veneer, matching existing in texture, color and decorative pattern, and install.
- Repointing around new blocks should match existing in joint profile and mortar color.

- Remove existing storefront signing and install new signing as shown in illustration.
- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions, and, for overhanging signs, type of bracket used for mounting on wall.
- Storefront signing should be located on building facade as shown in illustration.

- Remove blue baked enamel metal panels on right-hand storefront through which air conditioning units are mounted.
- Reinstall existing air conditioning units above storefront entries so that they do not project out from face of wall, and screen fron view behind open grillwork.

- Refurbish transom band behind existing *Sam's Army & Navy Dep't. Store* sign and blue baked enamel panels on right-hand storefront as necessary.
- Install new anodized aluminum fascia over original recessed awning cavity below new sign band, and flash into brick.

- Install new awnings on *Sam's Army & Navy Dep't. Store,* as shown in illustration, at same height and location as awning on right-hand storefront. Awnings should be of uniform design but can be of different coloring.

A complete set of working drawings and construction specifications has been prepared for the renovation of the facade of this building and is available from the Community Development Agency at the Rockingham Town Hall.

FACADE IMPROVEMENTS - Building No. 17

I.O.O.F. BLOCK
20 Rockingham Street

BUILDING USE
Commercial/Office/Meeting Hall

DATE(S)
1938

CONSTRUCTION
Wood Frame/Brick Veneer

BUILDING STYLE
Colonial Revival

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street.

Distinguishing Features:
original bronze and marble storefronts with recessed sign band; keystoned second floor window lintels; dentilated parapet cornice; second floor entrance surrounded with pedestals, pilasters and entablature.

Recommendations

This building is in an excellent state of overall maintenance and should be preserved without major alteration to either the building facade or the storefront.

- Repair cracks in stucco on north elevation, and repaint.

- Clean, scrape and prime all woodwork in preparation for repainting.
- Repaint exterior woodwork.
- Repaint woodwork around center entrance.
- Repaint woodwork around center storefront entrance, and refinish entry doors natural.
- Repaint woodwork in two closed off storefront entrances dark earth-tone color.

- Restore *I.O.O.F.* overhanging sign.

- Install new awning material of more colorful design.

FACADE IMPROVEMENTS - Building No. 18

AMERICAN LEGION CLUB
42 Rockingham Street

BUILDING USE
Commercial/Meeting Hall

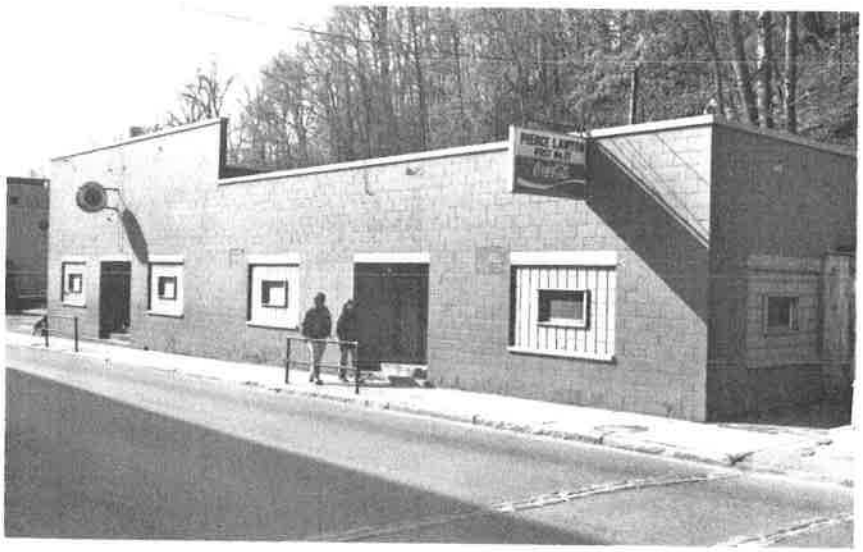
DATE(S)
Circa 1895 &

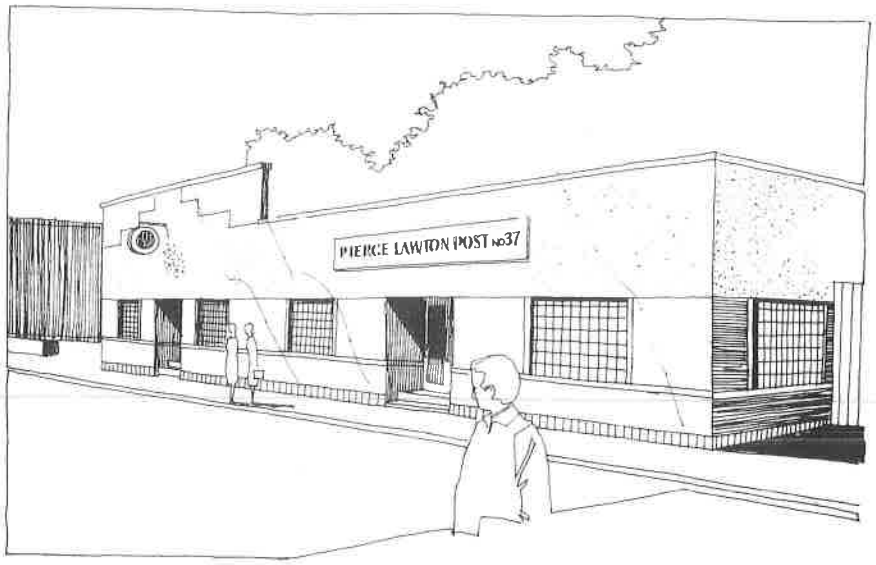
CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Commercial

Contributing Characteristics

Maintains facade line along street. Provides visual transition in building scale between compact, urban character of The Square and more spread out, strip development configuration of north end of Rockingham Street.





TOP: Historic View.
CENTER: Existing Condition.
BOTTOM: Recommended Improvements.

Recommendations

This building is in an excellent state of overall maintenance. Remodeling will help to transform a drab and uninteresting facade into a complementary, although contemporary, visual asset on the street.

- Remodel building facade by installing insulation and stucco-like finish as shown in illustration. Because of narrow width of sidewalk, area below windows would be masonry veneer. Art Deco style design is intended to complement style of Polish American Club on other side of street.

- Signing should be located on building facade as shown in illustration. Refurbish round *American Legion* overhanging sign.

- Install new fire exit door on south elevation, and rebuild entrance vestibule on north elevation with new entry door and concrete ramp to accommodate handi-capped access.

A complete set of working drawings and construction specifications has been prepared for the renovation of the facade of this building and is available from the Community Development Agency at the Rockingham Town Hall.

FACADE IMPROVEMENTS - Building No. 19

MISS BELLOWS FALLS DINER
90 Rockingham Street

BUILDING USE
Diner

DATE(S)
Circa 1935-1945

CONSTRUCTION
Wood Frame/Sheet Metal Veneer

BUILDING STYLE
Roadside Diner

Contributing Characteristics

Rare example of building type and architectural style.

Recommendations

The *Miss Bellows Falls Diner* is a unique example of early twentieth century, American roadside architecture. Its importance is enhanced by the fact that the diner continues to be used for the function for which it was originally built, and that its original appearance is almost perfectly preserved. The *Miss Bellows Falls* is the only surviving example of a barrel roofed diner in Vermont. This type of diner was made by the famed Worchester Lunch Car Company, one of the leading manufacturers of roadside diner architecture during the first half of the twentieth century.

- Reconstruct planter box which runs along front of diner next to sidewalk, and plant with mixed variety of evergreens and ground plantings.

- Replace deteriorated metal band along bottom edge of metal panels facing street with new, and cover with new 6 inch wide skirt. Skirt should be beveled along top edge to shed water; should be caulked along edge where wood abuts metal; and should be screwed to metal panels, with screw holes plugged and sanded smooth.

- Replace broken glass blocks in wall next to north entry door.

- Clean, scrape and prime, as necessary, all woodwork, and wood and asbestos siding in preparation for repainting.

- Repaint:
  1. Body color of contrasting, but compatible, darker grey color for siding and trim on additions.
  2. Red trim color which matches existing for roof cornice, sills and new skirt on diner.

FACADE IMPROVEMENTS - Building No. 20

NICK'S CAFE
65 Rockingham Street

BUILDING USE
Bar

DATE(S)
Circa 1880 & 1977

CONSTRUCTION
Wood Frame

BUILDING STYLE
Commercial

Contributing Characteristics

Maintains facade line along street. Provides visual transition in building scale between compact, urban character of The Square and more spread out, strip development configuration of north end of Rockingham Street.

Distinguishing Features:
recessed center entryway.

Recommendations

This building was rebuilt in 1977 following a fire which destroyed the two upper floors, and is in an excellent state of overall maintenance.

- Install new awning material of colorful design on existing awning mechanism.

FACADE IMPROVEMENTS - Building No. 21

ROCKINGHAM CANAL HOUSE
45 Rockingham Street

BUILDING USE
Commercial/Office/Apartment

DATE(S)
1883 & 1979

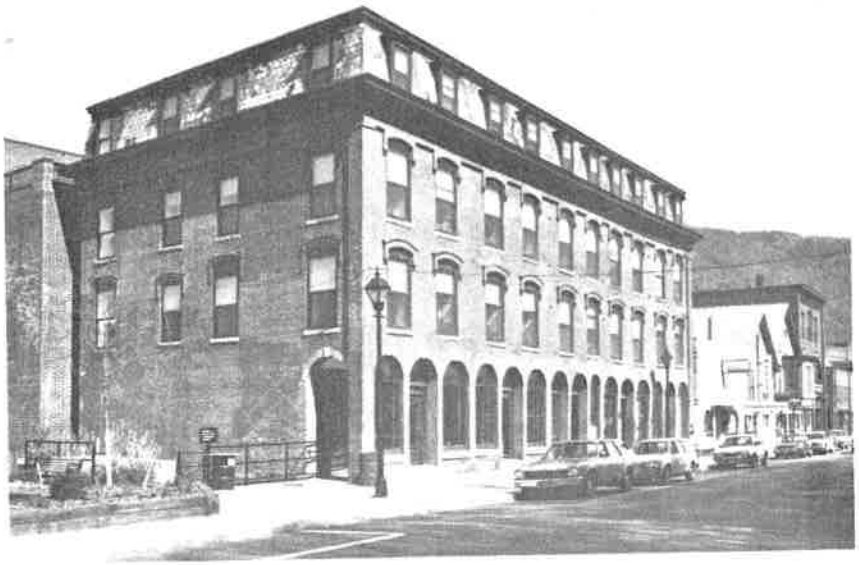
CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
French Second Empire

Contributing Characteristics

Rare example of building type and architectural style. Maintains facade line and building scale along street. Acts as focal point on street marking gateway to The Square when approaching C.B.D. from north along Rockingham Street.

Distinguishing Features:
semi-circular storefront window and door openings; stone sills and brick window lintels with arched tops and shoulders; bracketed wood roof cornice; fourth floor mansard with decorative slate roofing.



TOP: Historic View.
BOTTOM: Present View.

Comments

This building was successfully restored in 1979 and renovated for reuse. Because of the building's link with Bellows Falls' historic past, renovation has allowed the building to remain viable and competitive within the community, and to continue functioning as a valuable resource.

FACADE IMPROVEMENTS - Building No. 22

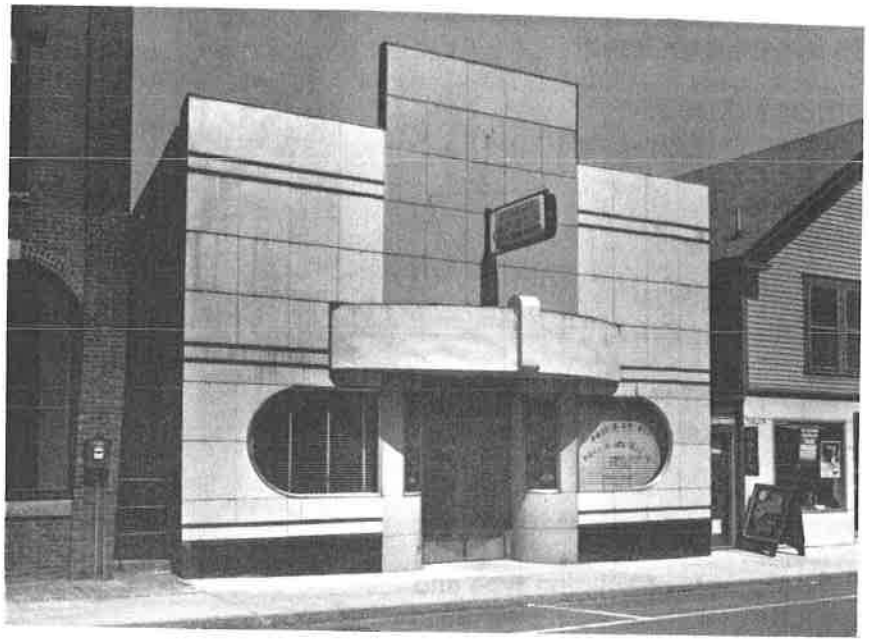
POLISH AMERICAN CLUB
37 Rockingham Street

BUILDING USE
Meeting Hall

DATE(S)
1937

CONSTRUCTION
Wood Frame/Enamel Panel Veneer

BUILDING STYLE
Art Deco



Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street.

Distinguishing Features:
multi-colored, baked enamel panel veneer on front facade; front windows with round ends and curved glass.

TOP: Existing Condition.
BOTTOM: Recommended Improvements.

Recommendations

The facade of this building is an unusual example of the Art Deco style and should be preserved without major alteration.

- Clean building facade with soap and water, or mild chemical solution.

- Remove existing overhanging sign.
- Repaint existing entrance marquee (canopy) in compatible background color, and install new sign on marquee in Art Deco style with neon striping, as shown in illustration.

- Repair existing entry doors as necessary, and refinish doors, casings and trim natural.

FACADE IMPROVEMENTS - Building No. 23

EMPORIUM BLOCK
27-35 Rockingham Street

BUILDING USE
Commercial/Office/Apartment

DATE(S)
Circa 1870

CONSTRUCTION
Wood Frame

BUILDING STYLE
Italianate Revival

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street.

Wood frame, clapboard construction helps break monotony of C.B.D.'s predominantly brick character. One of few surviving clapboarded buildings in C.B.D., and only one with gable facade facing street.

TOP: Historic View.
CENTER: Existing Condition.
BOTTOM: Recommended Improvements.

Recommendations

This building is in an excellent state of overall maintenance. The storefront portion of the facade should be restored in order to bring the appearance of the building back into harmony with the historic architectural character of the rest of The Square.

- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions, and, for overhanging signs, type of bracket used for mounting from wall.
- Storefront signing should be located on building facade as shown in illustration.
- Remove *Wards* overhanging sign and replace with new sign of more appropriate design.

- Remodel storefronts as shown in illustration.
- Remodeling will involve repairing structurally weakened foundation masonry and replacing storefront framing which is below sidewalk grade with new pressure treated material.
- Remodeling can be carried out either as a face-lift applied directly to face of existing storefronts, or as complete reconstruction on existing framing.
- Existing display windows and entry doors can be either reused or replaced with new of anodized aluminum.

- Clean, scrape and prime building exterior, as necessary, in preparation for painting.
- Repaint in color scheme appropriate to character of building.
    1. Body color for clapboards.
    2. Trim color.
    3. Two tone color scheme for storefronts.

A complete set of working drawings and construction specifications has been prepared for the renovation of the facade of this building and is available from the Community Development Agency at the Rockingham Town Hall.

FACADE IMPROVEMENTS - Building No. 24

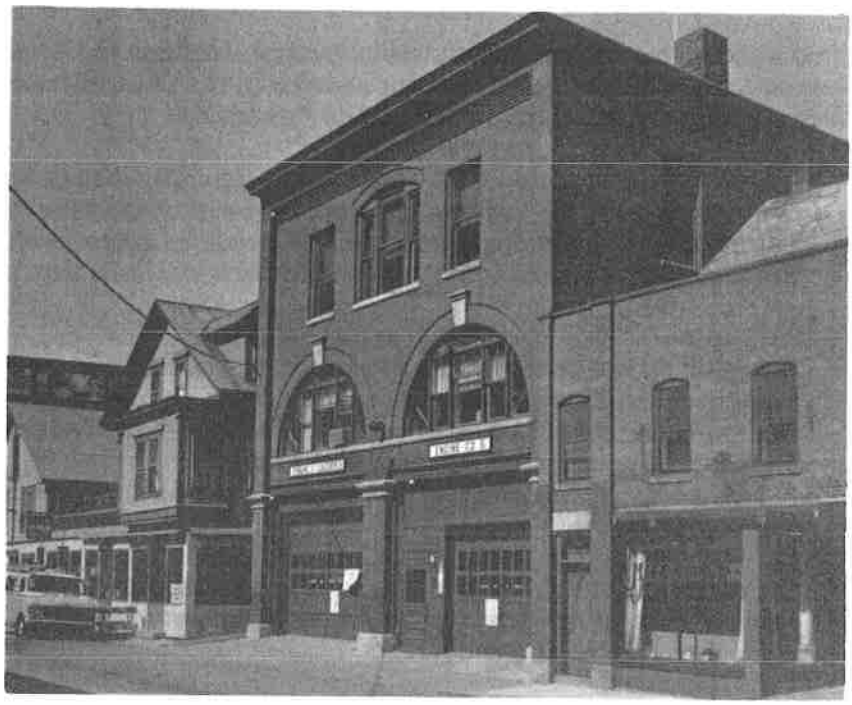
OLD FIRE STATION
17 Rockingham Street

BUILDING USE
Fire Station/Office/Commercial

DATE(S)
1904

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Romanesque Revival



Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street.

Distinguishing Features:
decorative brickwork and granite detailing; mixed window opening shapes, especially second floor semi-circular openings with granite sills and keystones, and mixed window sash.

Comments

This building is in an excellent state of general overall maintenance, and should be preserved without any significant changes to either its Rockingham Street or Canal Street facades.

Any development for reuse should include the restoration of the original triple section garage doors and decorative fanlight transoms.

FACADE IMPROVEMENTS - Building No. 25

BARBIERI'S
9-13 Rockingham Street

BUILDING USE
Commercial/Office

DATE(S)
Circa 1870-1910

CONSTRUCTION
Wood Frame & Load Bearing Brick

BUILDING STYLE
Commercial

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street.

Distinguishing Features:
original bronze storefronts.

TOP: Present view of Rockingham Street Facade.
CENTER: Existing Condition of Canal Street Facade.
BOTTOM: Recommended Improvements to Canal Street Facade.

Recommendations

This building is in an excellent state of overall maintenance and should be preserved without major alteration to either the building facade or the storefronts.

ROCKINGHAM STREET FACADE:

- Clean brick.
- Repoint brick wherever necessary, particularly at points where water, ice and snow can accummulate, or where there is water run-off down building face. Problem areas include window wills; window and door lintels; and storefront cornices.
- Repointing should match existing in joint profile and color.
- Replace deteriorated brick along sidewalk with new brick which matches existing in size, color and texture, and repoint repaired area 100%.
- Repair concrete facing on continuous lintel band over storefront display windows as necessary.

- Repair entry dcors as necessary, replacing deteriorated material with new which matches existing in profile and dimension.

- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions, and, for overhanging signs, type of bracket used for mounting from wall.
- Remove existing overhanging sign and replace with new sign of more appropriate design.

- Clean, scrape and prime all woodwork and painted trim in preparation for painting.
- Repaint in new color scheme:
  1. Trim color for window sash, and window and door casings.
  2. Accent color for display window sills and storefront lintels.
  3. Natural finish for entry doors.

CANAL STREET FACADE:

- Remove existing second floor windows and replace with new wood, double-hung sash as shown in illustration. New windows should be detailed with 1 by 4 trim.
- Remove asbestos siding from second floor and replace with clapboards.
- Repair existing corner boards and roof cornice as necessary, replacing deteriorated or missing material with new which matches existing in profile and dimension.

- LONG TERM: Remodel first floor as shown in illustration by constructing new storefront in openings between piers. New storefronts would improve pedestrian quality and activity on street by providing additional retail space, and would help to transform image of street from that of back alley to that of prime commercial frontage.

FACADE IMPROVEMENTS - Building No. 26

CORNER STORE
18 The Square

BUILDING USE
Commercial/Office/Apartment

DATE(S)
Circa 1890

CONSTRUCTION
Wood Frame

BUILDING STYLE
Italianate Revival

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street, helps to define corner of intersection by providing visual anchor, and acts as terminal focal point on The Sqyare when approaching from either Westminster or Bridge streets.

Wood frame, clapboard construction helps break monotony of C.B.D.'s predominantly brick character. One of few surviving clapboarded buildings in C.B.D.

TOP: Historic View.
BOTTOM: Present View.

Recommendations

- Repair, as necessary, entry door and sill of upper floor entrance on Rockingham Street. Deteriorated material should be replaced with new which matches in profile and dimension.

- Clean, scrape and prime building exterior in preparation for painting. Repaint:

    1. Body color for clapboards.
    2. Trim color.
    3. Accent color for window sash and entry doors.

FACADE IMPROVEMENTS - Building No. 27

EXNER BLOCK
7-25 Canal Street

BUILDING USE
Commercial/Office/Apartment

DATE(S)
Circa 1850 & 1905-1907

CONSTRUCTION
Wood Frame/Stamped Sheet Metal Veneer

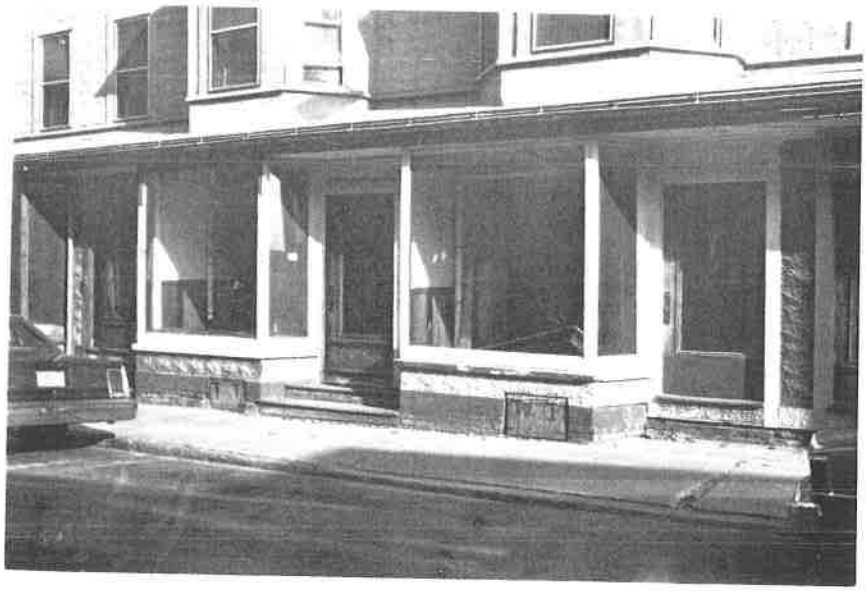
BUILDING STYLE
Italianate Revival

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street.

Wood frame construction helps break monotony of predominantly brick character of C.B.D. One of few surviving wood frame buildings in C.B.D.

Distinguishing Features:
original bay window style storefronts with decorative oak entry doors; second floor bay windows aligned directly above bay windowed storefronts; decorative stamped sheet metal siding in imitation of rusticated stone; large scale bracketed and dentilated roof cornice.



TOP: Overall Building.
BOTTOM: Storefronts.

Recommendations

This building should be preserved without major alteration to either the building facade or the storefronts. New storefront signing should be painted directly on the inside face of the display windows.

- Remove coal chute doors below display windows and replace missing sections of stamped sheet metal siding with new which matches existing as closely as possible.
- Replace deteriorated brick along sidewalk and fill in coal chute door openings with new brick which matches existing in size, color and texture.
- Repoint area between sidewalk and display windows 100%, matching existing joint profile and mortar color.

- Repair and/or replace, as and wherever necessary, broken or deteriorated woodwork around storefront display windows and entrances, and repair entry doors and sills.
- New material should match existing in profile and dimension.

- Replace roof and roof flashing
- Replace existing metal roof over storefronts with new standing seam roof. Replace existing storefront gutters and leaders with new which match existing in profile.

- Install new entry steps.

- Repair second and third floor windows as necessary.
- Deteriorated sash should be replaced with new which matches existing in size and number of panes.

- Install new storm window units, wherever needed, on interior face of first, second and third floor windows.

- Clean, scrape and prime building exterior wherever necessary in preparation for painting.
- Repaint in color scheme more appropriate to character of building:
  1. Body color for imitation masonry siding.
  2. Trim color for window trim, corner pilasters, roof cornice, and storefronts.
  3. Accent color for window sash and decorative brackets in roof cornice.
  4. Ceiling color for ceiling area beneath storefront roof.
  5. Natural finish on entry doors.

FACADE IMPROVEMENTS - Building No. 28

TOUSSAINT'S PAINT CENTER
1-5 Canal Street

BUILDING USE
Commercial/Office/Apartment

DATE(S)
1890 & 1906

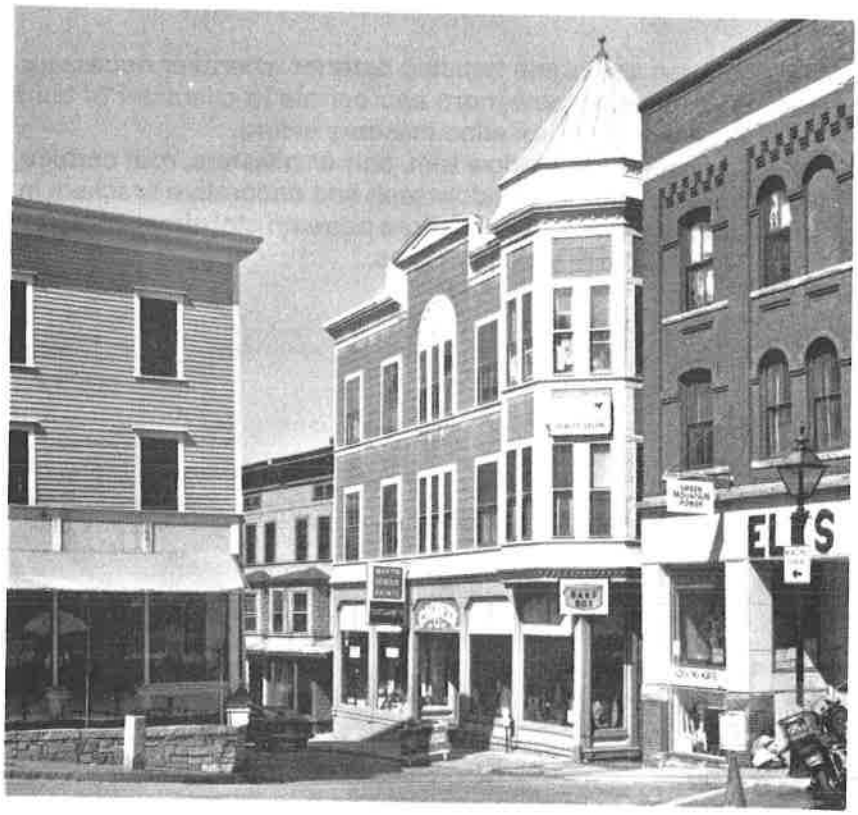
CONSTRUCTION
Wood Frame

BUILDING STYLE
Queen Anne

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street. Because of polygonal tower on second and third floors, defines northeast corner of The Square and marks entrance to Canal Street.

Wood frame construction helps break monotony of predominantly brick character of C.B.D. One of few surviving wood frame buildings in C.B.D.



TOP: Historic View.
BOTTOM: Present View.

Recommendations

This building is in an excellent state of overall maintenance and should be preserved without major alteration to either the building facade of the storefront. New storefront signing should be located in the storefront transoms.

- Replace deteriorated brick along sidewalk with new brick which matches existing in size, color and texture.
- Repoint area between sidewalk and display windows 100%, matching existing joint profile and mortar color.

- Repair woodwork around display windows, including sills, as necessary, replacing deteriorated material with new which matches existing in profile and dimension.

- Remove *Toussaint's* overhanging sign and replace with new sign of more appropriate design.
- Remove *Band Box* sign and replace with new wall mounted sign of more appropriate design located in display window transom.
- Remove *Peggy's Beauty Salon* sign below second floor tower window.

- Clean, scrape and prime building exterior in preparation for painting. Repaint in color scheme more appropriate to character of building:
  1. Trim color for window trim, corner boards, roof cornice, decorative third floor fan trim, tower trim, and storefront cornice.
  2. Storefront color.
  3. Accent color for decorative detailing in roof cornice and storefront cornice dentils.
  4. Accent color for display window sash.
  5. Roof color for storefront roof and cornice roof on tower. Color should match existing weathered copper color on tower roof.
  6. Foundation color.

FACADE IMPROVEMENTS - Building No. 29

ELKS BLOCK
2 The Square

BUILDING USE
Commercial/Office/Meeting Hall

DATE(S)
1885 & 1899

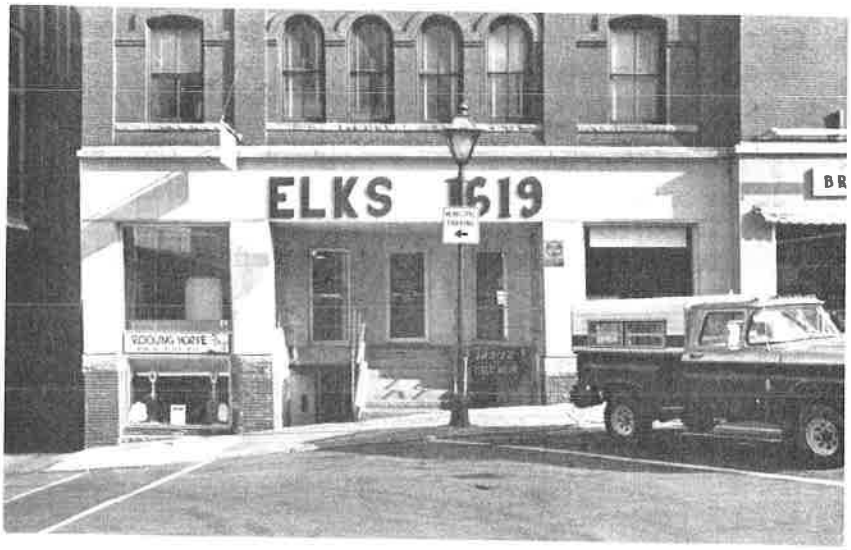
CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Italianate Revival

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street, and helps to define northeast corner of The Square.

Distinguishing Features:
arched window openings; corbelled decorative brickwork; granite pier bases, capitals, sills and cornice band.



TOP: Historic View.
CENTER: Existing Condition.
BOTTOM: Recommended Improvements.

Recommendations

This building is in an excellent state of overall maintenance. The storefront portion of the facade should be restored in order to bring the appearance of the building back into harmony with the historic architectural character of the rest of The Square.

- Repoint brick wherever necessary, particularly at points such as sills, lintels, decorative ledges and cornices where water, ice and snow can accummulate, or where there is water run-off down building face.
- Replace deteriorated brick along sidewalk with new brick which matches existing in size, color and texture, and repoint repaired area 100%.
- Repointing should match existing in joint profile and color.

- Clean brick.

- Repair second and third floor windows as necessary, replacing deteriorated woodwork with new which matches existing in profile and dimension.
- Deteriorated sash should be replaced with new which matches existing in size and number of panes.
- Install new storm window units on interior face of second and third floor windows.
- Recaulk second and third floor windows at point where frames abut masonry.
- Install sheetrock panels, painted flat black, to inside face of two third floor windows on left-hand side.

- Clean, scrape and prime upper floor windows as necessary in preparation for repainting, and repaint uniform color.

- Restore storefront as shown in illustration. Restoration will expose original brick piers, require installation of new display windows and construction of new storefront cornice, but will reuse existing entry doors and stairs.

- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions, and, for overhanging signs, type of bracket used for mounting from wall.
- Storefront signing should be located on building facade as shown in illustration.

A complete set of working drawings and construction specifications has been prepared for the renovation of the facade of this building and is available from the Community Development Agency at the Rockingham Town Hall.

FACADE IMPROVEMENTS - Building No. 30

ELKS BLOCK ANNEX
14 The Square

BUILDING USE
Commercial/Office/Meeting Hall

DATE(S)
Circa 1875

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Italianate Revival

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street.

Distinguishing Features:
arched window openings with granite keystones and sills.

TOP: Historic View.
CENTER: Existing Condition.
BOTTOM: Recommended Improvements.

Recommendations

This building is in an excellent state of overall maintenance. The storefront portion of the facade should be restored in order to bring the appearance of the building back into harmony with the historic architectural character of the rest of The Square.

- Repoint brick wherever necessary, particularly at points such as sills, lintels, decorative ledges and cornices where water, ice and snow can accummulate, or where there is water run-off down building face.
- Repoint crack running between second and third floor windows, and between third floor window and roof parapet.
- Repointing should match existing in joint profile and color.

- Clean brick.

- Repair second floor windows as necessary, replacing deteriorated woodwork with new which matches existing in profile and dimension.
- Deteriorated sash should be replaced with the which matches existing in size and number of panes.
- Install new storm window units on interior face of second floor windows.
- Recaulk second floor windows at point where frames abut masonry.

- Clean, scrape and prime upper floor windows as necessary in preparation for repainting, and repaint uniform color.

- Remodel storefronts as shown in illustration. Remodeling will involve minor reconstruction of existing display windows and entry doors, installation of new exterior sheathing, and construction of new sign band and storefront cornice.

- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions, and, for overhanging signs, type of bracket used for mounting from wall.
- Storefront signing should be located on building facade as shown in illustration.

- Remove *Snow & Lear Company* overhanging sign and replace with new sign of more appropriate design.

- Install new awning on right-hand storefront and align with existing awning on *Bristol Footwear* storefront.
- Replace awning material on *Bristol Footwear* with new, matching coloring and design with new awning on right-hand storefront.

A complete set of working drawings and construction specifications has been prepared for the renovation of the facade of this building and is available from the Community Development Agency at the Rockingham Town Hall.

FACADE IMPROVEMENTS - Building No. 31

1912 BLOCK
20 The Square

BUILDING USE
Commercial/Office/Meeting Hall

DATE(S)
1912

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Colonial Revival

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street. Because of gable parapet, helps to define mid-point of The Square's east side and compliments towering scale of Rockingham Town Hall on The Square's west side, directly opposite.

Distinguishing Features:
original bronze storefronts; second floor Chicago style windows beneath brick centils and heavy stone belt course; third floor Palladian window with semi-circular stone arch; gabled parapet.

Recommendations

This building is in an excellent state of overall maintenance and should be preserved without major alteration to either the building facade or the storefronts.

- Repoint brick wherever necessary, particularly at points such as sills, lintels, decorative ledges and cornices where water, ice and snow can accummulate, or where there is water run-off down building face.
- Repointing should match existing in joint profile and mortar color.

- Repair second floor windows as necessary, replacing deteriorated woodwork with new which matches existing in profile and dimension.
- Install new storm window units on interior face of second floor windows. Recaulk second floor windows at point where frames abut masonry.
- Clean, scrape and prime upper floor windows as necessary in preparation for repainting, and repaint uniform color.

- Remove existing speckle patterned, enamel faced paneling from display window transoms and around entry doors, and replace with new paneling of uniform color and design for all three storefronts.

- As storefront awnings need to be renewed, replace with material of uniform color and design.

- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions, and, for overhanging signs, type of bracket used for mounting from wall.
- Storefront signing should be located on building facade as shown in illustration.
- Remove *Whitehill Howe Company* overhanging sign and replace with new sign of more appropriate design.

- LONG TERM: Remove brick beneath storefront display windows and replace with slate panels.

FACADE IMPROVEMENTS - Building No. 32

ANDREW'S INN
44The Square

BUILDING USE
Hotel/Commercial

DATE(S)
1932-1933

CONSTRUCTION
Load Bearing Brick

BUILDING STYLE
Colonial Revival

Contributing Characteristics

Excellent example of building type and architectural style. Maintains facade line and building scale along street, helps to define corner of intersection by providing visual anchor, and acts as focal point on The Square when approaching from either Rockingham or Westminster streets.

Distinguishing Features:
original bronze storefronts; hotel entrance detailed in full "temple" idiom with Ionic pilasters and entablature; full complement of stylistic details - keystones, quoins, balustered parapet, et al.

TOP: Overall Building.
BOTTOM: Storefronts.

Recommendations

This building is in an excellent state of overall maintenance and should be preserved without major alteration to either the building facade or the storefronts.

- Finish cleaning, scraping, priming and repainting upper floor windows. Install new storm window units on interior face of windows.

- Repoint brick wherever necessary, particularly at points where water, ice and snow can accummulate, or where there is water run-off down building face.
- Repointing should match existing in joint profile and mortar color.

- Replace missing stones in roof parapet, and re-lead top joints between stones as necessary.
- Repaint roof cornice facing The Square in complementary earth-tone color.

- Restore storefront transoms by uncovering and replacing broken or missing pieces of textured glass with new.

- Reinstall existing air conditioning units above storefront entries so that they do not project out from face of wall, and screen from view behind open grillwork.

- As storefront awnings need to be renewed, replace with material of uniform coloring and design.

- Replace broken or missing slate panels beneath storefront display windows with new.
- Remove corrugated tin beneath *A.J. Hinds Dept. Store* display windows, and, if original slate has been removed or cannot be repaired, replace with new slate.

- Storefront signing should be uniform with regard to location on building facade and basic overall dimensions, and, for overhanging signs, type of bracket used for mounting from wall.

- All wall mounted signing should be relocated to continuous stone sign band above storefronts, if not located there already.
    - Relocate *Kane's Rexall Drugs* sign, or replace with new sign.
    - Refurbish *Rexall* overhanging sign.
    - Refurbish *Cote Jewelers* sign.
    - Relocate *A.J. Hinds Dept. Store* sign.
    - Remove *Restaurant* sign and replace with new sign of more appropriate design.
    - Remove *The Store* overhanging sign and replace with new wall mounted sign of appropriate design.

- LONG TERM: Restore restaurant storefront to be more compatible with other storefronts in building.

- Clean brick.

Municipal Improvements

This section deals with specific recommendations for improved on-street and off-street municipal parking, and for improved traffic circulation and pedestrian safety. Specific recommendations have been made for:

Rockingham Street between The Square and Canal Street;
Canal Street between The Square and Depot Street;
Bridge Street between The Square and Depot Street;
Westminster Street between The Square and Church Street.

In keeping with improvements which have already been made within the study area, and in particular in The Square, it is recommended that the sidewalk and curb rebuilding program be continued along the west side of Rockingham Street between The Square and Canal Street, along both sides of Canal Street between The Square and Depot Street, along the north side of Bridge Street between The Square and the Bellows Falls Canal, and along both sides of Westminster Street between The Square and Church Street. Because the concrete sidewalks were not replaced in The Square when the parking islands and landscaping were installed in 1976-1977, all of the existing sidewalks in The Square should also be replaced along with new granite curbing. If this rebuilding program is carried out one section at a time, as seems to have been done so far, an on-going maintenance cycle can be established which will allow for the systematic replacement of both sidewalks and curbing for the life of the downtown. Such a program will insure safe, even-surfaced, and well-maintained sidewalks. It will also avoid the necessity of having to resort to haphazard spot repair and replacement which only results in a collection of unintegrated surfaces and materials.

OVERVIEW

In 1975, when the original TOWN-SCAPE REPORT was published, there was a total of 155 on-street municipal parking spaces in the downtown. No figure for the total number of off-street municipal parking spaces was given, a figure which would have been 113. Of these, 31 were located in two off-street lots on the west side of Rockingham Street, and 82 were located in a lot, constructed in the mid-1950's, behind the *First Vermont Bank* on Church Street. 10 additional on-street spaces on Church Street, convenient to The Stairs, were also not included. Taken together, the total number of municipal parking spaces in 1975, at the time the first town-scape report was published, would have been 278.

As a result of the recommendations made in that first TOWN-SCAPE REPORT, 9 on-street parking spaces were lost in The Square, due to the installation of parking islands, but 90 off-street parking spaces were added with the construction of a large municipal parking lot on The Island in 1976 off of Depot Street.

This meant that the total number of on-street spaces had decreased from 165 to 156, but that the total number of off-street spaces had increased from 113 to 203, for a total count of 359.

Including the improvements along Rockingham Street which were completed at the end of 1982, the total number of municipal parking spaces in the downtown stands today at 359. Of these, 142 are on-street spaces, and 217 are off-street spaces. A Comparison with 1975-1976 figures indicates that there has been no change in the total number, but that while the number of off-street spaces has increased by 14 from 203 to 217, the number of on-street spaces has decreased by 11 from 156 to 142.

It is important to note, and remember, that as with the 31 so-called off-street parking spaces located in the two lots on the west side of Rockingham Street in the 1975-1976 off-street figures, 43 of the 217 off-street spaces in the current figures are similarly located along Rockingham Street in three so-called off-street lots which are in reality so conveniently accessible from the street as to be misleading in being labeled off-street. These three lots are, specifically, those located just to the north and the south of the *American Legion* and the new lot on the *Model Press* site on the opposite side of the street.

DEFINING THE PROBLEM

Parking in downtown Bellows Falls, like anywhere else, has always been an issue. And it remains an issue today among concerned business owners and town officials alike. It remains an issue but not necessarily a problem. Before any workable solutions can be either adopted or put into affect, the exact nature of the problem must be defined, understood, and then come to terms with. The so-called problem may, in all likelihood turn out to be not really a problem at all. It is even possible that the so-called parking problem is nothing more than a scape-goat for some other, far more crucial problem, a problem which has more to do with selling the downtown as a place to shop than with being able to find a place to park.

To try and remake downtown Bellows Falls into the image of a modern shopping center and then to compare parking in the downtown with the parking which is generally available in a modern shopping center is, at best, unfair to the downtown, and thoroughly misleading.

Shopping centers work on the principle of uniform store hours, an integrated storefront image, cooperative advertising, and plenty of parking within a direct line of view of the shopping center. While existing downtowns can successfully adopt many of these formulas, try as they will, they will never be what a shopping center is. Instead, the downtown must learn to accept that difference, and use it to its own best advantage.

In spite of the seemingly endless supply of parking which generally surrounds most shopping centers, the fact of the matter is that shoppers are frequently required to walk much greater distances between their cars and points of destination than would probably be the case in the downtown. The difference is that while the actual walking distance may be shorter in the downtown, the point of destination, which is almost always in view from the shopping center parking lot, generally is not. To avoid this problem, off-street municipal lots which are intended for short-term parking use must be located not only within convenient walking distance but, more importantly, within view of the downtown's center.

Sincere efforts have been made by the community to alleviate the parking problem through the construction of off-street municipal parking lots. In the mid-1950's, a large lot was built near the southern end of the downtown behind the *First Vermont Bank*. Then, in 1976, in an effort to create a more balanced distribution of spaces available for use in the downtown area, another large lot was constructed near the downtown's northern end on The Island. While each of these lots provides some 80 to 90 additional parking spaces, they are not exactly within convenient walking distance of The Square, and are difficult to find, whether driving to them to park, walking from them to go shopping, or returning to them to drive home. This physical inconvenience, in turn, generates a psychological reluctance on the part of the potential shopper and dampens the shopper's willingness to put up with the rigors of having to find a parking space in a municipal lot. This reluctance only encourages the shopper to stay away, and go elsewhere.

The use of these lots is, in fact, more appropriate to long-term, all day parking than the short-term parking required by shoppers. To expect a potential shopper to use on of these lots on a short-term basis is asking far more than the shopper is probably willing to put up with, or should have to.

Given this reassessment, and definition, of the downtown's existing facilities, what the downtown lacks is not a sufficient number of long-term parking spaces. These it has in ample supply in the two existing lots behind the *First Vermont Bank* and on The Island. What the downtown needs to provide is more short-term, high turnover shopper parking both within a more convenient walking distance of the center of the downtown, and with a direct line of view of The Square. Encouragingly, land for just such a lot is available.

PARKING ATTITUDES

All the parking in the world is not going to make a significant improvement if basic parking attitudes within the downtown are not changed. One major cause for concern, and a prime reason for a seeming lack of sufficient parking spaces in the downtown, is the fact that a significant number of business owners and employees park on the street and do not use the off-street municipal lots. Whether due to just plain laziness or to a misguided belief that the one on-street parking space they take up is not going to make a significant difference in the number of spaces still available to shoppers, the fact remains that by parking on the street they are depriving short-term on-street parking to those people for whom they are intended, the shopper.

Based on the mandatory two hour maximum parking limit, the potential loss during a normal eight hour business day, at the very least, is four potential customers. More realistically, the turnover is probably closer to every half-hour to forty-five minutes, or a potential loss of anywhere from eight to twelve customers. Because most shoppers are intent on getting their shopping done as quickly and conveniently as possible, they seek out the short-term spaces closest to their point of destination. When these are needlessly taken up by downtown business owners and employees, the shopper is forced to park in a less conveniently located off-street lot where the owner or employee should have parked in the first place.

People who are all day long-term parkers must be discouraged by whatever means necessary from parking in short-term off-street spaces and from moving their vehicles around from one on-street space to the next throughout the day in order to avoid having to drive to and walk back from one of the long-term off-street municipal parking lots. Their abuse of the system not only hurts their own business but the business of every other merchant in the downtown as well.

Enough emphasis cannot be placed on establishing, and enforcing, the basic concept within the downtown community that on-street parking is convenience parking; that on-street parking represents short-term use and must be reserved, exclusively, for the use of shoppers, and other short-term users!

Conversely, all day parking represents long-term use, the type of parking done by employers and employees alike. Long-term parking does not belong on the street in short-term spaces. Where it does belong is in long-term off-street municipal, and private, lots which are generally avoided by the short-term shopping public because they are less accessible and more inconvenient to use.

ROCKINGHAM STREET

Three off-street parking improvements, two of which would require major construction projects, are recommended for Rockingham Street. These include the upgrading of the two existing municipal lots on the west side of the street on either side of the *American Legion,* and enclosing the private lot in front of the *I.G.A.* so as to physically separate it from the street.

The east side of Rockingham Street underwent a dramatic improvement in the fall of 1982 with the installation of new concrete sidewalks, granite curbs, brick paved pedestrian crossing islands, and more appropriately scaled, and historically detailed, street lighting. These improvements were a continuation, in both design and character, of the improvements completed in The Square in 1976, and should be continued, in the very near future, down the west side of the street as well.

THE NORTHERN END OF THE STREET.

One area of particular concern exists at the head of Rockingham Street between the *I.G.A.* on the west and the *D.L.C. Liquor Store* on the east. With the installation of new sidewalks and curbing along the east side of the street, a positive demarcation line has been established between the pedestrian and the vehicular zones of the street. This is not the case on the west side of the street, particularly in front of the *I.G.A.*

Here, it is almost impossible to tell where the edge of the traveled right-of-way ends and the sidewalk begins. In fact, because the area normally set aside for a sidewalk is paved with asphalt, identical with the paving of the street and the *I.G.A.* parking lot immediately behind, there appears to be no sidewalk at all. At night, truckers stopping to eat in a nearby restaurant, park at all angles to the street across the sidewalk and into the parking lot, turning the whole area into a virtual no-man's land.

Equally detrimental is the visual impact this situation has on the image of the downtown as a whole. This end of Rockingham Street is the northern gateway to The Square, the historic and commercial heart of the downtown, and of Bellows Falls. As the northern gateway, this area is deserving of an image which is more in keeping with and appropriate to that historic character.

Of primary concern is the creation of a distinct pedestrian zone, safe and separate from both vehicular traffic and parked vehicles, in front of the *I.G.A.* This would be accomplished by closing off the *I.G.A.* parking to general access from the street, and establishing just two points of entry and exit between the street and the lot. This would allow for the installation of a new concrete sidewalk and granite curbing, and would prevent both the sidewalk and the parking lot from being used as an extension of the street's traveled right-of-way.

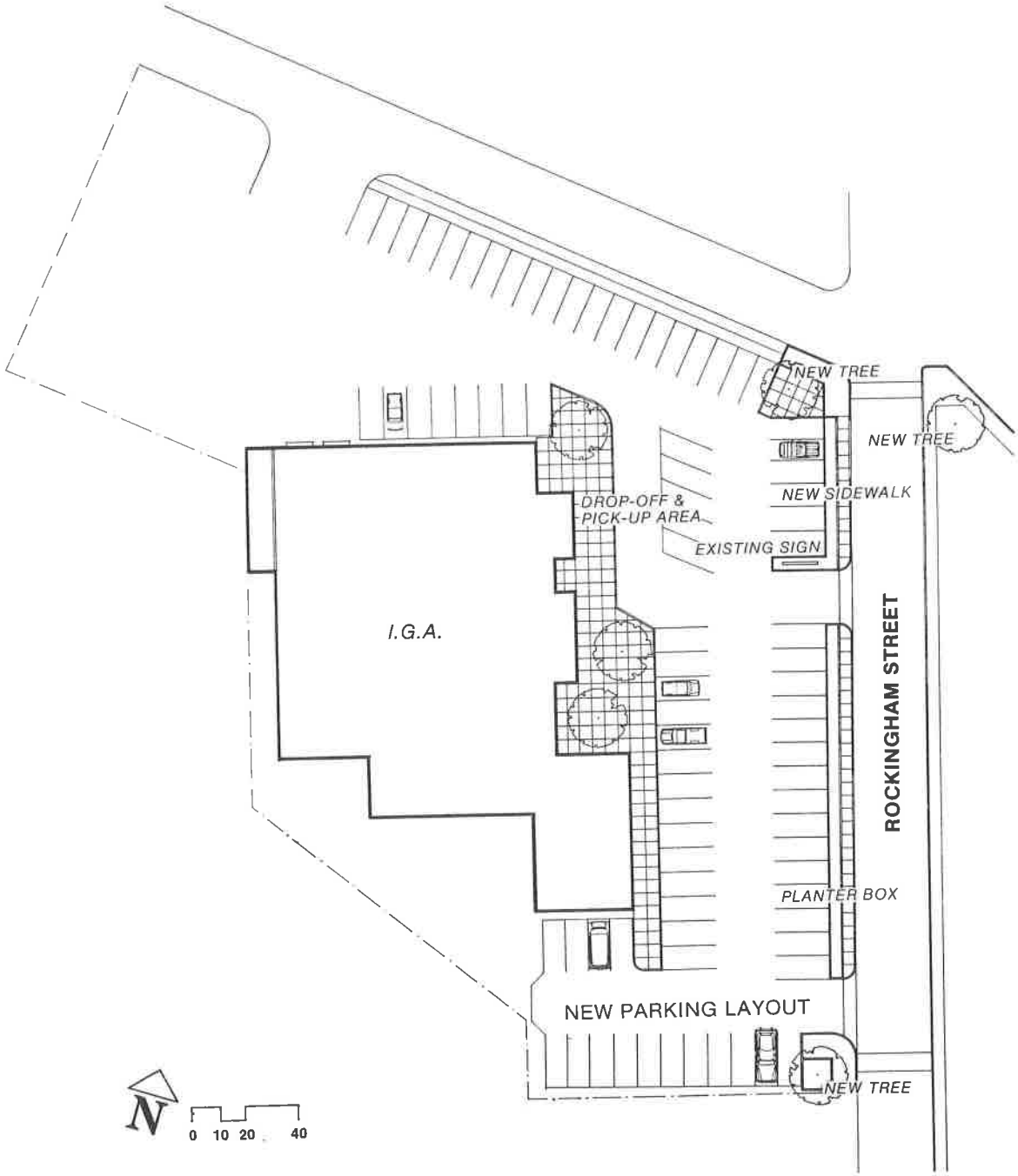
To help upgrade the aesthetic quality of this end of Rockingham Street, it is also recommended that a raised planter box, constructed out of pressure treated heavy timbers, be installed between the sidewalk and the *I.G.A.* parking lot. This would not only help to visually camouflage the parking lot from the street, but would also help to break up the overwhelming expanse of paved surfaces which stretches from the buildings on the east side of the street up to the front of the *I.G.A.*

A gateway effect could be easily created, as shown in the accompanying illustration, by planting trees across from one another on opposite corners at the head of the street. This effect could be continued down the street, toward The Square, by planting additional trees at the southeast corner of the *I.G.A.* lot, in the recently completed municipal lot on the *Model Press* site, and at the north end of the municipal lot on the opposite side of the street between the *American Legion* and the *Miss Bellows Falls Diner.*

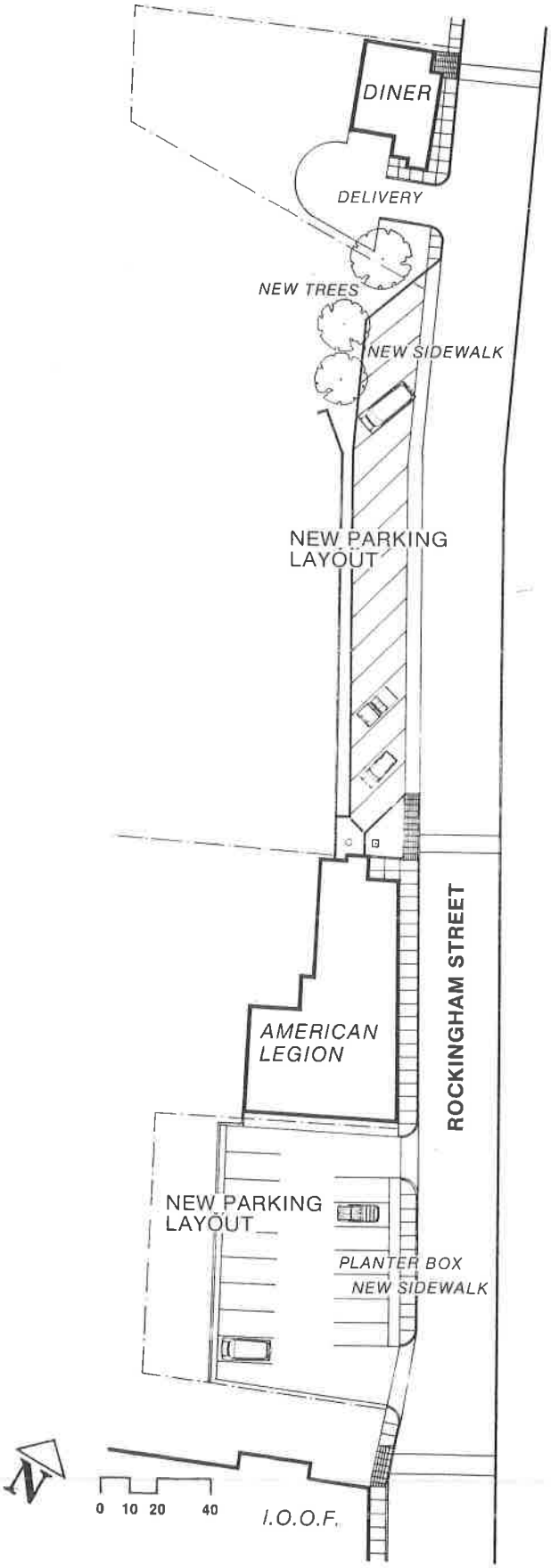
I.G.A. PARKING LOT

In the proposed recommendation for improving the parking in front of the *I.G.A.*, the parking has been rearranged, for the most part, along either side of a central traffic corridor. A paved pedestrian zone along the front of the building and a drop-off and pick-up lane directly in front of the *I.G.A.* have also been added. Trees have been added to the front of the building to integrate it visually with the trees along the street.

The proposed improvement would increase the existing capacity of the lot by 2 spaces, from a total of 81 to 83. 2 additional spaces could also be gained if the proposed drop-off and pick-up land were eliminated.



I.G.A. Parking Lot: Recommended Improvements



Recommended Improvements: American Legion and I.O.O.F. Parking Lots

MUNICIPAL LOT NORTH OF THE AMERICAN LEGION

A similar lack of definition between parking, pedestrian and traffic also exists in the municipal lot on the west side of Rockingham Street between the *American Legion* and the *Miss Bellows Falls Diner.* A solution to this unusual parking situation, in which vehicles drive across the sidewalk in order to park, was successfully adopted for the municipal parking recently completed on the *Model Press* site, and should be used here as well. As at the *Model Press,* this would require the installation of a new concrete sidewalk and a paved parking area defined at the edges by granite curning and wood guard rails. The principal objective would be to clean up the existing lot, to close down the existing width of the lot by lining the parking spaces up along the edge of a new sidewalk, and to create a well defined, safe and separate pedestrian zone along the edge of the street.

View looking north up Rockingham Street from the American Legion. No pedestrian zone is clearly defined between the parked vehicles on the left and the moving traffic on the right. The asphalt paving of the street merely extends across what should be a clearly defined sidewalk and pedestriams are asked to vie with parked and moving vehicles for use of the street. A concrete sidewalk should be constructed which clearly identifies a safe and separate pedestrian zone and more clearly defines the edge of the street.

As shown in the accompanying illustration, a second objective would be to introduce some much needed landscaping at the northern end of the lot, and to create a separate delivery area for the *Miss Bellows Falls Diner.* The proposed landscaping would help tie this lot in with those improvements recommended for the *I.G.A.* parking lot further up the street and would help to visually integrate the character of the street through the use not only of a uniform landscaping solution, but a parking solution as well.

The lot presently contains 17 municipal parking spaces, plus several private spaces for the *Miss Bellows Falls Diner.* Upgrading the lot, as shown in the illustration, would not result in the loss of any municipal spaces but would mean the elimination of several private spaces in order to create a separate delivery area for the diner. The loss of these spaces, which do not appear to be crucial to the diner's business because of the installation of additional parking spaces directly across the street at the *Model Press* site, could be compensated for by including the construction of the new delivery area, which would occur on private property, as a part of the municipal project.

MUNICIPAL LOT NORTH OF THE I.O.O.F. BUILDING

Recommendations for improving the existing off-street municipal lot on the west side of Rockingham Street between the *I.O.O.F.* building and the *American Legion* would involve paving the lot and defining the edges with granite curbing, and installing a raised planter box between the existing guard rail and the sidewalk. The planter box should match that constructed in front of the *I.G.A.*, and would help to tie together, visually, all of the recommended improvement for the west side of the street.

This lot presently contains 14 spaces, including one space which is reserved for the Bellows Falls Fire Chief. Once the fire station is relocated out on River Street, this space will become available for public use. Upgrading this lot with new paving could possibly increase that number by 2 spaces to 16.

CANAL STREET

Canal Street and Westminster Street both represent narrow, visually crowded street-scapes which are in need of improvement. While Westminster Street, in spite of heavy traffic congestion, continues to function as a viable, and valuable, part of the downtown's economic fabric, Canal Street does not. Much of the reason for this condition can be attributed directly to the fact that the *Exner Block*, the largest building on the street, remains vacant and underdeveloped, and its storefronts remain empty, unlit, and uninviting to the potential shopping public. Because of this situation, the potential to develop this street into a valuable economic resource based on increased pedestrian activity is completely lost to the community. As a consequence, everyone with an interest in the well-being of the downtown suffers.

Discouraged by an apparent unwillingness on the part of the owner to rehabilitate the building, property owners on the other side of the street, whose buildings front predominantly on Rockingham Street but whose rear elevations abut Canal Street, are discouraged, and have been unwilling to develop the rear facades of their buildings for commercial use. This situation will undoubtedly continue until such time as the *Exner Block* can be rehabilitated.

Because of its close proximity to The Square, and because it fronts not only on Canal Street but on the Bellows Falls Canal as well, the *Exner Block* is an ideal candidate for rehabilitation in retail shops, office space and residential housing. Similarly, because of the street's close proximity to The Square, Canal Street should be developed for retail shopping. Unfortunately, Canal Street is not going to be redeveloped and integrated into the commercial fabric of The Square until the void on the street which is the *Exner Block* is rehabilitated.

Canal Street also suffers from a second problem, congestion. The height and physical closeness of the buildings on either side, the fact that the street drops away from the level of The Square, and a sense of overcrowding created by parked and moving vehicles through an extremely narrow space, make Canal Street unattractive to the potential shopper. Canal Street looks more like a delivery lane, or back alley, than what should be one of the downtown's principal shopping streets. This condition could be corrected quite easily, by eliminating vehicular traffic in favor of the pedestrian.

This does not mean that through traffic should be eliminated from the street as was proposed in the 1975 TOWN-SCAPE REPORT. To the contrary, vehicular traffic should remain, if for no other reason than the fact that the street serves an extremely important function as a crucial point of access from The Square to the off-street municipal parking lot on The Island.

Parking, however, between The Square and the north end of the *Exner Block* should be eliminated. This, unfortunately, would mean the loss of 7 on-street spaces, parking which could not be replaced by additional on-street parking elsewhere but only in an off-street municipal lot.

View looking north along the east side of Canal Street. The Street's narrow width is not wide enough to accommodate traffic, parking and a sidewalk. The vehicles, because of their size and bulk, visually dominate the street-scape, forcing pedestrians to feel uninvited and unsafe. While it is, admittedly, not customary for vehicles to park up on the sidewalk, the street's overall image is not conducive to pedestrian activity.

View looking south along Canal Street from in front of the Exner Block. While revitalization of the street into a more active shopping environment will require renovation of the Exner Block and the opening up and renovation of a number of rear facades, no revitalization project will have much chance of success if a sidewalk is not constructed along the street's west side.

On the positive side, the removal of on-street parking would allow for the construction of a second sidewalk along the west side of the street, and would enable the owners of the buildings along that side to develop the rear facades of their buildings for potential commercial use. Removing much of the street's physical congestion by eliminating the parked vehicles would open the street up to increased pedestrian traffic and help to integrate this important commercial resource back into the economic fabric of the downtown. All of this, as was mentioned earlier, depends to a great extent on the ability to rehabilitate the *Exner Block*.

If, for whatever reasons, it should be decided that the development of additional commercial space along Canal Street would not be in the best interests of the economic well-being of the downtown, then it is strongly recommended that the parking on this street remain but be moved to the opposite side of the street. This would provide for better visibility, from The Square, of those storefronts which already exist along the east side of the street. Presently, they are partially hidden from view by the line of vehicles which are parked in front of them. Moving the parking to the opposite side of the street would probably require the installation of a curb along the west side and that the ground be paved from the curb up to the backs of the buildings, but would move them to the less visible side of the street and, in so doing, would help to open up the street and lessen the sense of visual congestion.

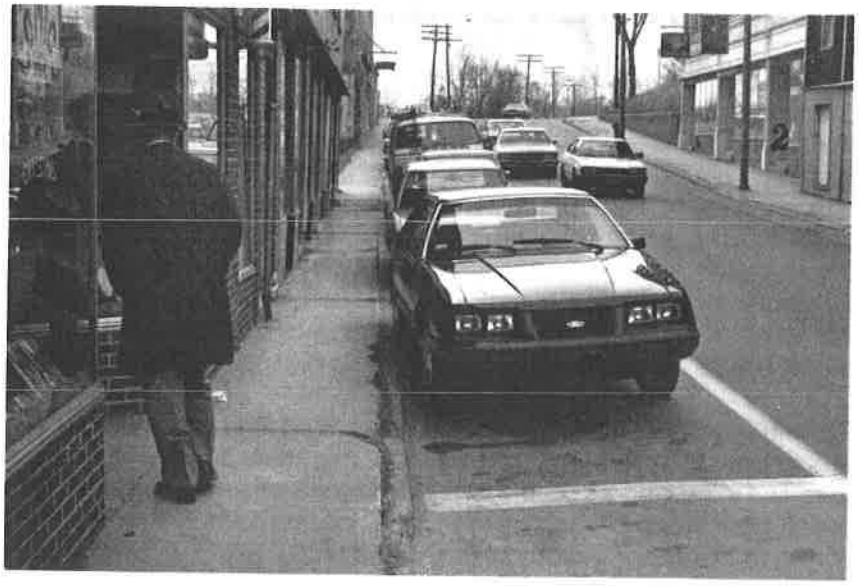
WESTMINSTER STREET

Because of its narrow configuration, Westminster Street is not wide enough to accommodate two sidewalks, one lane of on-street parking, and two lanes of two-way vehicular traffic. The narrowness of the street is a physical condition which has an adverse psychological effect on all who use it, in particular pedestrians. The closed in feeling of the street is created by the three story height of the buildings which line either side, by the narrow traffic lanes which are not wide enough to handle the large trucks which must use the street because there are no alternative routes of travel, and by the narrow sidewalks which are not wide enough to adequately convey to the pedestrian a feeling of being safe and separate from the vehicular traffic which is passing only inches away. In fact, the street is so narrow that the traffic lanes do not even meet the minimum width standard. In order to avoid hitting each other, trucks heading south along the street are frequently forced to gain extra room by driving up over the curb onto the sidewalk.

To remedy this situation, it is recommended that on-street parking be eliminated from the east side of the street between The Square and the 2 fire zone parking spaces in front of *Doc's*. While this would mean the loss of 14 parking spaces, removing the on-street parking would allow for the rebuilding of the sidewalks along both sides of the street to a minimum width of five feet, and for the widening of the two lanes of traffic to a standard width of fourteen feet.

In order to not lose valuable parking within the downtown, the on-street parking which would be lost along the east side of the street should be relocated off-street in the vacant lot immediately north of, and adjacent to *Doc's*. All 13 on-street parking spaces could be relocated off-street next to *Doc's* if the *Cray Block* is also acquired and demolished for off-street parking.

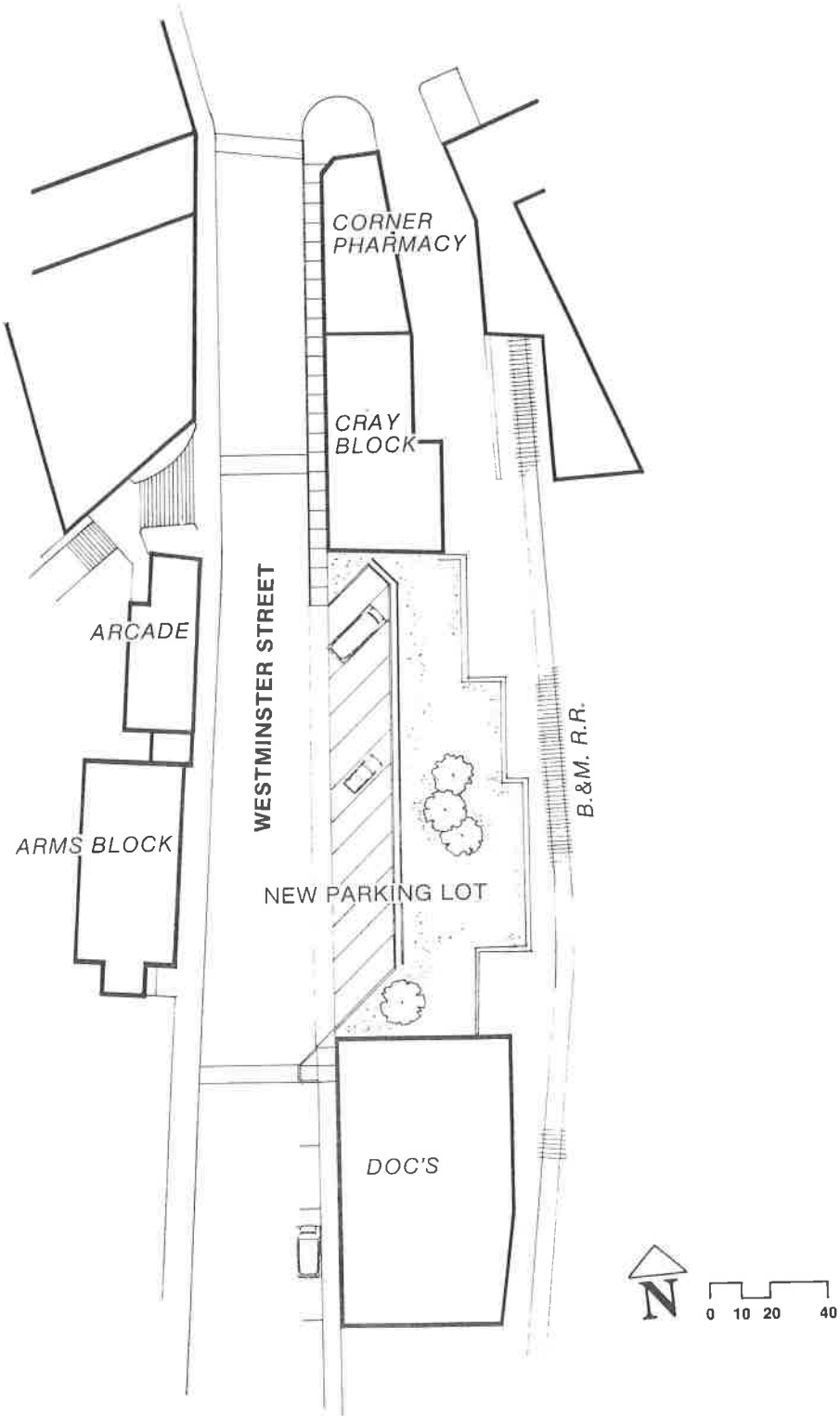
Because the *Cray Block* has been vacant for a number of years, has not been consistently maintained, and has settled dramatically and unevenly across its rear, east elevation, the building does not appear to have sufficient structural integrity to warrant rehabilitation. Based on this assumption, it would appear that the site would be better utilized for off-street parking.



View looking south along the east side of Westminster Street. The sidewalks along this side of the street are probably the narrowest in Bellows Falls. Wedged in between the building on one side and a long row of parked vehicles on the other, pedestrians are made to feel that use of the street belongs more to the vehicle than to them. The narrowness of the sidewalk has, undoubtedly, been a significant factor in discouraging potential businesses from locating in these storefronts.

View looking south along the west side of Westminster Street. Not only are the sidewalks too narrow in some places for pedestrian safety, they are also in a sad state of repair. They are, in fact, almost level in most places with the street, making it all too convenient for large trucks to ride up and over onto the sidewalk when negotiating the street's narrow width. Removing the line of parked vehicles along the east side of the street would allow not only for wider sidewalks but wider traffic lanes as well.

As shown in the accompanying illustration, the design for this new off-street parking facility would be laid out and constructed so as to conform with a similar off-street lot recently completed on Rockingham Street on the *Model Press* site. As with that municipal parking lot, parking vehicular would be required to drive up and across the sidewalk before parking in a paved lot defined at the edges by granite curbing and wood guard rails. However, as has been proven at the *Model Press* site, due to the fact that there is not enough room to provide a larger parking facility with a separate entrance and exit, as well as an interior circulation corridor, if proper caution is exercised on the part of the driver, this type of municipal parking facility can be just as safe as the more traditional type.



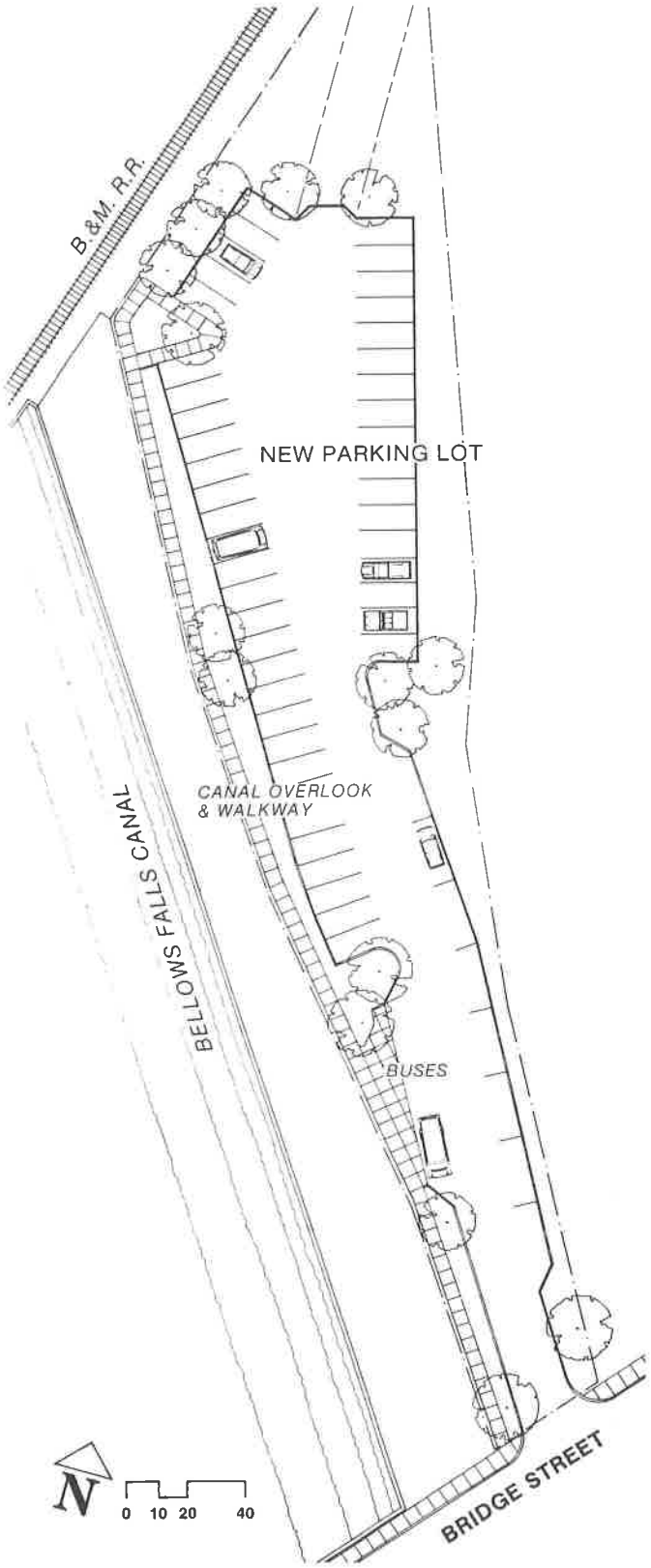
Westminster Street: Recommended Parking Improvements

NEW BRIDGE STREET MUNICIPAL PARKING LOT

In order to provide more conveniently accessible short-term off-street shopper parking with the downtown area, it is recommended that a new municipal parking lot be constructed off of Bridge Street on the east side of the Bellows Falls Canal between Bridge Street and the tracks of the Boston and Maine Railroad. This lot would have a significant advantage over the two existing off-street municipal lots in that it would be readily visible from The Square and could be reached by a short, straight walk via Bridge Street, across the canal. Because of its location off of one of the downtown's principal vehicular routes, it would be much more accessible than either of the existing lots from any direction of the compass.

This lot would also provide much needed parking for the proposed *visitor information center* to be constructed by the New England Power Company in conjunction with the new fish ladder which it is building around its power generating station at the southern end of the canal. While this attraction will probably only be in operation on a limited basis, primarily during the spring, it is expected to generate considerable traffic which not only will require sufficient off-street parking to accommodate it but also will contribute additional business to the downtown economy.

As shown in the accompanying illustration, the lot would provide an additional 54 spaces immediately adjacent to the downtown within convenient walking distance of The Square across the bridge, and could be laid out so as to include parking for two tour buses to accommodate tourist traffic visiting the proposed New England Power Company's *visitor information center*.



Bridge Street: Recommended Parking Improvements

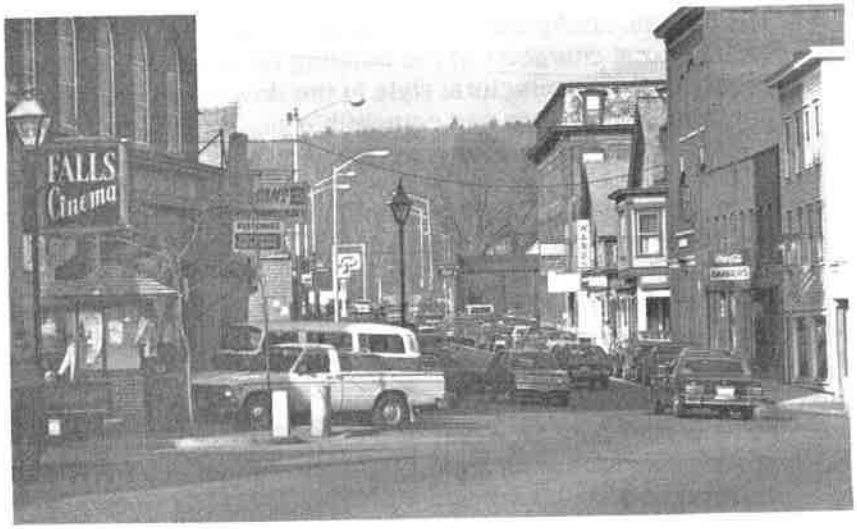
Signing Standards

The image of the downtown is determined as much by the quality of its signs as by the character of its architecture. The residents of Bellows Falls know where their community services are located. Large, glaring signs which might be appropriate to a commercial strip development are not in keeping with the predominantly nineteenth century character of the downtown. An attractively and uniformly signed business district will be more inviting to the potential shopper than one in which each merchant tries to competitively "out-sign" his or her neighbor.

Signs are one of the most important visual characteristics of the street-scape. Good signing can provide variety and life to the street, and can often provide that much needed splash of color on what otherwise might remain a dull facade. Conversely, bad signing can detract from and ruin even the most outstanding piece of architecture.

Existing signs which are either in poor taste or, because of their existing location, detract from the building's overall appearance should be taken down and replaced with new signing of more appropriate design, or should be relocated on the building's facade. It is the building owner's responsibility to take a more active interest in the building's appearance, and to see to it that existing and prospective future tenants do likewise!

Signs should be designed, and installed on the building's facade, so as to complement the existing architecture and reinforce the character of the building's overall design. A new signing ordinance has been developed for the central business district which has been specifically designed to do just that. The intent



TOP: View looking north up Rockingham Street from The Square.

BOTTOM: View of storefronts along the east side of The Square.

While to a limited degree a variety of sign types, shapes and sizes can add visual interest and vitality to the street-scape, many of the signs in the downtown area are unnecessarily large and are inappropriately located on their buildings. Signing should not be so uniform as to be dull and uninteresting but could be better coordinated with The Square's historic architecture so as to produce a more visually pleasing, overall effect. For example, as can be seen in the bottom photograph, each of the storefront signs on the Andrew's Inn building should be located in the stone sign band, as is the Cote's Jewelers sign. While each sign should remain distinct and different, uniformity of location would be more in keeping with the building's architectural character.

of the new ordinance is to avoid unnecessary confusion as to what types of signs are permitted and where they should be located. The real purpose is to discourage inappropriate signing which only detracts from the overall image of the downtown, and promotes the advantage of a few at the expense of the rest.

SIGNING GUIDELINES

In an effort to encourage good signing which is in keeping with the architectural character of the downtown, some general guidelines are listed below.

1. Signs should be the work of a professional sign maker and should be made out of materials of only the highest quality.

2. Signs should be designed as much for the pedestrian as for the passing motorist.

3. Stock signs purchased from the distributors of commercial products are not appropriate to the character of the downtown and should be avoided.

4. The content of a sign should be limited to either the name, function, or activity of the business which is being identified, but might also include the brand name of one principal product sold. In general, the advertising of all products sold should only be done on the interior face of the display window.

5. The overall, configuration, and specific type-face of the sign should be in keeping with the architectural character of the building on which it is located. This does not mean that because the predominant architectural style in the downtown is Victorian, all signing must be Victorian. To the contrary, appropriate and compatible signing can be found from almost any period, including contemporary designs and styles.

6. Signs, however, which are "colonial" in design are not appropriate to the architectural character of the downtown and should be avoided!

7. Signs should be formal in design and should be characterized by dignified type-face, restrained ornament, compatible colors, and simplicity of shape.

8. Symbols representing the service being offered or the general type of merchandise being sold, i.e.: a barber pole for a barber shop, a mortise and pestle for a drug store, or a pair of eye glasses for an optometrist, are an appropriate alternative to lettering and can add visual variety to the street-scape.

9. The overall size of a sign should be determined as much by its location on the building or storefront as by its design. No sigh should cover over or obscure from view the architectural details of either the building facade or the storefront on which it is located.

10. On buildings with more than one storefront, the size and location of principal storefront signing should be uniform for each storefront, whether for a wall mounted sign or for an overhanging one.

11. Signs which are historically significant or are representative of a previous commercial style of design should be preserved, and restored, whenever possible.

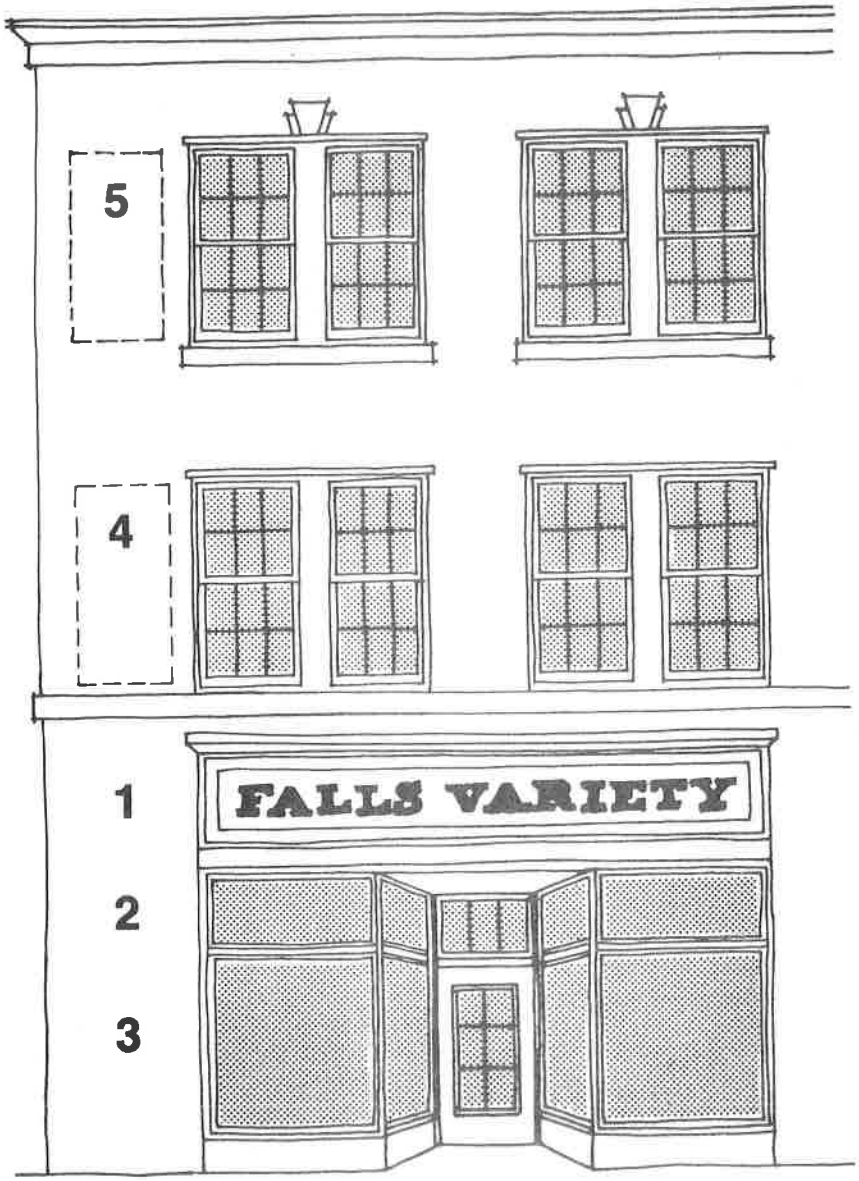
STOREFRONT SIGNING

The accompanying illustrations identify appropriate sign locations for buildings and storefronts located in the Bellows Falls central business district. Based on the examples given, an appropriate sign location can be selected for almost any storefront within the downtown area.

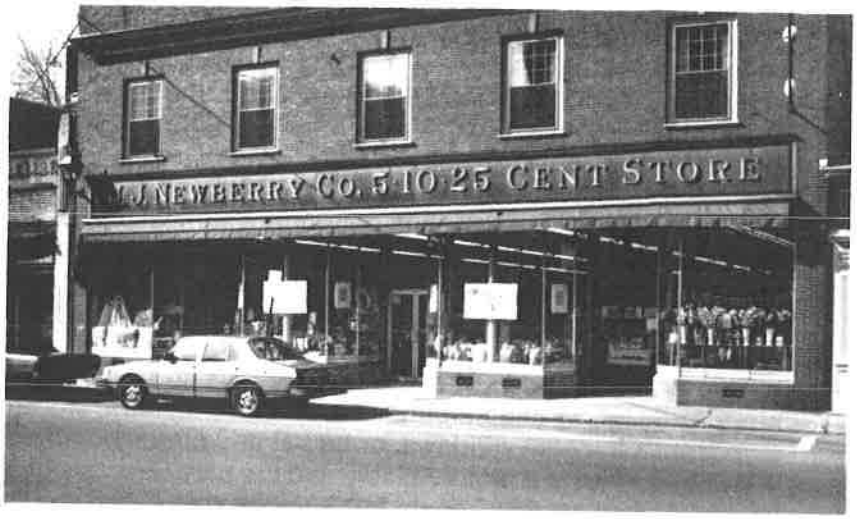
1. Principal storefront signing should be contained within an existing sign band. A sign band is usually an integral part of the overall storefront design, and is located on the building's facade immediately above the storefront. Where the sign band is not clearly defined by either the architecture of the building or the design of the storefront, the length of the sign should be no longer than the overall length of the storefront.

2. Where no sign band exists, and only where sufficient space is available, a separate sign panel should be located on the building's facade immediately above the storefront. The sign panel should not cover over any architectural details or require that any details be removed. The length of the panel should be no longer than the overall length of the storefront.

3. Where no sign band exists, or where there is no space available for a separate sign panel, principle storefront signing should either be located within the storefront cornice, be painted directly on the storefront's transom windows, or be painted directly on the storefront's display windows. The choice will depend on the space available and the particular design of the storefront. In some cases, the glass in the transom windows could be replaced with a sign panel on which the sign would be located.

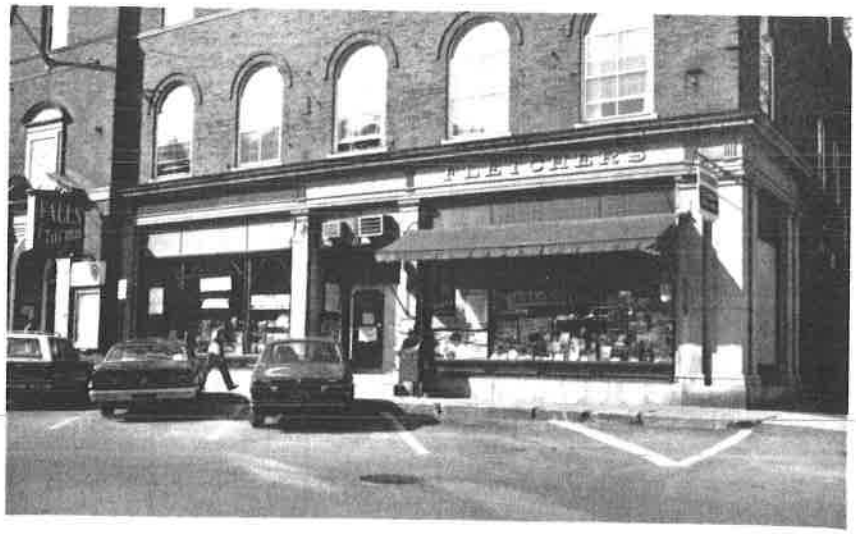


Principal storefront signing can be located either above the storefront within an existing sign band or cornice, or as a separate sign panel (1); or can be painted directly on either the transom (2) or the display window (3). Second and third floor signing should be located next to the window in which the business is located (4 and 5).



The J.J. Newbury Co. 5 10 25 Cent Store is an example of a sign located within an existing sign band. The sign band is an integral part of the overall storefront design.

Because this storefront does not have an existing sign band which is an integral part of the storefront's overall design or a storefront cornice, the sign should be mounted on the wall above the storefront as a separate sign panel.



Fletcher's is an example of a sign located within the storefront cornice.

OVERHANGING SIGNS

Overhanging signs represent a special problem. Most overhanging signs are designed to catch the eye of the passing motorist, not the pedestrian. In order to be easily read at 25 to 30 miles per hour, they are almost always too large in proportion to the overall size of the storefront on which they are located. Stacked one against the other down the length of the street, they frequently block each other from view and, consequently, are harder to read than signs laid flat against the facade of the storefront. Crowded with all sorts of product advertising, they provide more visual clutter along the street than useful information to the potential shopper. Nevertheless, many merchants believe that an overhanging sign is a source of identification which is essential to the continued vitality of their business.

Overhanging signs do not need to be as large as a business owner might be led to believe. A smaller overhanging sign will produce less visual clutter along the street-scape and, if properly designed, can be just as effective in attracting attention and identifying a business as a sign twice its size.

If an overhanging sign must be used, it should be positioned on the face of the building or storefront where a wall mounted sign would normally be located. The important point is that an overhanging sign should be in keeping with the overall design of the building on which they are located, and should look as if it belongs!

Overhanging signs for upper story businesses are not appropriate to the nineteenth century character of the downtown, and should be avoided.

UPPER STORY SIGNING

The name of second and third story businesses should be either painted directly on the glass of the appropriate entrance, or identified by a street-level information directory located next to the entrance.

Second and third story businesses can also be identified either by a sign painted directly on the glass of the appropriate second or third story window, or by a wall mounted sign located next to the window. There should be sufficient space available for the sign to float on the wall without covering either the window or any architectural details around the window. The height and width of the sign, where space allows, should not be more than the overall height and width of the window, and the sign should be positioned so that it does not extend below the window sill or up above the window sill.

PEDESTRIAN SIGNING

No matter what their visual impact, overhanging signs do provide a convenient source of identification for the pedestrian. The typical storefront sign, mounted high and flat against the facade, is easily read from the sidewalk across the street but not from the sidewalk directly in front of the store being identified. What is needed, then, is a readable and easily spotted alternative to the overhanging sign for convenient pedestrian identification.

Several stores within the central business district already use an effective alternative - a small sign displaying the name of the store which is placed in the window. The sign is usually painted directly on the glass of the display window, facing the sidewalk and near the store's entrance. Located about 5 ft. off of the sidewalk, the sign is easily spotted by the shopper walking along the sidewalk and gazing in at the store window, and readily identifies the store being passed. The sign needs to be only large enough to be easily read but should be painted a color which will stand out through the reflection of the glass.

It is recommended that the Bellows Falls Chamber of Commerce promote the pedestrian storefront sign as a much needed shopper convenience. Each merchant within the central business district should be encouraged to participate. Like uniform store hours, if every merchant displayed such a sign, the potential shopper would know what to look for when shopping in the downtown.

Bellows Falls Park

The 1975 BELLOWS FALLS TOWN-SCAPE REPORT stated that,

> *The center and focus of Bellows Falls is The Square. This focus is strengthened by the height, intricacy and architectural quality of its buildings, and by the sharp lay of the surrounding topography, bordered along the one side by steep hills and along the other by the canal. Dominated by the tower of the Town Hall, The Square is the center of town government, entertainment, shopping, professional services, and social groups. More than any other space in Bellows Falls, it epitomizes the town's image.*
>
> *Despite its attributes, this image is tarnished by traffic congestion, noise, poor building maintenance, inadequate parking and a lack of pedestrian amenities. These problems, in turn, affect the volume of shoppers and visitors, building occupancy, the tax base, and the sense of well being within the community.*

While much effort has been put into correcting some of these deficiencies, especially in the areas of building maintenance, parking, and overall image, some of these issues remain as applicable today as they were then.

In keeping with its comments about the need to improve the overall image of the downtown and to create better pedestrian amenity, the REPORT then went on to recommend the creation of an open plaza on the site of the present *Corner Store.* The reason given was that The Square lacked a civic space for such things as a town Christmas tree, band concerts, holiday celebrations, and general outdoor pedestrian recreation. Unfortunately, the recommendation required the willful demolition of an existing building, one of The Square's important architectural focal points, and the resultant loss of an irreplaceable economic resource.

For whatever reasons, the proposed project was never carried out. In its stead, other municipal improvements were undertaken which have significantly changed, for the better, the image of the downtown. The need, however, for such an amenity, for a pedestrian recreational park within the environs of the downtown, remains today as important as it was when first proposed in 1975.

Fortunately, the opportunity is at hand to make its creation a reality, and to do without having to resort to the intentional demolition of any buildings or structures which are vital to the economic fabric of the downtown. On the night of December 28, 1981, a disastrous fire destroyed the *Star Hotel* and severely damaged the adjacent *Green Mountain Power Corporation* building. Through purchase and the arrangement of long-term leases, these sites could become available for development by the town into a park for pedestrian recreation.

The opportunity thus provided is not only unique, but also remarkable in that the site is ideally located between The Square and the Bellows Falls Canal. A park development at this location would provide many things. As shown in the accompanying illustrations, it will help to narrow down and therefore better define the width of Bridge Street; it will provide as many as 6 additional on-street parking spaces within the center of The Square itself; it will open up a view of the Bellows Falls Canal directly from The Square and help to visually integrate this invaluable historic resource with the architectural fabric of the downtown; it will provide much needed open space directly within the heart of the downtown, as well as a site for such things as the town Christmas tree, holiday celebrations and other public events; and it will provide a better pedestrian link, along a straight new sidewalk, between both the proposed municipal parking lot off of Bridge Street on the east side of the canal, and the proposed New England Power Company's *Visitor Information Center.* The *Visitor Information Center* will be located next to the *U.S. Post Office* and is being built by the New England Power Company in conjunction with the fish ladder which it is constructing around its power generating plant at the southern end of the canal.

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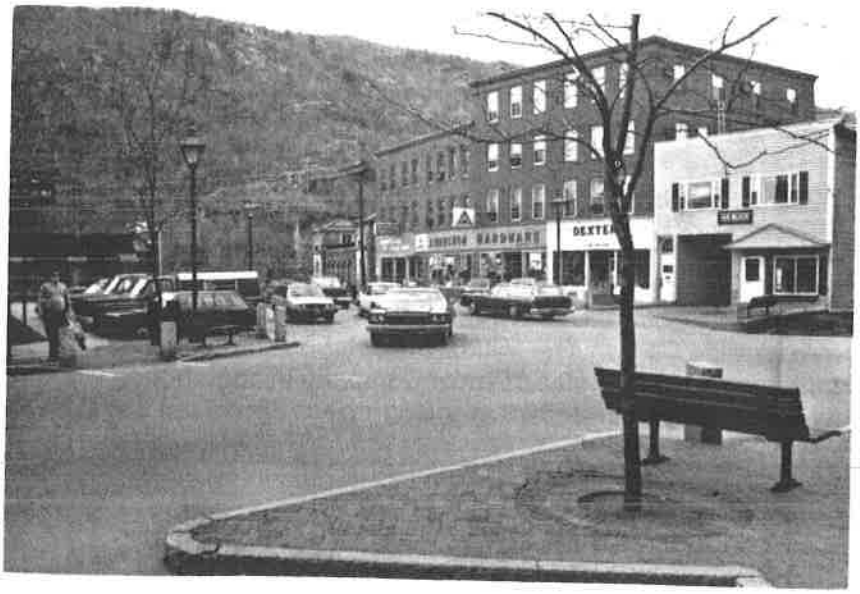
Tuke Rd



View of the south end of The Square from in front of the Centennial Block.
TOP: Circa 1885.
CENTER: Circa 1910.
BOTTOM: 1983.

Originally, this end of The Square was enclosed on all sides by a handsome collection of commercial buildings. Over the years, a number of these were remodeled or torn down and replaced. The Aubuchon Hardware building had its gable roof remodeled into a full fourth story and the Chamber of Commerce decorated with a more elaborate roof cornice. In 1930, the present U. S. Post Office replaced a number of buildings along the south side of Bridge Street down near the Bellows Falls Canal.

On December 28th of 1982, the east side of The Square was dramatically changed when the Star Hotel was destroyed in a devastating fire. While undoubtedly there are those who would probably prefer to see another building put up in its place, the fire opened up this side of The Square and provided a unique opportunity for the construction of a much needed municipal improvement. With a spectacular view of the canal, it is hoped that the proposed Bellows Falls Park will provide an enjoyable location for a wide variety of possible uses.

'BELLOWS FALLS CANAL

EMPLOYEE PARKING

N.E.P.CO.
TRANSFORMER
YARD

B&M R

B.&M. R.R.

RAILING

CANAL OVERLOOK

RETAINING WALL
& SEATING

30' SPRUCE TREE

COBBLESTONE &
BRICK PAVING

BRIDGE STREET

ANDREW'S INN

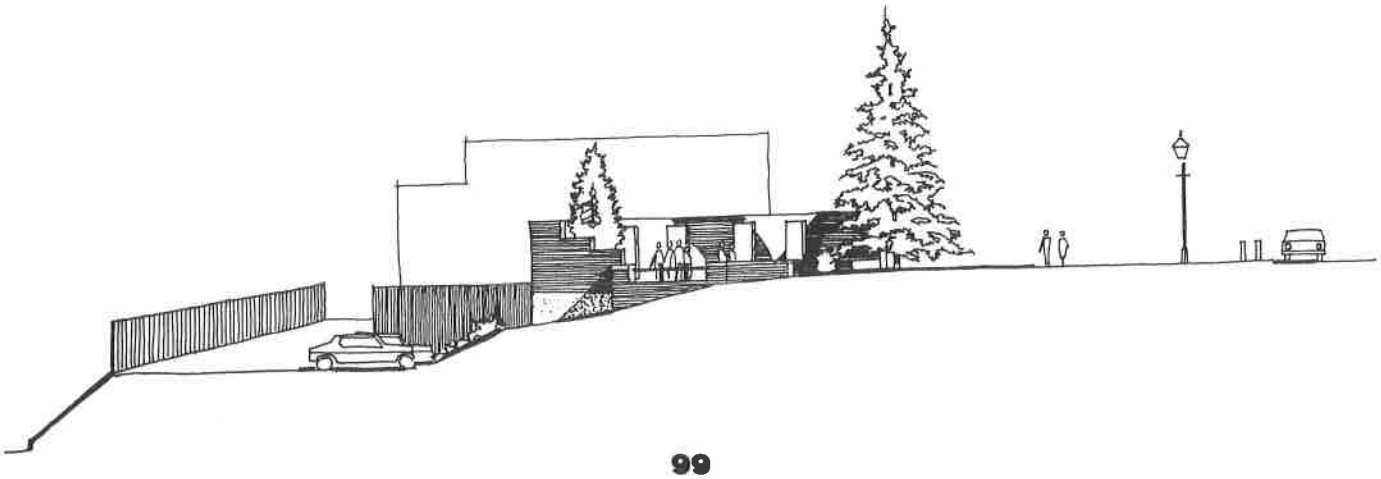
NEW CROSSWALK

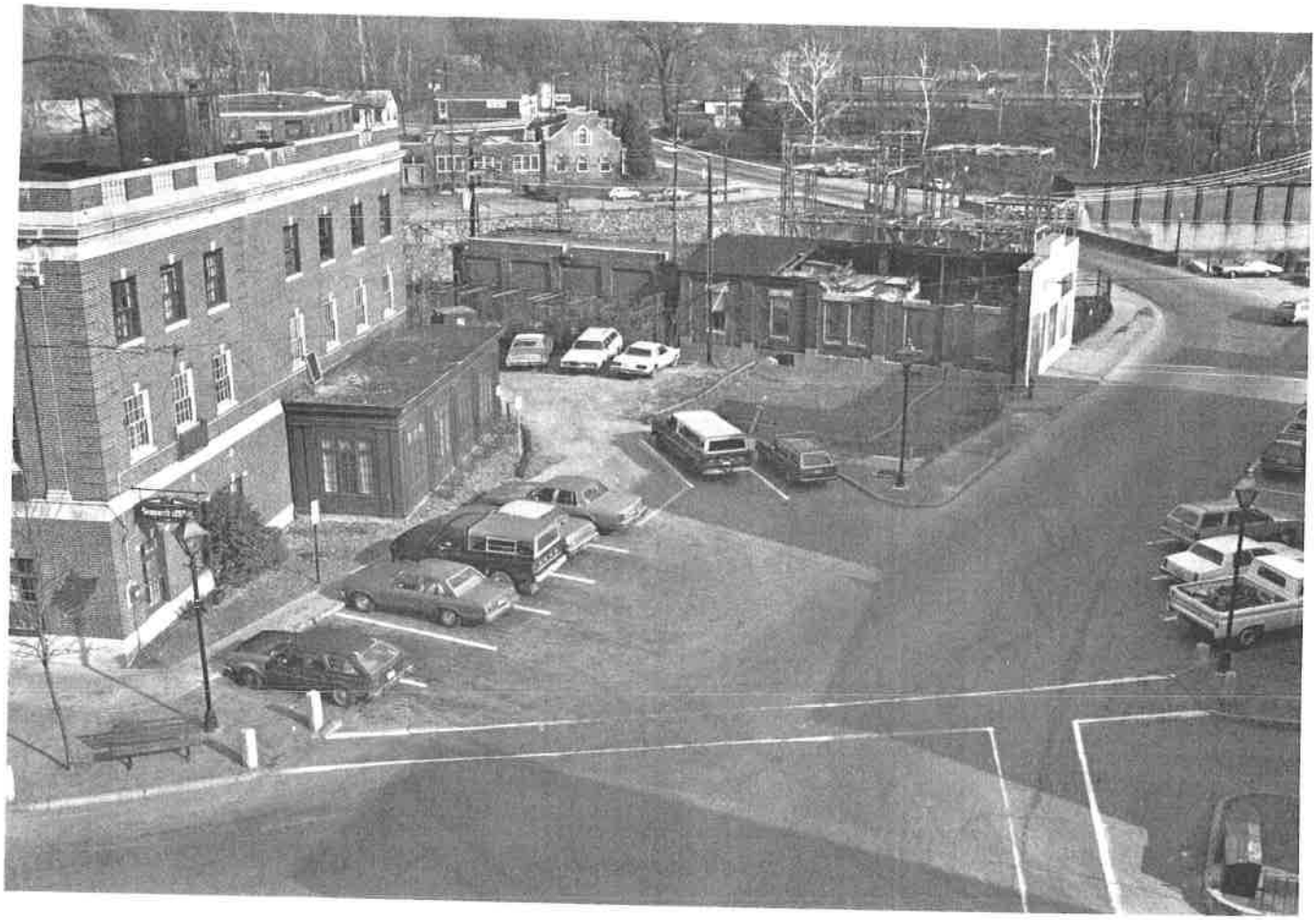
NEW SIDEWALK

0 10 20 40

THE SQUARE

Map and Section of Proposed Bellows Falls Park

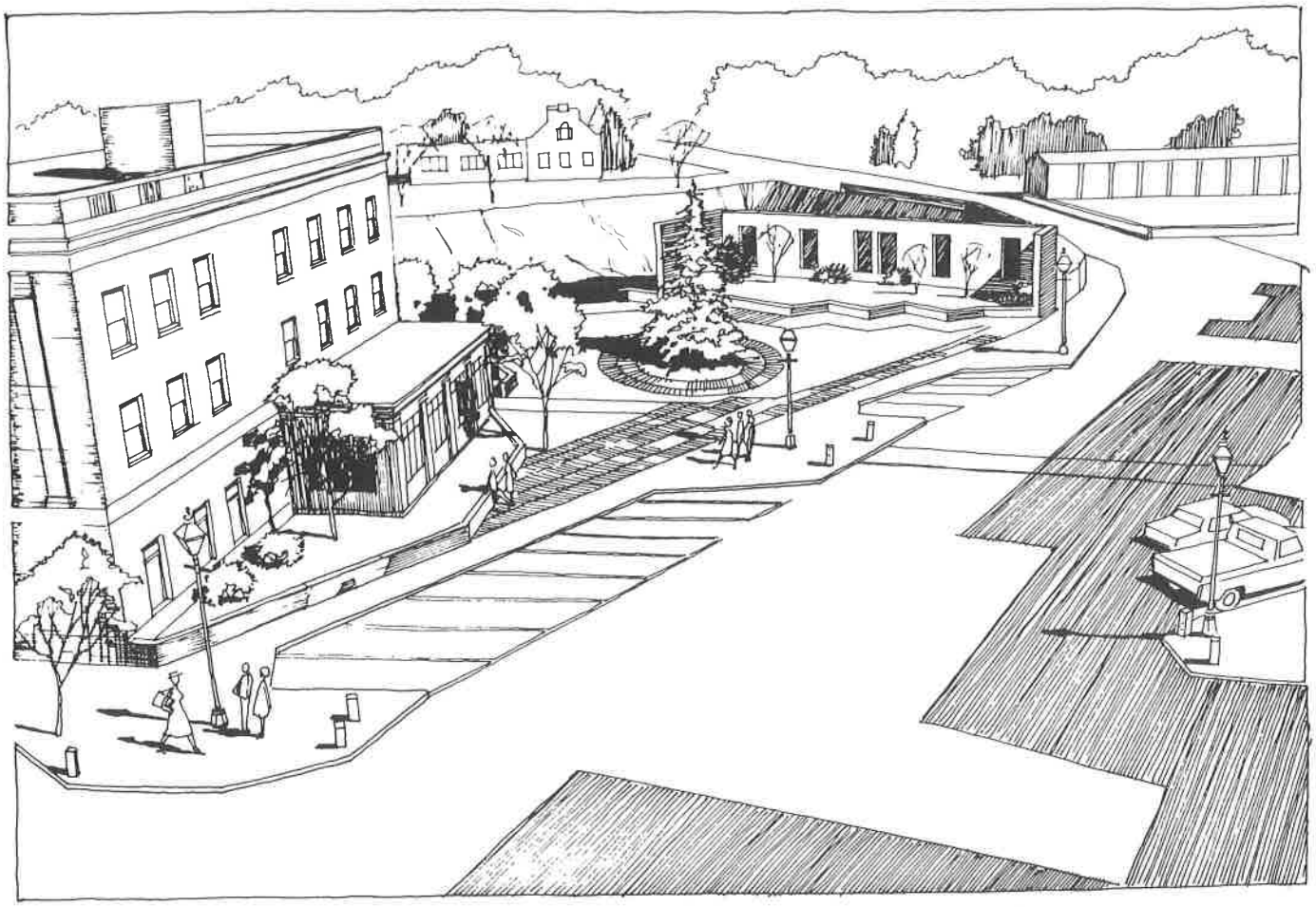




Bird's Eye View of Star Hotel Site: Existing Conditions

As shown in the bird's-eye-view illustration and the site plan, the new park would require the demolition of most of the existing ruins of the *Green Mountain Power Corporation* building which remain on the site. On its own initiative, the company has already scheduled this demolition work. Because the New England Power Company wants to retain ownership of their portion of the park site for possible future expansion of their existing transformer facility, their portion of the site would have to be leased. This would mean that no permanent fixtures relating to the park's design could be installed. Because part of the park would also have to be built on property owned by the *Andrew's Inn,* a similar lease arrangement would have to be made with them too.

In order to compensate for the loss of *Andrew's Inn* employee parking, which at present is located on the spot where the park's canal overlook would be constructed, employee parking would have to be provided elsewhere. As part of the park development, it is recommended that employee parking for the hotel be constructed adjacent to the existing service road and fire lane along the west side of the canal, off of Bridge Street.



Bird's Eye View of Star Hotel Site: Recommended Improvements

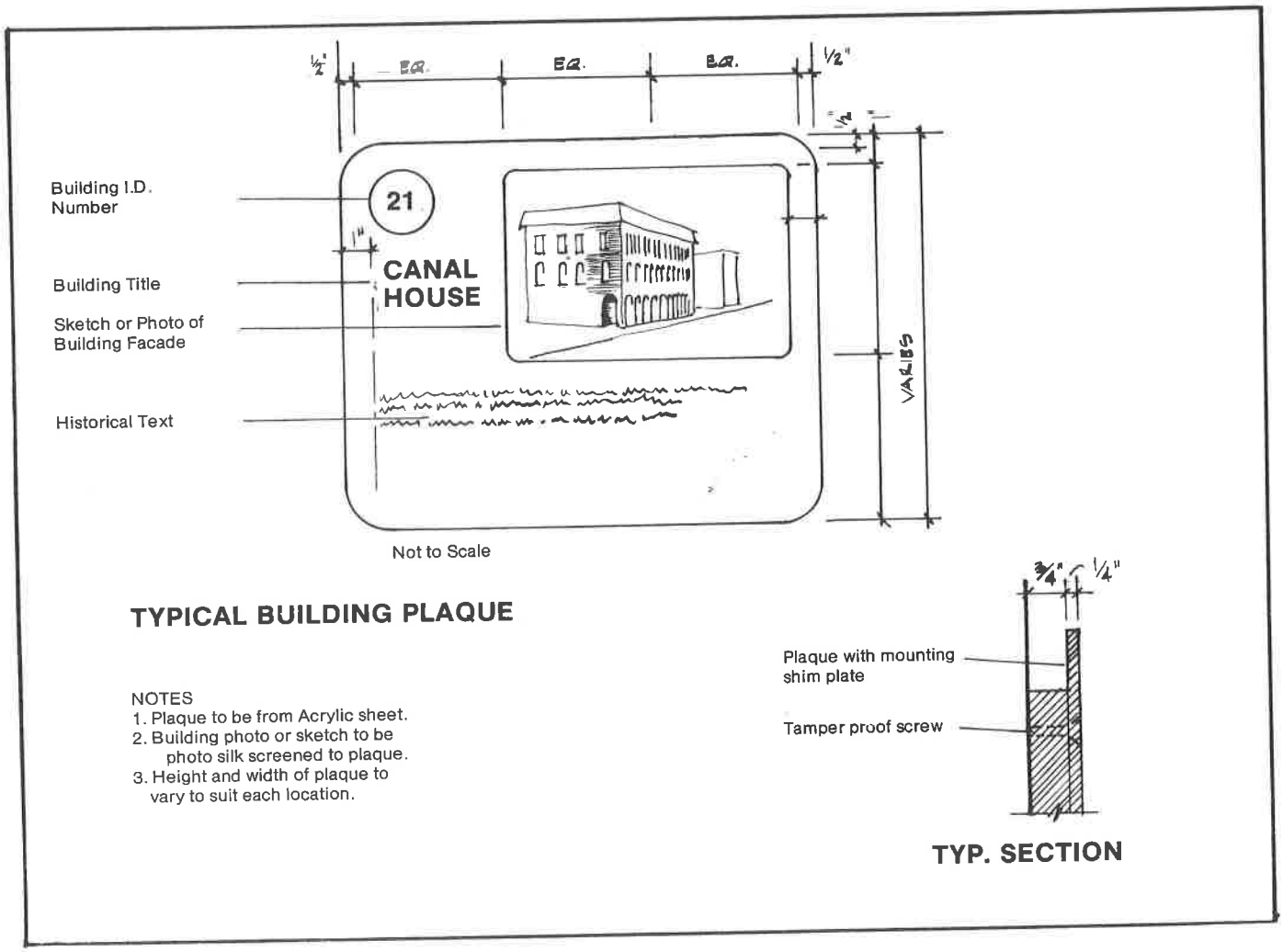
The existing crosswalk between the front of the *Andrew's Inn* and the Chamber of Commerce would be relocated further to the east, toward the center of the park, and hotel deliveries, loading and unloading would take place at this new crosswalk location, next to a new pedestrian crosswalk island. The design and construction of the new sidewalk along the side of the park and of the new on-street parking would be identical to that already completed in the rest of The Square.

As shown in the bird's-eye-view, the rear walls of the existing front section of the *Green Mountain Power Corporation* building would be kept as a screen between the park and the New England Power Company's transformers, and to provide an architectural backdrop to the park in keeping with the surrounding brick architecture of The Square. At the center, the park would be dominated by a permanent Blue Spruce town Christmas tree. The perimeter would be defined by a continuous bench which would provide both seating and a planter-box effect for the landscaping behind. The paving would be a mixture of concrete, brick and granite cobblestones, and the whole would be illuminated by a series of lighting standards identical in design to those already located throughout The Square.

Walking Tour

In order to promote an awareness of and an interest in the architectural, social, and economic history of Bellows Falls, a self-guiding walking tour through the downtown and to immediately adjacent sites of special interest should be developed. While providing a convenient guide for residents and visitors alike, the real benefit would be the tying together of a number of individual pamphlets and brochures already available from the Bellows Falls Chamber of Commerce.

In its simplest terms, the walking tour would include a multi-fold illustrated brochure which would contain a self-guiding map of the walk route and a description, in company with a photograph, of each site to be visited on the route. At each site, a large plaque would identify the site and would provide additional history, comments and photographs, as appropriate.



Walking Tour: Historic Site Marker

The historic sites and points of interest which should be included on the walking tour are - the *Emmanuel Church; The Stairs* which connect Church Street with Westminster; *The Square,* with special emphasis of certain key buildings such as the *Centennial Block* and the *Rockingham Town Hall;* the *Rockingham Canal House,* the former Rockingham Hotel; the two, brick, Greek Revival style, *canal operators houses* on Canal Street; the *Bellows Falls Canal;* the *indian petroglyphs;* the *Great Falls* and *Gorge* of the Connecticut River; the *Moore & Thompson Paper Mill* complex; the New England Power Company's *fish ladder* and *visitor information center;* the *Boston & Maine Railroad tunnel* beneath The Square; and the *Adams Grist Mill.*

THE ROUTE

As shown on the accompanying map, the tour would begin at the Bellows Falls Chamber of Commerce and would follow a route up *The Stairs* to the *Emmanual Church*. From there, it would come back down through the *Centennial Arcade* into *The Square*, and then move up Rockingham Street to the *Rockingham Canal House*. Passing down to Canal Street by way of the stair along the side of the building, the tour would take in the canal operators houses on the street, walk over the *Bellows Falls Canal* on the Depot Street bridge and proceed up to the tracks of the Boston & Maine Railroad.

From here, two routes could be taken. The most obvious would be up Depot Street to Bridge Street and then along Bridge Street to the river and the *petroglyphs*. The other would be along the canal and would only be possible once the proposed municipal off-street parking lot off of Bridge Street along the east side of the canal is completed. The design for the lot provides for the construction of a sidewalk along the canal which would connect the passenger platform along the east side of the tracks just to the north of the lot with the sidewalk along the north side of Bridge Street. This alternate route, once completed, would afford an exceptional view of the canal and a back-door look at the downtown.

From the *petroglyphs*, where the Falls and Gorge and the two bridges across the river would also be viewed, the route could either proceed back up Bridge Street to the canal or down along the river to the former *Moore & Thompson Paper Mill* complex. By either route, the walk would come out on the canal, the fish ladder, the New England Power Company's *visitor information center*, and end up back in The Square. The last two sites could then be taken in down along Mill Street, the *railroad tunnel* beneath The Square and the *Adams Grist Mill*.

FALLS MOUNTAIN OVERLOOK

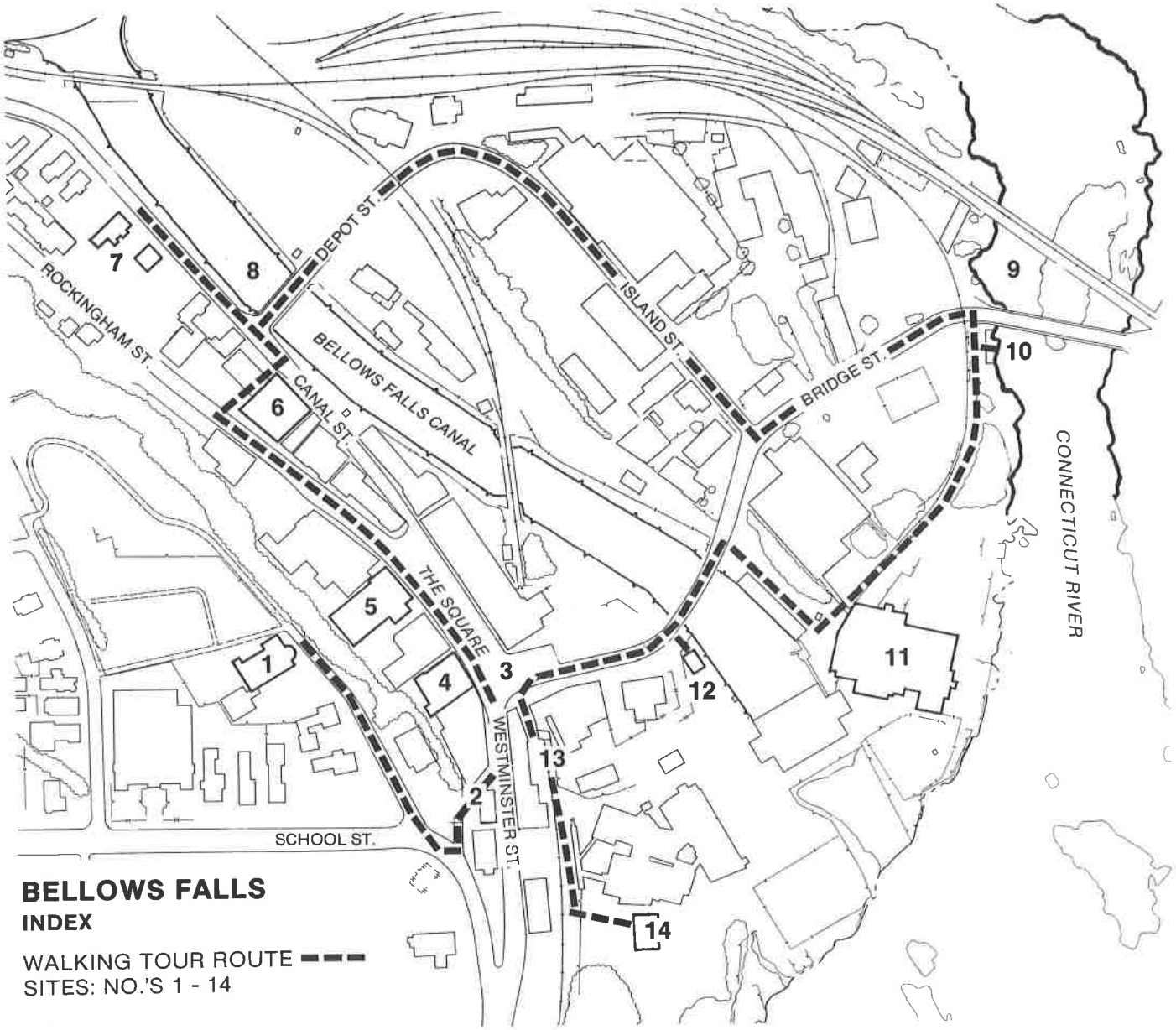
One additional point of interest which might be included is the spectacular view of Bellows Falls and the Connecticut River valley from the Falls Mountain overlook high up on the cliff above Bellows Falls on the other side of the river. The overlook is reached by a three-quarter mile hike up the mountain from the end of Mountain View Road, past the elementary school, in North Walpole, New Hampshire.

PHOTOGRAPHIC DISPLAY

In conjunction with the walking tour, it is also recommended that a permanent photographic display of the social, economic, industrial and architectural history of Bellows Falls should be put together and put up in the public lobby of the *Centennial Arcade*. Because of its location in the lobby, it would be on the tour route between the *Emmanuel Church* and The Square, and would prove an invaluable addition to the tour. It would also provide a much needed indoor attraction within the downtown for visitors during the colder months of the year.

A BRIEF HISTORY

The present character of Bellows Falls owes as much to its geographical setting as to its historic development. Confined on the east by the *Great Falls* and *Gorge of the Connecticut River*, split down the middle by the *Bellows Falls Canal*, and hemmed in on the west by a series of escarpments and plateaus, Bellows Falls developed according to the dictates of its unique topography. While the commercial area of *The Square* and the residential neighborhoods behind grew up to the west of the canal, industrial growth took place predominantly to the east on land between the canal and the river known as *The Island*.



Walking Tour: Map of Route and Sites

An encapsulated overview of that unique development was included in the *Bellows Falls Historic District* nomination to the *National Register of Historic Places.*

> *Bellows Falls derives its significance largely from its historical relationship to the Great Falls of the Connecticut River, the locus of various human activities through hundreds of years. Native Americans used the river for a main artery of travel and congregated at the Falls to catch migrating salmon and shad. Early white settlers followed suit and then developed overland transport routes that focused on the first bridge across the Connecticut River built here in 1785. To expedite the early river traffic, one of the first canals in the United States was opened in 1802 to bypass the Falls; that canal also provided water to power Bellows Falls' emerging industry,*
>
> *When the railroads passed through the area circa 1850, they also focused on the river crossing, and Bellows Falls became one of the most important railroad junctions in northern New England. In the 1870's, the available water power attracted the establishment of paper mills that were among the first in the United States to use wood pulp - as opposed to rags - for raw material. By the turn of the present century, Bellows Falls had expanded into an important manufacturing center with a business district whose architectural character reflected its vigor and prosperity. Subsequently the industrial activities have declined but Bellows Falls retains to an unusual extent the historic fabric of its earlier ascendancy, and recently has undertaken substantial efforts toward its preservation.*

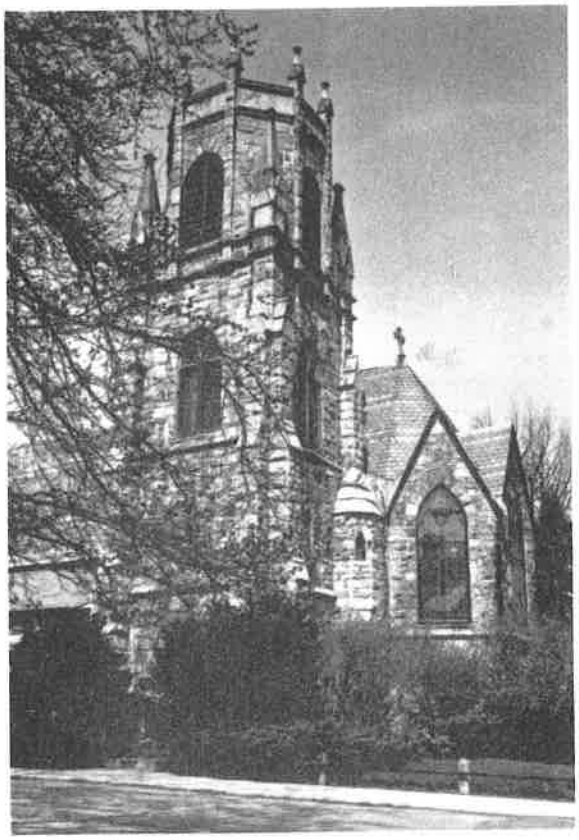
THE SITES

In order to encourage the funding that will be necessary to publish the illustrated brochure and purchase the plaques which will be located at each site on the tour, a photograph and brief description of each site are included herein. These should provide a glimpse of Bellows Falls' unique history, and reinforce the importance of completing this aspect of the study.

SITE NO. 1 *EMMANUEL CHURCH*. The *Emmanuel Church* is a rare example of Gothic Revival style architecture. Constructed between 1863 and 1867, the church was designed by Richard Upjohn, a personal friend of the church's pastor and one of the most influential architects of post Civil War America. Upjohn was responsible for revolutionizing ecclesiastical architecture throughout America through the imaginative and innovative use of the Gothic style. His most famous work is New York City's Trinity Church on lower Broadway.

Designed in imitation of a rural parish church from the English countryside, the *Emmanuel Church* is the only example of his work in Vermont. The stone is New Hampshire granite, the interior is Chestnut detailed with decorative polychroming and gild, and the lancet shaped windows are colorful stained glass, many of which depick scenes from the Bible. The parish cemetery is located just to the north and contains the grave of Hetty Green. Nineteenth century Bellows Falls' most famous resident, Hetty Green was known as the "Witch of Wall Street" and was reputed to have been the richest woman in America.

SITE NO. 2 *THE STAIRS*. The 44 steps which make up *The Stairs* are the only pedestrian link between the lower commercial level of *The Square* and the higher level of the bluff behind and to the west of *The Square* where much of the village's residences are located. The original steps were constructed out of wood sometime during the mid-nineteenth century and have been a unique feature of the downtown ever since.



SITE NO. 1: Emmanuel Church.

SITE NO. 2: The Stairs.

SITE NO. 3: The Square.

View looking north with the Rockingham Town Hall (Site 5) on the left.
TOP: Circa 1915.
BOTTOM: 1983.

SITE NO. 3 *THE SQUARE. The Square* represents the commercial heart and architectural center of Bellows Falls. Hemmed in on the west by a steep escarpment, and confined on the east by the *Bellows Falls Canal, The Square* is enclosed on all sides by a relatively uniform array of three story brick buildings which give it a distinctly urban-like character and help to distinguish it from other Vermont communities of similar size. Unlike so many communities across the United States, Bellows Falls survives today much as it always has, a tight commercial grouping physically inseparable from those economic resources from which its growth and prosperity derived - the *Bellows Falls Canal* (SITE NO. 8), the railroad, and various mill complexes (SITE NO.'S 11 & 14). The railroad's association was so close, in fact, that it required the construction of a *railroad tunnel* directly beneath *The Square* (SITE NO. 13).

Besides the *Centennial Block* (SITE NO. 4) and the *Rockingham Town Hall* (SITE NO. 5), other buildings of interest in and around *The Square* would be the *Bellows Falls Fire Station* on Rockingham Street, am impressive 1904 Romanesque style building; the *Exner Block* on Canal Street, unusual for its stamped sheet metal siding in imitation of rough cut stone which was added to the building when it was remodeled in 1905-1907; and the *U.S. Post Office* on Bridge Street. Built in 1930, because of the Spanish flavor of its Georgian design, a local tradition has taken root which claims that the plans of this building were actually intended for a post office in Santa Fe, New Mexico, but somehow were misdirected to Bellows Falls.

SITE NO. 3: The Square.

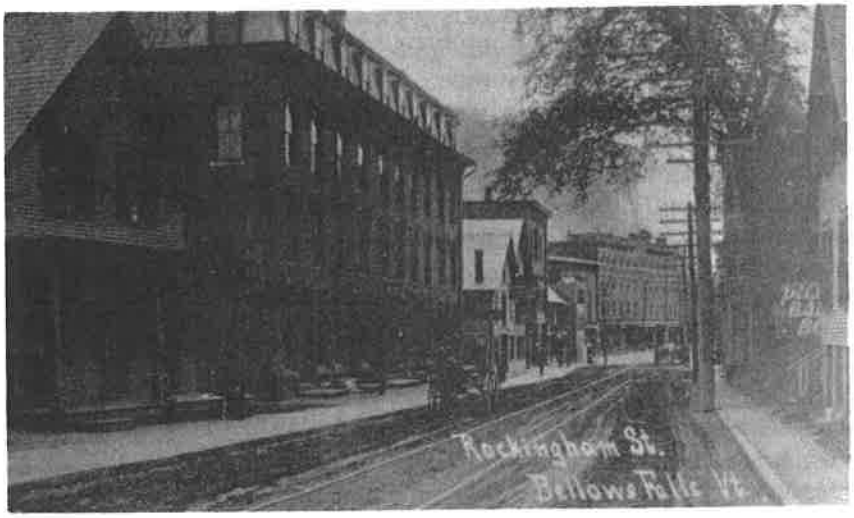
View looking south with the Centennial Block (Site 4) to the right of center.
TOP: Circa 1885.
BOTTOM: 1983.

SITE NO. 4 *CENTENNIAL BLOCK.* Constructed by the National Bank of Bellows Falls during the centennial anniversary of the American Revolutionary War, the *Centennial Block* is the only example of High Victorian Italiante style architecture in Bellows Falls. Richly detailed in a polychromatic counterpoint of chiseled limestone on orange-red brick, the date of the buildings construction and the event which that construction celebrates are emblazoned on a semi-circular plaque located in the parapet.

SITE NO. 5 *ROCKINGHAM TOWN HALL.* In 1887, Bellows Falls built an impressive town hall in the Romanesque style commensurate with its importance as one of the leading transportation, commercial and manufacturing centers of New England. Complete with a five story clock tower, the town hall dominated *The Square*. When that town hall was destroyed by fire in 1925, the village decided to replace it with an even more imposing building. Like its predecessor, the present *town hall* boasts a clock tower, although nearly half again as tall, which is the architectural focal point not only of *The Square* but the surrounding village-scape as well. Designed in an ecclectic mixture of Georgian and Gothic styles, the tower can be seen from almost every approach to *The Square* and is reminiscent of the tower on the town hall in Florence, Italy.

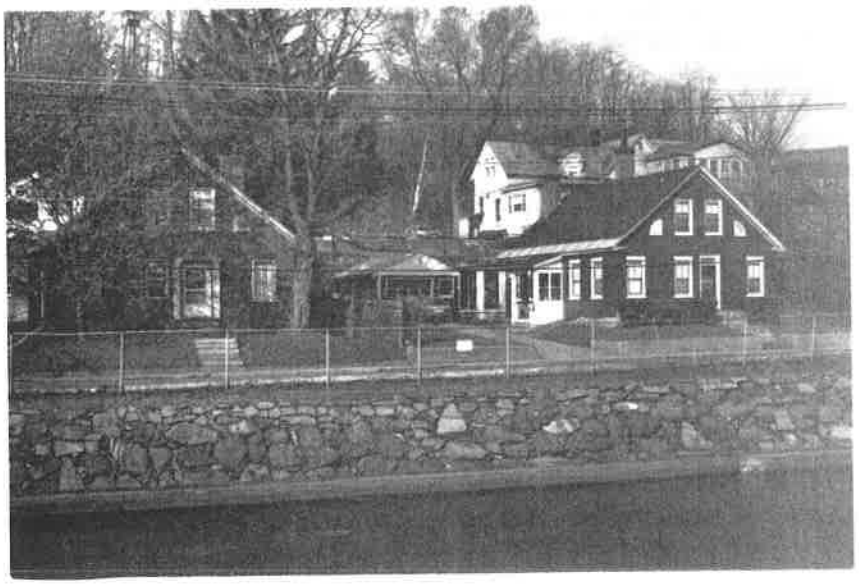
SITE NO. 6 *ROCKINGHAM CANAL HOUSE.* Originally known as the Hotle Rockingham, Leverett T. Lovell, II was the owner of this imposing French Second Empire style railroad hotel at the time of its construction in 1883. In honor of the occasion, and obviously proud of his ownership, the date and his name are emblazoned in polychromatic and scallop shaped slate shingles of the south and west slopes of the building's mansard roof. Detailed across the first floor by an unusual row of arched storefront openings which form a continuous arcade, this brick building is the last of the great railroad hotel buildings to survive in Bellows Falls. Built in response to Bellows Falls' preeminence as one of the major transportation, commercial and manufacturing centers in New England, the hotels were enjoyed by tourists and businessmen alike. The most famous, long since destroyed by fire, was the Island House located on the highest point of land on *The Island.*

SITE NO. 7 *CANAL OPERATORS' HOUSES.* These two operators' houses are the only examples of Federal style domestic architecture in downtown Bellows Falls. Built sometime before 1820, two one and one-half story, brick houses with front gable facades were built to house the men and their families who operated the locks of the *Bellows Falls Canal.* They are very similar stylistically to canal operator's houses found along the entire length of the Erie Canal.



SITE NO. 6: Rockingham Canal House.

View looking south down Rockingham Street with the Rockingham Canal House on the left.
TOP: 1910.
BOTTOM: 1983.



SITE NO. 7: Canal Operators House.

SITE NO. 8 *BELLOWS FALLS CANAL.* Soon after the first bridge was constructed across the *Great Falls* and *Gorge of the Connecticut River* in 1785, a canal was constructed to by-pass the *Great Falls,* thereby opening up the river to commercial traffic. Financed with English capital, the original *Bellows Falls Canal* was dug during the decade from 1791 to 1802. It had an average width of 22 feet and a depth of 4 feet. North of the present Bridge Street bridge, the original canal followed the alignment of the present waterway. From the bridge, the canal veered southwest, dropping 48 feet through eight locks to the river's lower level south of the gorge. Each of those original locks measured 75' in length by 20' in width. Together with other locks already in operation along the river in Massachusetts, with the opening of the *Bellows Falls Canal,* the Connecticut River became the first major river in the United States to receive this kind of improvement for navigation. By 1810, over 250 miles of the river was open to continuous navigation by commercial traffic.

The *canal* also provided the primary source of water power to the mills which quickly sprang up around its southern end. Following the decline in river traffic caused by the coming of the railroad, in 1875, in response to the ever increasing demand to provide more water volume to power the village's rapidly increasing mill operations, the canal was enlarged to a width of 75 feet and a depth of 17. With the conversion of most mill operations to electricity following the First World War, the canal was enlarged once again in 1927-1928 to its present 100 foot width and the present hydroelectric power generating station was constructed across its south end.

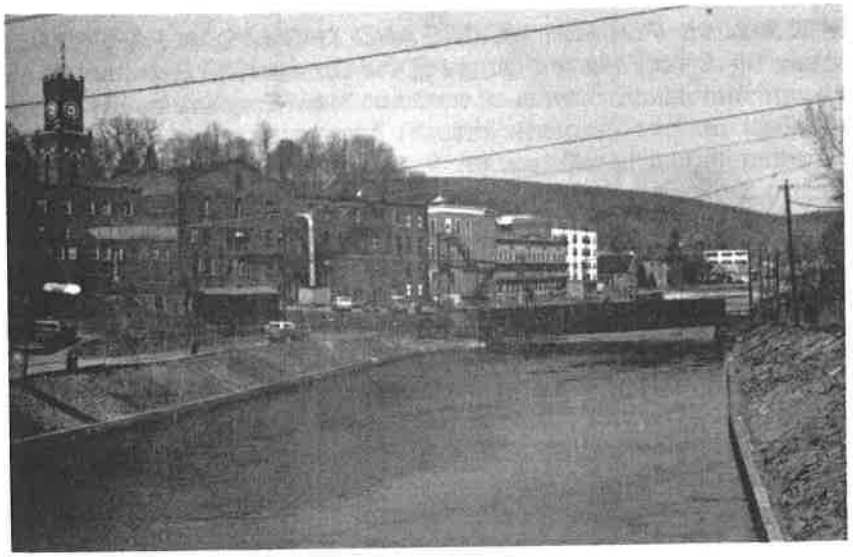
SITE NO. 9 *GREAT FALLS AND GORGE OF THE CONNECTICUT RIVER.* Much of the early history of Bellows Falls is unique largely because of this deep river gorge from which the village derives its name. Known as the *Great Falls and Gorge of the Connecticut River,* vast numbers of Atlantic Salmon would collect below the gorge on their annual migration to the headwaters of the Connecticut River to spawn. The annual gathering became a primary source of food for the native Americans living in the area and, following 1773, for immigrant white settlers as well.

Following the arrival of the white settler, the beauty of the *Great Falls* was widely publicized throughout both the eastern United States and England, and became an important tourist attraction even as early as the end of the eighteenth century. With the opening of the *Bellows Falls Canal,* however, in 1802 much of the water which ran through the gorge was diverted through the canal and the attraction turned from that of a spectacular waterfall to that of a spectacular river gorge.

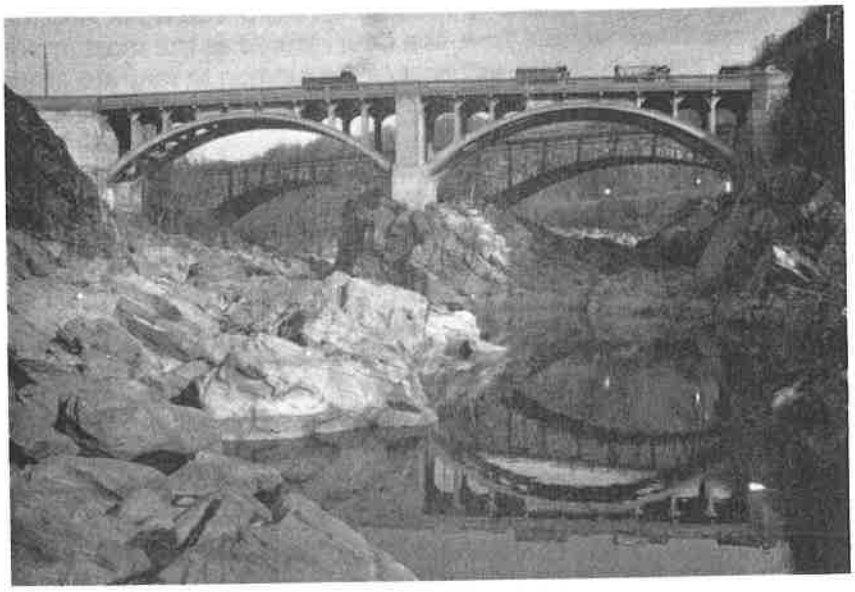
More important than its natural beauty, the gorge was the only place along the entire length of the Connecticut River where a bridge of relatively short span could be constructed. In 1785, Enoch Hale constructed the first bridge across the river on the site of the present bridge, and began the transformation of Bellows Falls into an important commercial crossroads. The bridge remained the only one across the river for more than a decade. The present *Vilas Bridge* is the third to occupy the site and is an unusual example of cast-in-place, open web reinforced concrete construction.

The stone arched *railroad bridge* located immediately to the north of the *Vilas Bridge* was built in 1899 by the Fitchburg Railroad. This bridge is unique in that it is supported by the two shallowest arches of any masonry bridge in the United States.

SITE NO. 10 *INDIAN PETROGLYPHS.* The *indian petroglyph* carvings commemorate either a specific indian ceremony lost to time or a successful annual catch of Atlantic Salmon and shad. Carved with stone implements anywhere from 300 to 2,000 years ago, the earliest known reference to the carvings was made by Benjamin Hall in his book "History of Eastern Vermont - 1779-1789". In the 1930's, a local chapter of the Daughters of the American Revolution had many of the carvings recut and painted yellow to make them stand out more prominently. While some of their original delicacy and form was undoubtedly lost in the recutting, it is hoped that others, as yet untouched, may survive buried beneath the rubble.

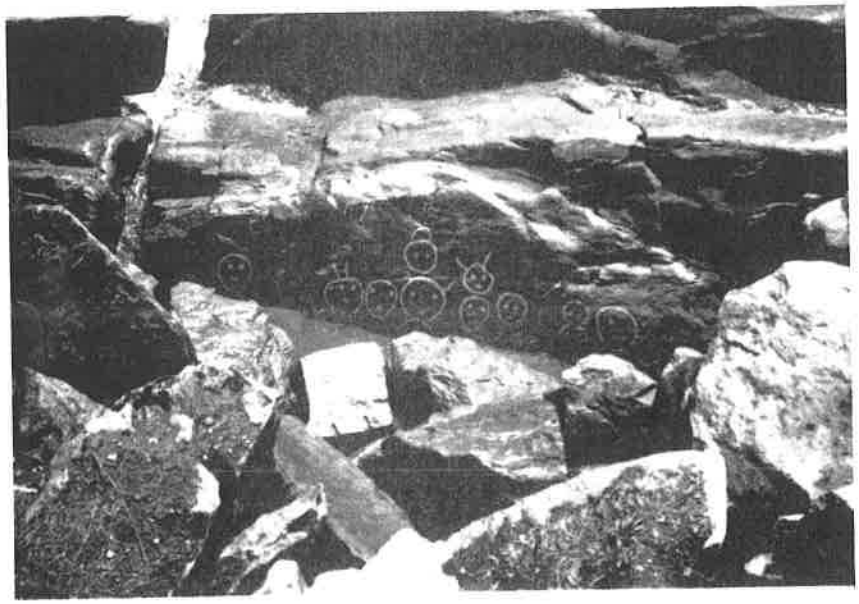


SITE NO. 8: Bellows Falls Canal.



SITE NO. 9: Great Falls and Gorge of the Connecticut River.

View looking north from below the falls. The Vilas Bridge, constructed in 1930, is in the foreground with the 1899 Fitchburg Railroad Bridge behind.



SITE NO. 10: Indian Petroglyphs.

SITE NO. 11 *FORMER MOORE AND THOMPSON PAPER MILL COMPLEX.* If *Enoch Hale's bridge* across the *Great Falls and Gorge of the Connecticut River* and the *Bellows Falls Canal* made Bellows Falls the commercial crossroads of northern New England by the mid-nineteenth century, by the turn of the twentieth century the paper industry had transformed Bellows Falls into one of New England's most important industrial centers, second only in fact to Holyoke, Massachusetts. The predominant economic force in Bellows Falls' industrial development, with the manufacture of farm machinery trailing a distant second, the local paper mills produced almost every kind of paper known to the trade.

The *Moore and Thompson Paper Mill* complex played a leading role in the development of that industry and remains the largest complex of that kind to survive in Bellows Falls from that period of its economic preeminence. A collection of sixteen, predominantly multi-story, brick gable roofed buildings variously connected together, most of the buildings in the complex were built in 1880-1881. The complex remained operational through a series of period shutdowns following World War I up until the early 1970's when manufacturing ceased and the machinery was sold.

SITE NO. 12 *BELLOWS FALLS FISH LADDER & NEW ENGLAND POWER COMPANY VISITOR INFORMATION CENTER.* The *fish ladder* is part of a much larger project being undertaken by the U.S. Department of Fish & Game to reestablish the breeding of Atlantic Salmon at the headwaters of the Connecticut River. At one time, the river ranked as the most important in New England for its salmon population. The fish ladder will enable the salmon to migrate around the *Great Falls and Gorge of the Connecticut River* in their journey to the river's headwaters.

In conjunction with the *fish ladder*, the New England Power Company is also planning to construct a *visitor information center* which will provide a photographic display and history of Bellows Falls, the *Bellows Falls Canal*, the fish ladder, and the power generating operations of the power company, as well as a visitor observation platform overlooking the fish ladder.

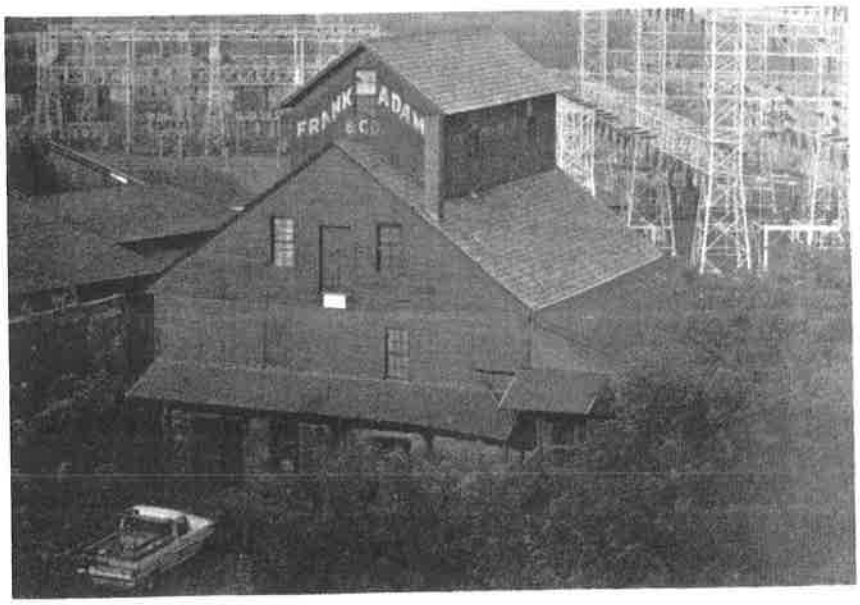
SITE NO. 13 *BOSTON AND MAINE RAILROAD TUNNEL.* The decade of the 1840's brought to Bellows Falls the railroad fever then sweeping the country. As the railroad era began, the canal era abruptly came to an end, and what had previously been moved by river barge was shipped by rail. By 1851, there were four rail lines serving Bellows Falls, the last of which, the Vermont Valley Railroad, completed the vital connection with the south to Brattleboro, Springfield, Massachusetts and New Haven, Connecticut.

However, because of the steep grades through and around Bellows Falls, construction of the Vermont Valley line required that a *railroad tunnel* be built beneath *The Square*. Over 400 feet in length, the tunnel is partially cut through solid rock and is lined with rough cut stone blocks. The portals at either end are decorated with radiating voussiors around round arch openings. Now owned by the Boston and Maine Railroad, the tunnel is only one of two such railroad tunnels in Vermont.

SITE NO. 14 *ADAMS GRIST MILL & HISTORICAL MUSEUM.* John Cary built this grist mill in 1831. It was bought by the Adams family in 1875 and remained in their ownership until the early 1960's when it ceased operations. All of the water rights at the south end of the *Bellows Falls Canal* originally belonged to this mill, and retained an exclusive right for grist milling long after other water-powered industries were established in the vicinity. Much of the mill's machinery, including both its hydraulic turbine and its electric power systems, survive intact, and operational. Complementing its technological importance, the mill has been adapted for a museum of local Bellows Falls history.

SITE NO. 11: Moore and Thompson Mill.

SITE NO. 13: Railroad Tunnel.



SITE NO. 14: Adams Grist Mill.

Appendix

THE SECRETARY OF THE INTERIOR'S STANDARDS FOR THE REHABILITATION OF HISTORIC BUILDINGS

The following "STANDARDS FOR REHABILITATION" shall be used by the Secretary of the Interior when determining if a rehabilitation project qualifies as "certified rehabilitation" pursuant to the Economic Recovery Tax Act (P.L. 97-34) of 1981. These standards are a section of the Secretary's "Standards for Historic Preservation Projects" and appear in Title 36 of the Code of Federal Regulations, Part 1208 (formerly 36 CFR Part 67).

1. Every reasonable effort shall be made to provide a compatible use for a property which requires minimal alteration of the building, structure, or site and its environment, or to use a property for its originally intended purpose.

2. The distinguishing original qualities or character of a building, structure, or site and its environment shall not be destroyed. The removal or alteration of any historic material or distinctive architectural features should be avoided when possible.

3. All buildings, structures, and sites shall be recognized as products of their own time. Alterations that have no historical basis and which seek to create an earlier appearance shall be discouraged.

4. Changes which may have taken place in the course of time are evidence of the history and development of a building, structure, or site and its environment. These changes may have acquired significance in their own right, and this significance shall be recognized and respected.

5. Distinctive stylistic features or examples of skilled craftsmanship which characterize a building, structure, or site shall be treated with sensitivity.

6. Deteriorated architectural features shall be repaired rather than replaced, wherever possible. In the event replacement is necessary, the new material should match the material being replaced in composition, design, color, texture, and other visual qualities. Repair or replacement of missing architectural features should be based on accurate duplications of features, substantiated by historic, physical, or pictorial evidence rather than on conjectural designs or the availability of different architectural elements from other buildings or structures.

7. The surface cleaning of structures shall be undertaken with the gentlest means possible. Sandblasting and other cleaning methods that will damage the historic building materials shall not be undertaken.

8. Every reasonable effort shall be made to protect and preserve archeological resources affected by, or adjacent to any project.

9. Contemporary design for alterations and additions to existing properties shall not be discouraged when such alterations and additions do not destroy significant historical, architectural or cultural material, and such design is compatible with the size, scale, color, material, and character of the property, neighborhood or environment.

10. Wherever possible, new additions or alterations to structures shall be done in such a manner that if such additions or alterations were to be removed in the future, the essential form and integrity of the structure would be unimpaired.

GUIDELINES FOR APPLYING THE SECRETARY OF THE INTERIOR'S STANDARDS FOR REHABILITATION

The following guidelines are designed to help individual property owners formulate plans for the rehabilitation, preservation, and continued use of historic buildings consistent with the intent of the Secretary of the Interior's "Standards for Rehabilitation." The guidelines pertain to buildings of all occupancy and construction types, sizes, and materials. They apply to permanent and temporary construction on the exterior and interior of historic buildings as well as new attached or adjacent construction.

Techniques, treatments, and methods consistent with the Secretary's "Standards for Rehabilitation" are listed in the "recommended" column on the left. Not all recommendations listed under a treatment will apply to each project proposal. Rehabilitation approaches, materials, and methods which may adversely affect a building's architectural and historic qualities are listed in the "not recommended" column on the right. Every effort will be made to update and expand the guidelines as additional techniques and treatments become known.

Specific information on rehabilitation and preservation technology may be obtained by writing to the Technical Preservation Services Division, Heritage Conservation and Recreation Service, U.S. Department of the Interior, Washington, D.C. 20243, or the appropriate State Historic Preservation Officer. Advice should also be sought from qualified professionals, including architects, architectural historians, and archeologists skilled in the preservation, restoration, and rehabilitation of old buildings.

THE ENVIRONMENT

Recommended	*Not Recommended*
Retaining distinctive features such as the size, scale, mass, color, and materials of buildings, including roofs, porches, and stairways that give a neighborhood its distinguishing character.	Introducing new construction into neighborhoods that is incompatible with the character of the district because of size, scale, color, and materials.
Retaining landscape features such as parks, gardens, street lights, signs, benches, walkways, streets, alleys and building set-backs that have traditionally linked buildings to their environment.	Destroying the relationship of buildings and their environment by widening existing streets, changing paving material, or by introducing inappropriately located new streets and parking lots that are incompatible with the character of the neighborhood.
Using new plant materials, fencing, walkways, street lights, signs, and benches that are compatible with the character of the neighborhood in size, scale, material and color.	Introducing signs, street lighting, benches, new plant materials, fencing, walkways and paving materials that are out of scale or are inappropriate to the neighborhood.

BUILDING SITE

Recommended	*Not Recommended*
Identifying plants, trees, fencing, walkways, outbuildings, and other elements that might be an important part of the property's history and development.	
Retaining plants, trees, fencing, walkways, street lights, signs, and benches that reflect the property's history and development.	Making changes to the appearance of the site by removing old plants, trees, fencing, walkways, outbuildings, and other elements before evaluating their importance in the property's history and development.
Basing decisions for new site work on actual knowledge of the past appearance of the property found in photographs, drawings, newspapers, and tax records. If changes are made they should be carefully evaluated in light of the past appearance of the site.	Leaving plant materials and trees in close proximity to the building that may be causing deterioration of the historic fabric.

BUILDING SITE--continued

Recommended	*Not Recommended*
Providing proper site and roof drainage to assure that water does not splash against building or foundation walls, nor drain toward the building.	

Archeological features

Recommended	*Not Recommended*
Leaving known archeological resources intact.	Installing inderground utilities, pavements, and other modern features that disturb archeological resources.
Minimizing disturbance of terrain around the structure, thus reducing the possibility of destroying unknown archeological resources.	Introducing heavy machinery or equipment into areas where their presence may disturb archeological resources.
Arranging for an archeological survey of all terrain that must be disturbed during the rehabilitation program. The survey should be conducted by a professional archeologist.	

BUILDING: STRUCTURAL SYSTEMS

Recommended	*Not Recommended*
Recognizing the special problems inherent in the structural systems of historic buildings, especially where there are visible signs of cracking, deflection, or failure.	Disturbing existing foundations with new excavations that undermine the structural stability of the building.
Undertaking stabilization and repair of weakened structural members and systems.	Leaving known structural problems untreated that will cause continuing deterioration and will shorten the life of the structure.
Replacing historically important structural members only when necessary. Supplementing existing structural systems when damaged or inadequate.	

BUILDING: EXTERIOR FEATURES--continued

Masonry: Adobe, brick, stone, terra cotta, concrete, stucco and mortar

Recommended *	*Not Recommended*
Retaining original masonry and mortar, whenever possible, without the application of any surface treatment.	Applying waterproof or water repellent coatings or surface consolidation treatments unless required to solve a specific technical problem that has been studied and identified. Coatings are frequently unnecessary, expensive, and can accelerate deterioration of the masonry.
Repointing only those mortar joints where there is evidence of moisture problems or when sufficient mortar is missing to allow water to stand in the mortar joint.	Repointing mortar joints that do not need repointing. Using electric saws and hammers to remove mortar can seriously damage the adjacent brick.
Duplicating old mortar in composition, color, and texture.	Repointing with mortar of high Portland cement content can often create a bond that is stronger than the building material. This can cause deterioration as a result of the differing coefficient of expansion and the differing porosity of the material and the mortar.
Duplicating old mortar in joint size, method of application, and joint profile.	Repointing with mortar joints of a differing size or joint profile, texture or color.
Repairing stucco with a stucco mixture that duplicates the original as closely as possible in appearance and texture.	
Cleaning masonry only when necessary to halt deterioration or to remove graffiti and stains and always with the gentlest method possible, such as low pressure water and soft natural bristle brushes.	Sandblasting, including dry and wet grit and other abrasives, brick or stone surfaces; this method of cleaning erodes the surface of the material and accelerates deterioration. Using chemical cleaning products that would have an adverse chemical reaction with the masonry materials, i.e., acid on limestone or marble.

* For more information consult Preservation Briefs: 1: "The Cleaning and Waterproof Coating of Masonry Buildings" and Preservation Briefs: 2: "Repointing Mortar Joints in Historic Brick Buildings" (Washington, D.C.: Heritage Conservation and Recreation Service, 1975 and 1976). Both are available from the Government Printing Office or State Historic Preservation Officers.

BUILDING: EXTERIOR FEATURES--continued

Masonry: Adobe, brick, stone, terra cotta, concrete, stucco and mortar

Recommended	*Not Recommended*
Repairing or replacing, where necessary, deteriorated material with new material that duplicates the old as closely as possible.	Applying new material which is inappropriate or was unavailable when the building was constructed, such as artificial brick siding, artificial cast stone or brick veneer.
Replacing missing significant architectural features, such as cornices, brackets, railings, and shutters.	Removing architectural features such as cornices, brackets, railings, shutters, window architraves, and doorway pediments.
Retaining the original or early color and texture of masonry surfaces, including early signage wherever possible. Brick or stone surfaces may have been painted or whitewashed for practical and aesthetic reasons.	Removing paint from masonry surfaces indiscriminately. This may subject the building to damage and change its appearance.

Wood: Clapboard, weatherboard, shingles and other wooden siding

Recommended	*Not Recommended*
Retaining and preserving significant architectural features, wherever possible.	Removing architectural features such as siding, cornices, brackets, window architraves, and doorway pediments. These are, in most cases, an essential part of a building's character and appearance that illustrate the continuity of growth and change.
Repairing or replacing, where necessary, deteriorated material that duplicates in size, shape, and texture the old as closely as possible.	Resurfacing frame buildings with new material that is inappropriate or was unavailable when the building was constructed such as artificial stone, brick veneer, asbestos or asphalt shingles, and plastic or aluminum siding. Such material can also contribute to the deterioration of the structure from moisture and insects.

Architectural Metals: Cast iron, steel, pressed tin, aluminum and zinc

Recommended	*Not Recommended*
Retaining original material, whenever possible.	Removing architectural features that are an essential part of a building's character and appearance, illustrating the continuity of growth and change.

BUILDING: EXTERIOR FEATURES--continued

Architectural Metals: Cast iron, steel, pressed tin, aluminum and zinc

Recommended	*Not Recommended*
Cleaning when necessary with the appropriate method. Metals should be cleaned by methods that do not abrade the surface.	Exposing metals which were intended to be protected from the environment. Do not use cleaning methods which alter the color, texture, and tone of the metal.

Roofs and Roofing

Recommended	*Not Recommended*
Preserving the original roof shape.	Changing the essential character of the roof by adding inappropriate features such as dormer windows, vents, or skylights.
Retaining the original roofing material, whenever possible.	Applying new roofing material that is inappropriate to the style and period of the building and neighborhood.
Providing adequate roof drainage and insuring that the roofing materials provide a weathertight covering for the structure.	
Replacing deteriorated roof coverings with new material that matches the old in composition, size, shape, color, and texture.	Replacing deteriorated roof coverings with new materials that differ to such an extent from the old in composition, size, shape, color, and texture that the appearance of the building is altered.
Preserving or replacing where necessary, all architectural features that give the roof its essential character, such as dormer windows, cupolas, cornices, brackets, chimneys, cresting, and weather vanes.	Stripping the roof of architectural features important to its character.

Windows and Doors

Recommended *	*Not Recommended*
Retaining amd repairing window and door openings, frames, sash, glass, doors, lintels, sills, pediments, architraves, hardware, awnings and shutters where they contribute to the architectural and historic character of the building.	Introducing or changing the location or size of windows, doors, and other openings that alter the architectural and historic character of the building.

BUILDING: EXTERIOR FEATURES--continued

Windows and Doors

*Recommended**	*Not Recommended*
	Replacing window and door features on significant facades with historically and architecturally incompatible materials such as anodized aluminum, mirrored or tinted glass.
	Removing window and door features that can be repaired where such features contribute to the historic and architectural character of the building.
	Changing the size or arrangement of window panes, muntins, and rails where they contribute to the architectural and historic character of the building.
Improving the thermal performance of existing windows and doors through adding or replacing weather-stripping and adding storm windows and doors which are compatible with the character of the building and which do not damage window or door frames.	Installing on significant facades shutters, screens, blinds, security grills, and awnings which are historically inappropriate and which detract from the character of the building.
	Installing new exterior storm windows and doors which are inappropriate in size or color, which are inoperable, or which require removal of original windows and doors.
	Installing interior storm windows that allow moisture to accumulate and damage the window.
Replacing missing or irreparable windows on significant facades with new windows that match the original in material, size, general muntin and mullion proportion and configuration, and reflective qualities of the glass.	Replacing sash which contribute to the character of a building with those that are incompatible in size, configuration, and reflective qualities or which alter the setback relationship between window and wall.

*For more information consult Preservation Briefs: 3: "Conserving Energy in Historic Buildings" (Washington, D.C. Heritage Conservation and Recreation Service, 1978). It is available from the Government Printing Office or State Historic Preservation Officers.

BUILDING: EXTERIOR FEATURES--continued

Windows and Doors

Recommended

Not Recommended

Installing heating/air conditioning units in the window frames when the sash and frames may be damaged. Window installations should be considered only when all other viable heating/cooling systems would result in significant damage to historic materials.

Storefronts

Recommended

Retaining and repairing existing storefronts including windows, sash, doors, transoms, signage, and decorative features where such features contribute to the architectural and historic character of the building.

Where original or early storefronts no longer exist or are too deteriorated to save, retaining the commercial character of the building through 1) contemporary design which is compatible with the scale, design, materials, color, and texture of the historic buildings; or 2) an accurate restoration of the storefront based on historical research and physical evidence.

Not Recommended

Introducing a storefront or new design element on the ground floor, such as an arcade, which alters the architectural and historic character of the building and its relationship with the street or its setting or which causes destruction of significant historic fabric.

Using materials which detract from the historic or architectural character of the building, such as mirrored glass.

Altering the entrance through a significant storefront.

Entrances, porches, and steps

Recommended

Retaining porches and steps that are appropriate to the building and its development. Porches or additions reflecting later architectural styles are often important to the building's historical integrity and, wherever possible, should be retained.

Not Recommended

Removing or altering porches and steps that are appropriate to the building's development and style.

BUILDING: EXTERIOR FEATURES--continued

Entrances, porches, and steps

Recommended

Repairing or replacing, where necessary, deteriorated architectural features of wood, iron, cast iron, terra cotta, tile, and brick.

Not Recommended

Stripping porches and steps or original material and architectural features, such as hand rails, balusters, columns, brackets, and roof decoration of wood, iron, cast iron, terra cotta, tile and brick.

Enclosing porches and steps in a manner that destroys their intended appearance.

Exterior Finishes

Recommended

Discovering the historic paint colors and finishes of the structure and repainting with those colors to illustrate the distinctive character of the property.

Not Recommended

Removing paint and finishes down to the bare surface; strong paint strippers whether chemical or mechanical can permantently damage the surface. Also, stripping obliterates evidence of the historical paint finishes.

Repainting with colors that cannot be documented through research and investigation to be appropriate to the building and neighborhood.

BUILDING: INTERIOR FEATURES

Recommended

Retaining original material, architectural features, and hardware, whenever possible, such as stairs, elevators, hand rails, balusters, ornamental columns, cornices, baseboards, doors, doorways, windows, mantel pieces, paneling, lighting fixtures, parquet or mosaic flooring.

Repairing or replacing, where necessary, deteriorated material with new material that duplicates the old as closely as possible.

Not Recommended

Removing original material, architectural features, and hardware, except where essential for safety or efficiency.

Replacing interior doors and transoms without investigating alternative fire protection measures or possible code variances.

Installing new decorative material and paneling which destroys significant architectural features or was unavailable when the building was constructed, such as vinyl plastic or imitation wood wall and floor coverings, except in utility areas such as bathrooms and kitchens.

BUILDING: INTERIOR FEATURES--continued

Recommended	*Not Recommended*
Retaining original plaster, whenever possible.	Removing plaster to expose brick to give the wall an appearance it never had.
Discovering and retaining original paint colors, wallpapers and other decorative motifs or, where necessary, replacing them with colors, wallpapers or decorative motifs based on the original.	Changing the texture and patina of exposed wooden architectural features (including structural members) and masonry surfaces through sandblasting or use of other abrasive techniques to remove paint, discoloration and plaster, except in certain industrial or warehouse buildings where the interior masonry or plaster surfaces do not have significant design, detailing, tooling, or finish; and where wooden architectural features are not finished, molded, beaded, or worked by hand.
Where required by code, enclosing an important interior stairway in such a way as to retain its character. In many cases glazed fire rated walls may be used.	Enclosing important stairways with ordinary fire rated construction which destroys the architectural character of the stair and the space.
Retaining the basic plan of a building, the relationship and size of rooms, corridors, and other spaces.	Altering the basic plan of a building by demolishing principal walls, partitions, and stairways.

NEW CONSTRUCTION

Recommended	*Not Recommended*
Keeping new additions and adjacent new construction to a minimum, making them compatible in scale, building materials, and texture.	
Designing new work to be compatible in materials, size, color, and texture with the earlier building and the neighborhood.	Designing new work which is incompatible with the earlier building and the neighborhood in materials, size, scale, and texture.

NEW CONSTRUCTION--continued

Recommended	*Not Recommended*
Using contemporary designs compatible with the character and mood of the building or the neighborhood.	Imitating an earlier style or period of architecture in new additions, except in rare cases where a contemporary design would detract from the architectural unity of an ensemble or group. Especially avoid imitating an earlier style of architecture in new additions that have a completely contemporary function such as a drive-in bank or garage.
	Adding new height to the building that changes the scale and character of the building. Additions in height should not be visible when viewing the principal facades.
	Adding new floors or removing existing floors that destroy important architectural details, features and spaces of the building.
Protecting architectural details and features that contribute to the character of the building.	
Placing television antennae and mechanical equipment, such as air conditioners, in an inconspicuous location.	Placing television antennae and mechanical equipment, such as air conditioners, where they can be seen from the street.

MECHANICAL SYSTEMS: HEATING, AIR CONDITIONING, ELECTRICAL, PLUMBING, FIRE PROTECTION

Recommended	*Not Recommended*
Installing necessary mechanical systems in areas and spaces that will require the least possible alteration to the structural integrity and physical appearance of the building.	Causing unnecessary damage to the plan, materials, and appearance of the building when installing mechanical systems.
Utilizing early mechanical systems, including plumbing and early lighting fixtures, where possible.	Attaching exterior electrical and telephone cables to the principal elevations of the building.

MECHANICAL SYSTEMS: HEATING, AIR CONDITIONING, ELECTRICAL, PLUMBING, FIRE PROTECTION--continued

Recommended	*Not Recommended*
Installing the vertical runs of ducts, pipes, and cables in closets, service rooms, and wall cavities.	Installing vertical runs of ducts, pipes, and cables in places where they will be a visual intrusion.
	Concealing or "making invisible" mechanical equipment in historic walls or ceilings. Frequently this concealment requires the removal of historic fabric.
	Installing "dropped" acoustical ceilings to hide mechanical equipment. This destroys the proportions and character of the rooms.
Insuring adequate ventilation of attics, crawlspaces, and cellars to prevent moisture problems.	
Installing thermal insulation in attics and in unheated cellars and crawlspaces to conserve energy.	Installing foam, glass fiber, or cellulose insulation into wall cavities of either wooden or masonry construction. This has been found to cause moisture problems when there is no adequate moisture barrier.

SAFETY AND CODE REQUIREMENTS

Recommended	*Not Recommended*
Complying with code requirements in such a manner that the essential character of a building is preserved intact.	
Working with local code officials to investigate alternative life safety measures that preserve the architectural integrity of the building.	
Investigating variances for historic properties allowed under some local codes.	

SAFETY AND CODE REQUIREMENTS--continued

Recommended	*Not Recommended*
Installing adequate fire prevention equipment in a manner that does minimal damage to the appearance or fabric of a property.	
Adding new stairways and elevators that do not alter existing exit facilities or other important architectural features and spaces of the building.	Adding new stairways and elevators that alter existing exit facilities or important architectural features and spaces of the building.

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1 PRESERVATION BRIEFS

The Cleaning and Waterproof Coating of Masonry Buildings

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

Why Clean?

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

- Is the cleaning being done to improve the appearance of the building or to make it look new? The so-called "dirt" actually may be weathered masonry, not accumulated deposits; a portion of the masonry itself thus will be removed if a "clean" appearance is desired.
- Is there any evidence that dirt and pollutants are having a harmful effect on the masonry? Improper cleaning can accelerate the deteriorating effect of pollutants.
- Is the cleaning an effort to "get your project started" and improve public relations? Cleaning may help local groups with short term fund raising, yet cause long term damage to the building.

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

What Is The Dirt?

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

If the proposed cleaning is to remove paint, it is important in each case to learn whether or not exposed brick is historically appropriate. Many buildings were painted at the time of construction or shortly thereafter; retention of the paint, therefore, may be more appropriate historically than exposing the brick, in spite of current attitudes about "natural" brick. Even in cases where unpainted masonry is appropriate, the retention of the paint may be more practical than removal in terms of long range preservation of the masonry. In some cases, however, removal of the paint may be desirable. For example, the old paint layers may have built up to such an extent that removal is necessary prior to repainting. It is essential, however, that research on the paint type, color, and layering be completed on the entire building before removal.

What Is The Construction Of The Building?

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

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

Other building materials also may be affected by the cleaning process; some chemicals, for example, may have a corrosive effect on paint or glass. The portions of building elements most vulnerable to deterioration may not be visible, such as embedded ends of iron window bars. Other totally unseen items, such as iron cramps or ties which hold the masonry to the structural frame, also may be subject to corrosion from the use of chemicals or even from plain water (Fig. 1). The only way to prevent problems in these cases is to study the building construction in detail and evaluate proposed cleaning methods with this information in mind.

Previous treatments of the building and its surroundings also should be evaluated, if known. Earlier waterproofing applications may make cleaning difficult. Repairs may have been stained to match the building, and cleaning may make

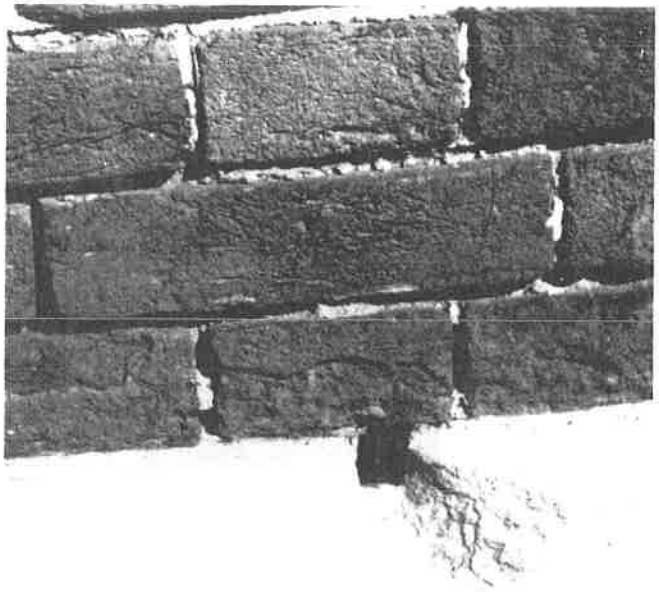

Figure 1. The iron anchor shown here originally was hidden from view. An increase in volume due to rusting created internal pressures on the stone and brick, causing spalling. Careful study of the building construction can result in the identification of these potential problem areas and they can be taken into consideration while planning a cleaning project.

these differences apparent. Salts or other snow removal chemicals used near the building may have dissolved and been absorbed into the masonry, causing potentially serious problems of spalling or efflorescence. Techniques for overcoming each of these problems should be considered prior to the selection of a cleaning method.

Types Of Cleaning

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

Planning A Cleaning Project

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

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

The proposed cleaning project also may cause property damage. Wind drift, for example, may carry cleaning

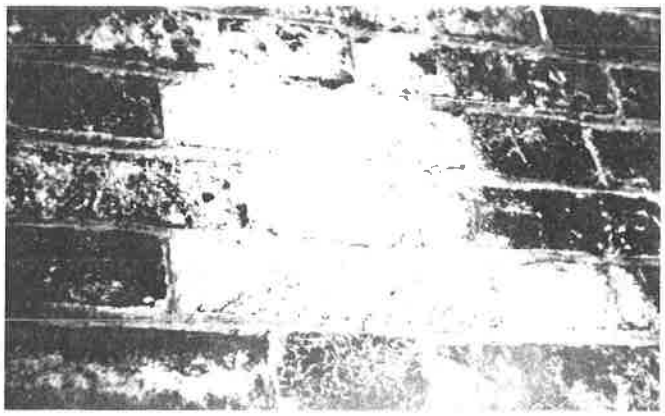

Figure 2. The white deposits are efflorescence, soluble salts deposited on the surface of the masonry. These salts usually originate in the masonry or mortar, migrate from the ground below through capillary action, or are brought in by air pollution. The salts also may be the result of chemical reactions resulting from selection of an improper cleaner.

chemicals onto nearby automobiles, causing etching of the glass or spotting of the paint finish. Similarly, airborne dust can enter surrounding buildings, and excess water can collect in nearby yards and basements.

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

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

The level of cleanliness desired also should be determined prior to selection of a cleaning method. Obviously, the intent of cleaning is to remove most of the dirt. A "brand new" appearance, however, may be inappropriate for an older building, and may require an overly harsh cleaning method. It may be wise, therefore, to determine a lower level of acceptable cleaning. The precise amount of residual dirt considered acceptable would depend upon the type of masonry and local conditions.

Cleaning tests, whether using simple or complex methods, should be applied to an area of sufficient size to give a true indication of effectiveness. The test patch should include at least a square yard, and, with large stones, should include several stones and mortar joints. It should be remembered that a single building may have several types of masonry materials and similar materials may have different surface finishes; each of these differing areas should be tested separately. *The results of the tests may well indicate that several methods of cleaning should be used on a single building.*

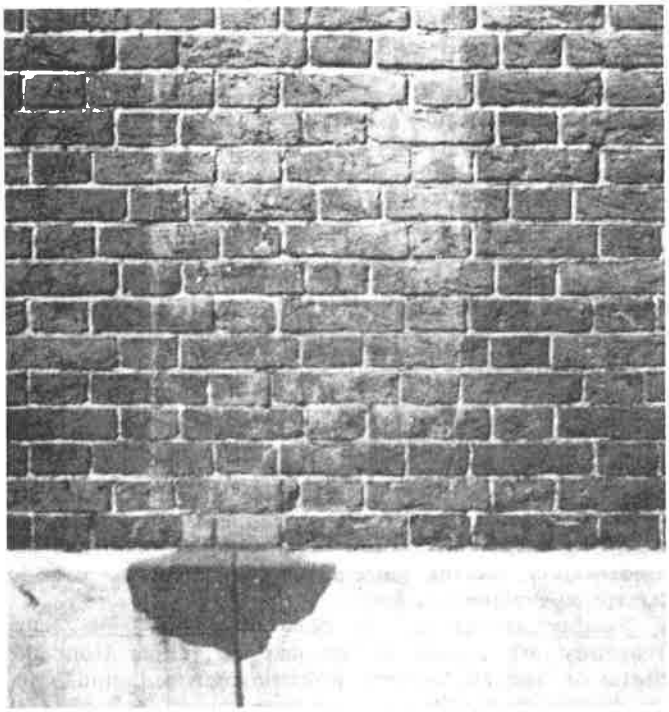

Figure 3. The hazy appearance of a portion of the brick is caused by a residue resulting from cleaning. This film occurred in spite of thorough rinsing. Test patches such as this should always be allowed to weather prior to continuing with the cleaning.

The cleaning budget should include money to pay for these tests. Usually contractors are more willing to conduct a variety of tests if they are reimbursed for their time and materials, particularly if the tests include methods with which the contractor is not familiar.

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

Potential Problems Of Cleaning

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

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

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

Another source of surface disfigurement is chemicals such as iron and copper in the water supply; even "soft" water may contain deleterious amounts of these chemicals. Water methods cannot be used during periods of cold weather because water within the masonry can freeze, causing spalling and cracking. Since a wall may take over a week to dry after cleaning, no water cleaning should be permitted for several days prior to the first average frost date, or even earlier if local forecasts predict cold weather.

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

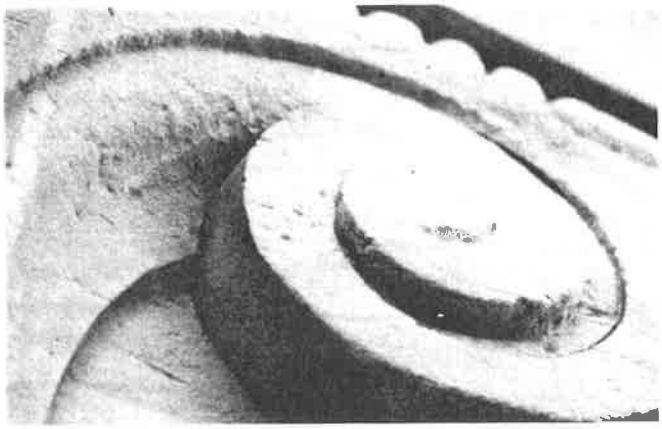

Figure 4. Sandblasting has rounded the corners of this marble capital and pitted the formerly smooth surface. Not only is the stone harmed visually, the increased roughness of the surface also will collect new dirt more quickly than smooth stone.

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

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

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

Grit blasting, unfortunately, still is widely used in spite of these serious effects. In most cases, blasting will leave

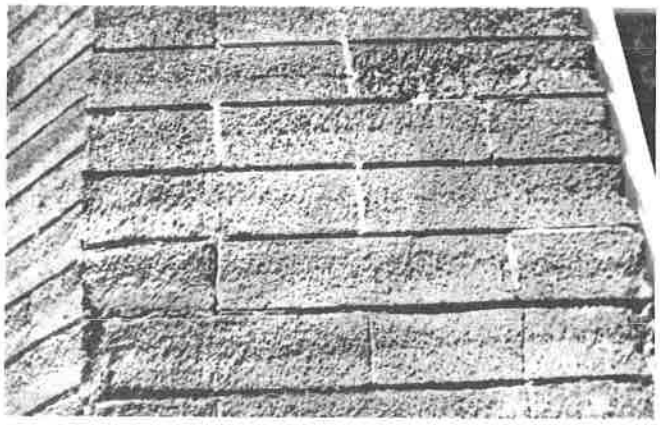

Figure 5. This brickwork was sandblasted to remove paint. Note the severe erosion which has occurred, especially in the softer center sections of this "hard burned" late 19th-century brick. Although this is a severe example, the same problem of increased roughness and porosity will occur even on more skillfully performed jobs where the effect is less evident visually.

minute pits on the surface of the masonry. This additional roughness actually increases the surface area on which new dirt can settle and on which pollutants can react.

Mortar joints, especially those with lime mortar, also can be eroded by mechanical cleaning. In some cases, the damage may be visual, such as loss of joint detail or increased joint shadows. Joints constitute a significant portion of the masonry surface (up to 20% in a brick wall) so this change should not be considered insignificant. In other cases, however, the erosion of the mortar joint may permit increased water penetration, leading to the necessity for complete repointing.

Other problems of mechanical methods have been mentioned in the discussion of project planning. In addition, wet blasting or water rinses can create the potential hazards of water methods.

Problems Of Water Repellent And Waterproof Coatings

Is waterproofing necessary? Coatings frequently are applied to historic buildings without concern for the requirement or the consequences of the coating. Most historic buildings have survived for years without coatings, so why are they needed now? Water penetration to the interior usually is not caused by porous masonry but by deteriorated gutters and downspouts, deteriorated mortar, capillary moisture from the ground (rising damp), or condensation. Coatings will not solve these problems. In the case of rising damp, in fact, the coatings will allow the water to go even higher because of the retarded rate of evaporation. The claim also is made that coatings keep dirt and pollutants from collecting on the surface of the building thus reducing the requirement for future cleaning. While this at times may be true, at other times the coatings actually retain the dirt more than uncoated masonry. More important, however, is the fact that these coatings can cause greater deterioration of the masonry than that caused by pollution, so the treatment may be worse than the problem one is attempting to solve.

Types of coatings: Masonry coatings are of two types: water*proof* coatings and water *repellent* coatings. Waterproof coatings seal the surface from liquid water and from water vapor; they usually are opaque, such as bituminous coatings and some paints. Water repellents keep liquid water from penetrating the surface but allow water vapor to enter and leave through the "pores" of the masonry. They usually are transparent, such as the silicone coatings, although they may change the reflective property of the masonry, thus changing the appearance.

Waterproof coatings: These coatings usually do not cause problems as long as they exclude *all* water from the masonry. If water does enter the wall, however, the coating can intensify the damage because the water will not be able to escape. During cold weather this water in the wall can freeze, causing serious mechanical disruption, such as spalling. In addition, the water eventually will get out by the path of least resistence. If this path is toward the interior, damage to interior finishes can result; if it is toward exterior cracks in the coating, it can lead to damage from the build-up of salts as described below.

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

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

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

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

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

This publication has been prepared in response to Executive Order 11593, "Protection and Enhancement of the Cultural Environment," which directs the Secretary of the Interior to ". . . develop and make available to Federal agencies and State and local governments information concerning professional methods and techniques for preserving, improving, restoring and maintaining historic properties." It has been written by Robert C. Mack, AIA, Architect, Interagency Historic Architectural Services Program, Office of Archeology and Historic Preservation, National Park Service, U.S. Department of the Interior, Washington, D.C. 20240. November 1975.

2 PRESERVATION BRIEFS

Repointing Mortar Joints in Historic Brick Buildings

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Repointing, also known as "tuck pointing" or simply "pointing," is the process of removing deteriorated mortar from the joints of a masonry wall and replacing it with new mortar. The selection of improper techniques or materials in the repointing of historic buildings not only can alter the visual aspects of a building but also can lead to further deterioration of the masonry. The purpose of this leaflet is to provide general guidance on the methods and materials for the repointing of historic brick buildings, for the benefit of building owners, architects and craftsmen.

Identifying The Problems

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

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

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

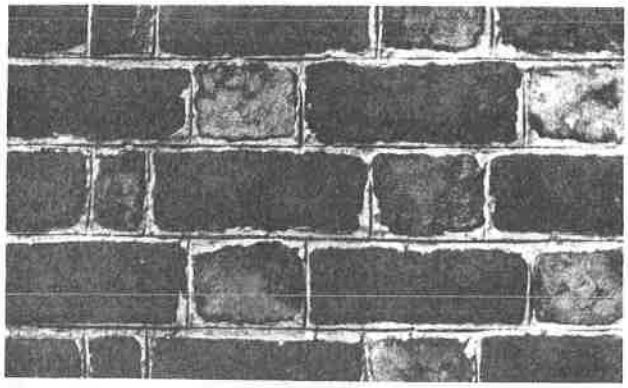
The architect/consultant also must recognize logistical considerations and the relationship of the repointing to other proposed work. For example, if paint is to be removed or gutters replaced, it may be logistically advisable to conduct research relating to these items before beginning to repoint. If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

Research

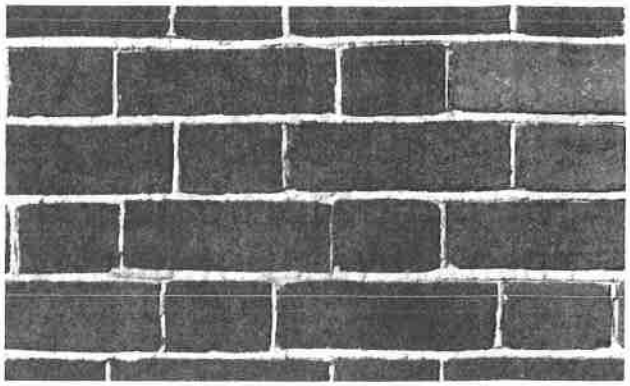
The repointing work will possibly involve analysis not only of the mortar but also of the bricks and the techniques originally used in striking the joints.

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

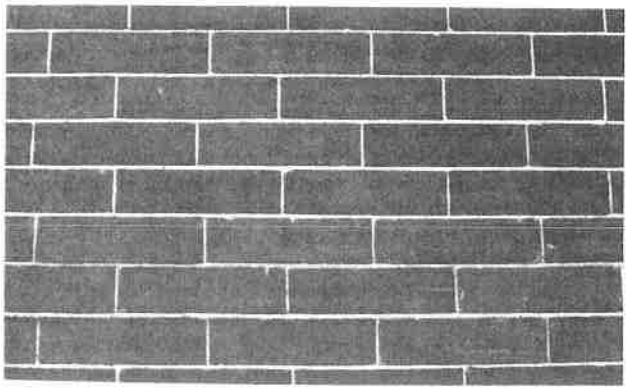
Pointing styles and the methods of producing them should be studied. (Fig. 1) It is important to examine both the horizontal and the vertical joints to determine which were struck first and whether they are the same style. Some buildings, for example, have horizontal joints which were tooled concave while the vertical joints were finished flush with the surface of the brick, then stained to match the



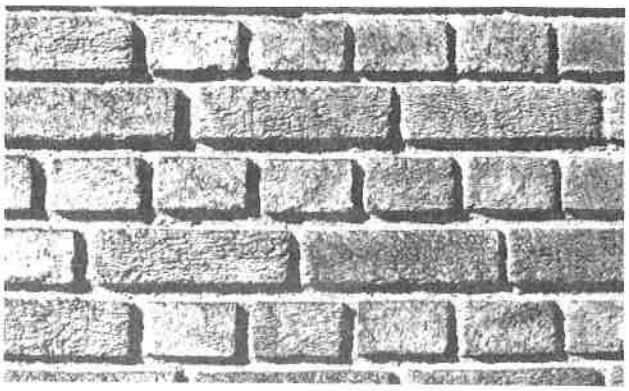
A. Colonial grapevine joint, Flemish bond.
ca. 1720.



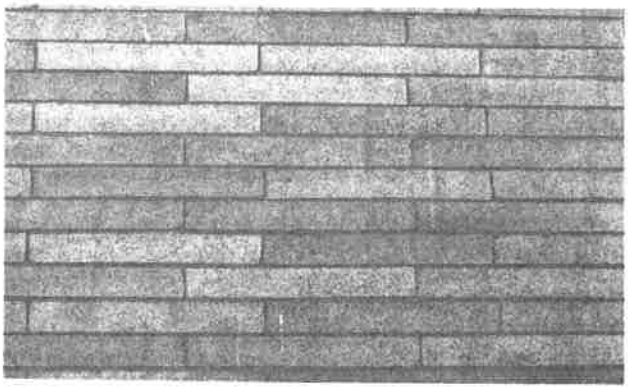
B. Beaded joint, Flemish bond.
ca. 1809.



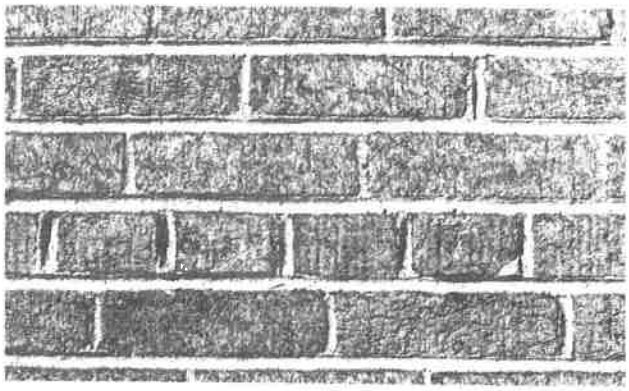
C. Flush joint, common bond.
mid-19th century.



D. Raked joint, English bond.
early 20th century.



E. Flush joint, one-third running bond.
early 20th century.



F. Concave joint, common bond.
early 20th century.

Figure 1. A variety of joint types and brick bonding patterns are illustrated here. Note the difference in uniformity of the bricks in A and B, which are handmade, and those from C through F, which are machinemade. It is evident in A, B, and F that the vertical joints were struck before the horizontal joints. Also note in B and E that the vertical joints are narrower than the horizontals.

brick, creating the illusion of horizontal bands. This technique was used extensively in late 19th and early 20th century architecture.

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

Planning The Work

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

It is a common error to assume that hardness or high strength is a measure of durability. Stresses within a wall caused by expansion and contraction or by settlement must be accommodated in some manner; in a masonry wall these stresses should be relieved by the mortar rather than the brick. A mortar which is stronger and harder than the masonry units will not "give," thus causing the stresses to be relieved by the masonry units, usually in the form of cracking and spalling. (Fig. 2) Uneven movement in the masonry also can break the bond between the mortar and the brick, opening hairline cracks to water penetration. Mortars with a high percentage of portland cement can have the above described deleterious effects. Additional information on this problem is contained in *Studies of Stone-Setting Mortars; Building Materials and Structures Report 139*, published by the National Bureau of Standards in 1953. Porous mortar permits water within the wall to migrate and escape. Mortar with a high cement content does not permit this movement, and the water trapped within the wall may be subjected to freeze-thaw cycles which can spall soft, older brick.

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

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

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

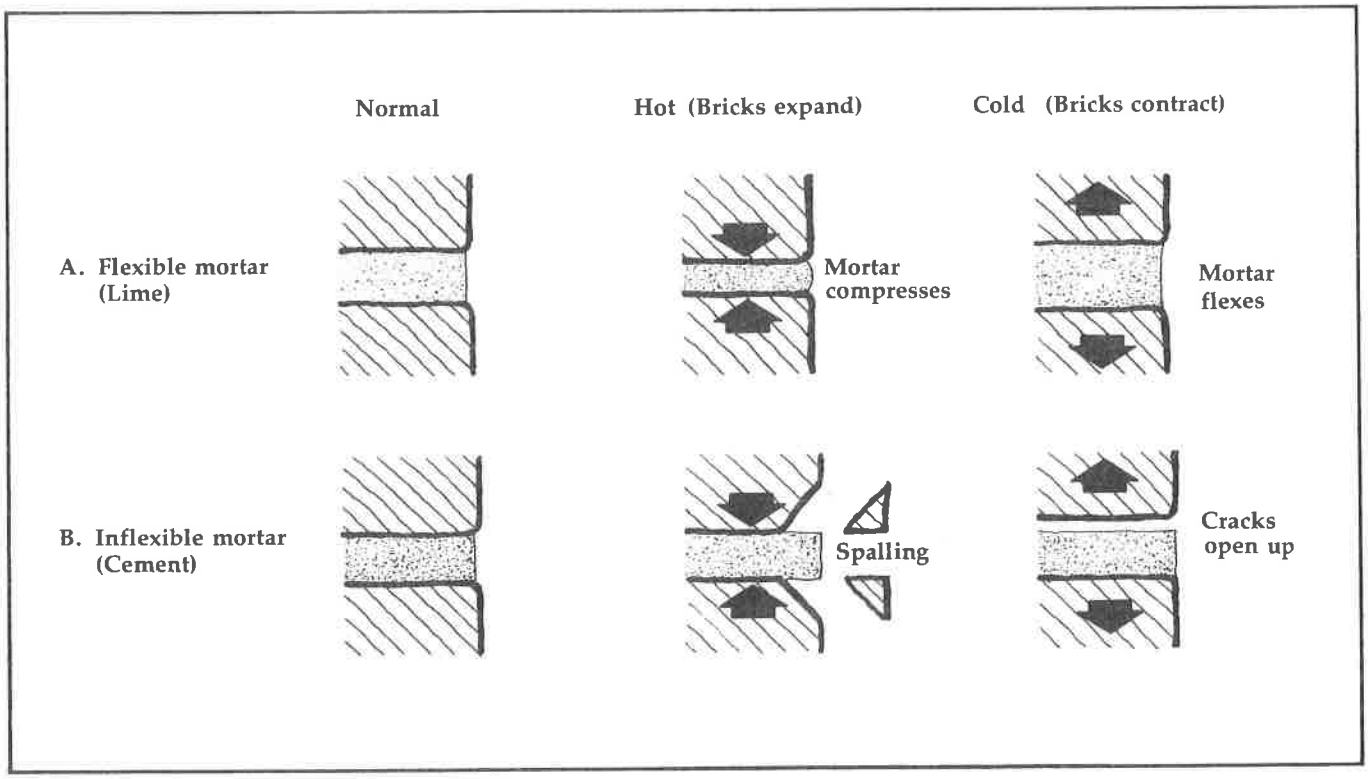


Figure 2. Diagrammatic sketches showing effects of temperature change upon masonry. Flexible mortar (A) expands and contracts with temperature changes. Bricks bonded by inflexible mortar (B) tend to spall at the edges (the area of greatest stress) in hot weather and separate from the mortar when it is cold. This latter condition opens cracks, permitting the entry of water and causing additional deterioration. Adapted from Maintenance of Old Buildings, *Document D10; National Swedish Institute for Building Research, Stockholm, 1975.*

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

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

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

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

Materials Specifications

Modern materials specified for use in repointing mortar should conform to specifications of the American Society for Testing and Materials (ASTM) or comparable Federal specifications.

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

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

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

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

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

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

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

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

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

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

Execution Of The Work

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

Joint preparation: Generally old mortar should be cut out to a minimum depth of one inch to insure an adequate bond between the new mortar and the existing masonry and to prevent mortar "popouts." For joints less than three-eighths of an inch thick, cutting the mortar back one-half inch usually is sufficient if the mortar behind that point is in good condition. Any loose or disintegrated mortar beyond this minimum depth should be removed (Fig. 3). Unless the mason is unusually skilled and extremely careful, the use of power tools for mortar removal inevitably will damage the brick. (Fig. 4) Damage to the edges of the brick will significantly affect the character of the brickwork; in addition, absorption of water is increased since the softer inside of the

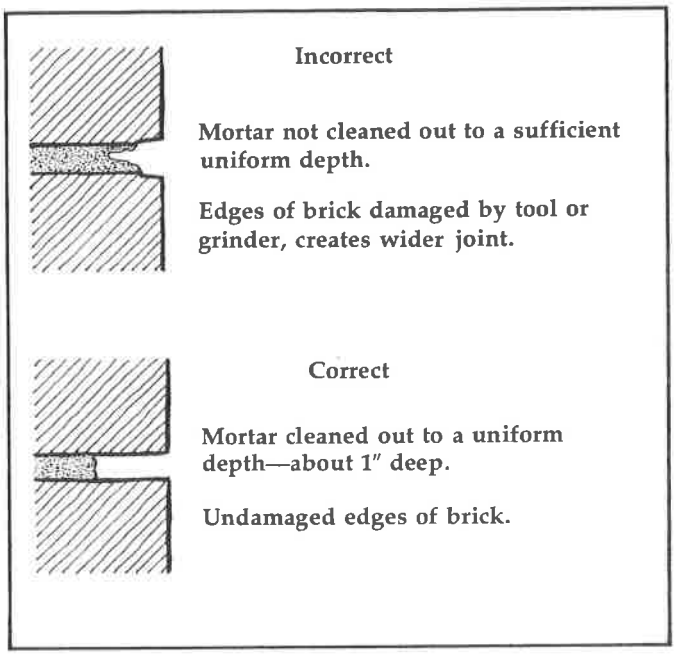


Figure 3. Comparison of incorrect and correct preparation of mortar joints for repointing.

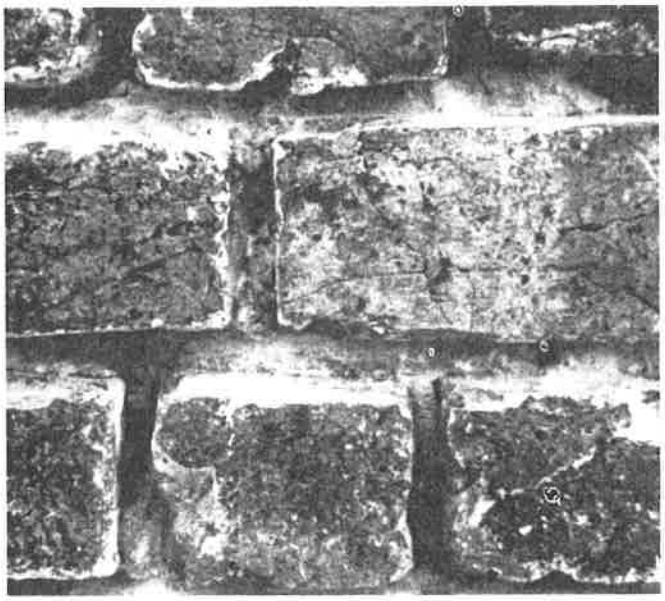


Figure 4. The damage to the edges and corners of these bricks was caused by using a power grinder in cleaning the joints. Extensive hand work is required to prevent damage to the bricks during joint preparation.

brick is no longer protected by the hard burned outer surface. Where joints are uniform and fairly wide, and the bricks were machinemade with straight edges, it may be possible to use a grinder. A test patch will establish the feasibility of using a grinder. *If there is any chance of damage to the masonry occurring, however, hand methods should be used exclusively.* Although hand work is slower, it is easier to control and is less likely to cause irreversible damage.

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

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

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

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

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

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

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

The rate of stiffening can be controlled by dampening the brick and old mortar before beginning to fill the joint. Free water or excessive dampness in the joint must be avoided; too much water will delay the tooling or cause excess shrinkage. If the joint is too dry, water will be absorbed from the mortar before it is properly set, thus reducing bond strength and increasing the probability of leaks.

When the final layer of mortar is thumb print hard, the joint is tooled in a manner to match the appearance of the old mortar. Tooling the finished joint at the right stage of firmness is important for uniform color. If finished while too

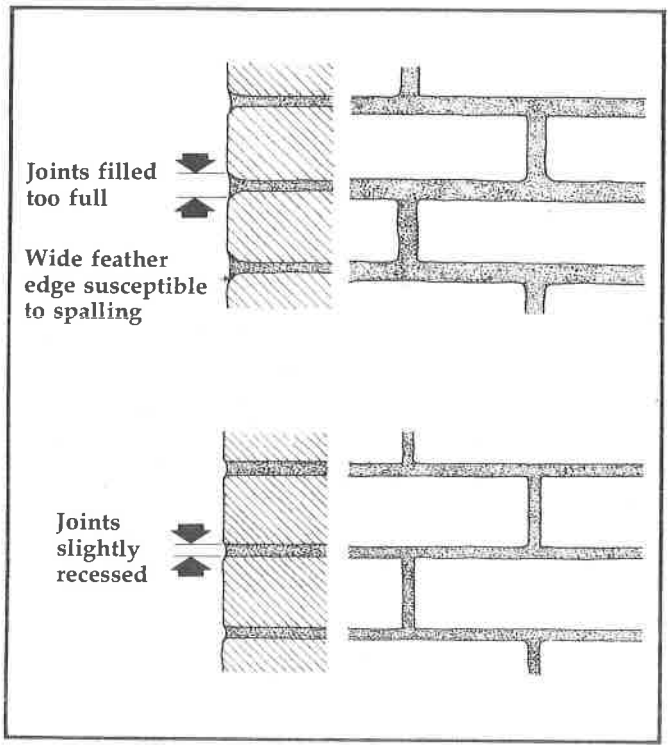


Figure 5. Comparison of visual effect of full mortar joints vs. slightly recessed joints. Filling joints too full hides the actual joint thickness and changes the character of the original brickwork.

soft, the color will be lighter than expected and hairline shrinkage cracks are likely to occur. If tooled when too hard, there may be dark streaks called tool burning, and good closure of the mortar against the brick will not be achieved.

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

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

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

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

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

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

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

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

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

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

Further information on cleaning is contained in Preservation Briefs: No. 1, "The Cleaning and Waterproof Coating of Masonry Buildings," available from the Technical Preservation Services Division, Office of Archeology and Historic Preservation, National Park Service, Washington, D.C. 20240.

Summary

For the owner: It is important for the owner or administrator of an historic building to be aware that repointing is likely to be a slow and expensive project. Schedules for both the repointing work and other activities will require careful coordination in order to avoid unanticipated conflicts. The work cannot be rushed or overly economized if the building is to retain the proper visual characteristics and if the job is to be durable and watertight.

Figure 6. This photograph shows the significant visual changes which can result from improper repointing procedures. Note the increased thickness of the joints, the color variation, and the difference in the method of tooling, all noticeable even from a distance.

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

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

While careful preservation, restoration and maintenance can hold back deterioration, it is important to understand that repointing work probably will not last the life of the structure. Nevertheless, if the first mortar joint has proved durable for many years, careful repointing should also have a long life. Additional repointing jobs can be undertaken as needed without altering structural soundness and original appearance.

Information for this brief was based in part upon:

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Brick Institute of America. "Cleaning Clay Products Masonry," *Technical Notes on Brick Construction*, Number 20 (revised), 1964.

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Cliver, E. Blaine. "Tests for the Analysis of Mortar Samples," *Bulletin* of the Association for Preservation Technology, Volume VI, Number 1, 1974, pp. 68–73.

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

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

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

Planning for Repointing of an Historic Brick Building

	Early Planning and Research	Preparing for the Work	Execution of the Work
Owner	Notes problems: Leaks, loose mortar, visible cracks, etc. Contacts consultant / architect Considers problems: High expense due to hand methods and time for work; traffic and circulation problems; scaffolding in place for extended periods Considers alternative approaches explained by consultant / architect	Selects timing for execution of work Plans availability and programming of contract funds	Awards and administers contract, or hires craftsmen (if by day labor)
Architect	Identifies true cause of problem Identifies additional consultants required Presents technical aspects of problem to the owner along with possible alternatives and probable costs Recognizes logistical considerations: Research; test panels; brick manufacture Conducts research: Mortar analysis (material types and proportions, sand color); craft techniques (bond patterns, joint types); special materials Identifies potential problems from use of improper materials and techniques Advises whether work should be done by contract, day labor or with owner's maintenance personnel	Prepares specifications Scope of work Selection of materials: ASTM or Federal Specs when available but special specs for some materials Joint preparation: Permitted and excluded tools; method of tool use; method of joint preparation Mortar application: Method of mortar application; replacement of loose brick or stone; joint tooling; "aging" Cleaning repointed surface Evaluates past preservation work of potential contractors or craftsmen	Insures understanding of contract objectives and unusual conditions by contractor and/or craftsmen Provides close supervision, especially during earliest phases of work Prepares change orders as needed Keeps close watch for hidden historical evidence as well as unrecognized deterioration
Craftsman		Possible early involvement: Assists in preparing tests samples or panels to help consultant in final selection of methods and materials Assists in locating special materials Recognizes potential logistical problems, large amounts of hand work, etc., in preparation of bid	Coordinates repointing with other related work Executes work in accordance with plans and specifications Understands that stop orders may be issued to facilitate detailed investigation or recording of previously concealed conditions or architectural features

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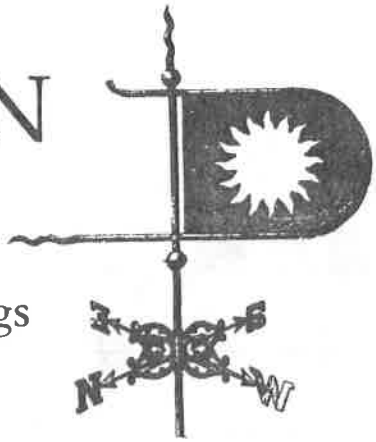
3 PRESERVATION BRIEFS



Conserving Energy in Historic Buildings

Baird M. Smith, AIA

Technical Preservation Services Division

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

With the dwindling supply of energy resources and new efficiency demands placed on the existing building stock, many owners of historic buildings and their architects are assessing the ability of these buildings to conserve energy with an eye to improving thermal performance. This brief has been developed to assist those persons attempting energy conservation measures and weatherization improvements such as adding insulation and storm windows or caulking of exterior building joints. In historic buildings, many measures can result in the inappropriate alteration of important architectural features, or, perhaps even worse, cause serious damage to the historic building materials through unwanted chemical reactions or moisture-caused deterioration. This brief recommends measures that will achieve the greatest energy savings with the least alteration to the historic buildings, while using materials that do not cause damage and that represent sound economic investments.

Inherent Energy Saving Characteristics of Historic Buildings

Many historic buildings have energy-saving physical features and devices that contribute to good thermal performance. Studies by the Energy Research and Development Administration (see bibliography) show that the buildings with the poorest energy efficiency are actually those built between 1940 and 1975. Older buildings were found to use less energy for heating and cooling and hence probably require fewer weatherization improvements. They use less energy because they were built with a well-developed sense of physical comfort and because they maximized the natural sources of heating, lighting and ventilation. The historic building owner should understand these inherent energy-saving qualities.

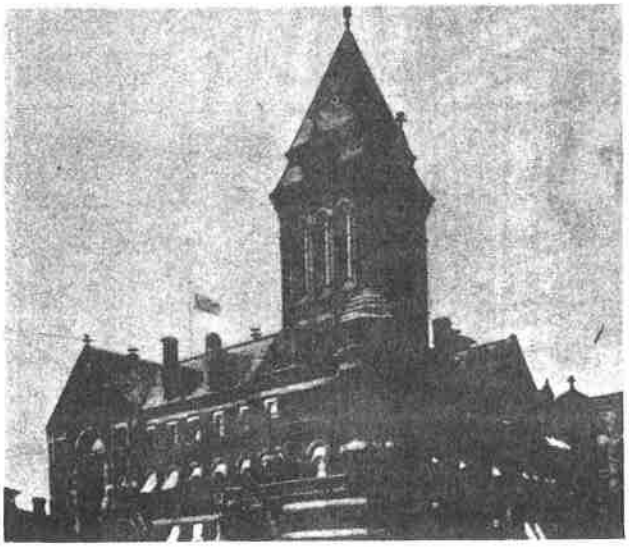


Figure 1. This 1891 Courthouse and Post Office in Rochester, New York, has built-in energy conserving features such as, heavy masonry walls, operable windows, an interior skylighted atrium which provides light and ventilation, and roof-top ventilators which keep the building cooler in the summer. Also note the presence of awnings in this old photograph.

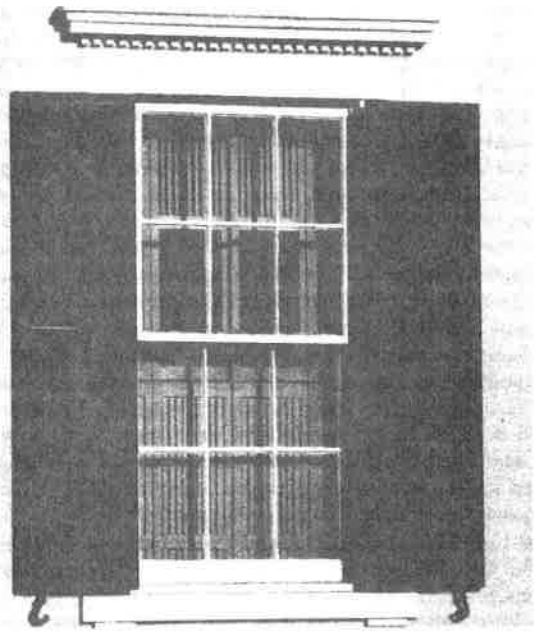


Figure 2. Shutters can be used to minimize the problem of summer heat gain by shading the windows. If operable shutters are in place, their use will help reduce the summer cooling load. (Photo: Baird Smith)

The most obvious (and almost universal) inherent energy saving characteristic was the use of *operable windows* to provide natural ventilation and light. In addition, historic commercial and public buildings often include interior light/ventilation courts, roof-top ventilators, clerestories or skylights (see figure 1). These features provide energy efficient fresh air and light, assuring that energy consuming mechanical devices may be needed only to supplement the natural energy sources. Any time the mechanical heating and air conditioning equipment can be turned off and the windows opened, energy will be saved.

Figure 3. Southern mansions typify climate conscious design. The wide roof overhangs, exterior porches, shade trees, heavy masonry walls (painted white), and living quarters on the second floor (to catch evening breezes and escape the radiant heat from the earth's surface) all are energy saving characteristics which provide reasonably comfortable living spaces without mechanical air conditioning. (Photo: Marcia Axtmann Smith)

Early builders and architects dealt with the poor thermal properties of windows in two ways. First, the number of windows in a building was kept to only those necessary to provide adequate light and ventilation. This differs from the approach in many modern buildings where the percentage of windows in a wall can be nearly 100%. Historic buildings, where the ratio of glass to wall is often less than 20%, are better energy conservers than most new buildings. Secondly, to minimize the heat gain or loss from windows, historic buildings often include interior or exterior shutters, interior venetian blinds, curtains and drapes, or exterior awnings (see figure 2). Thus, a historic window could remain an energy efficient component of a building.

There are other physical characteristics that enable historic buildings to be energy efficient. For instance, in the warmer climates of the United States, buildings were often built to minimize the heat gain from the summer sun. This was accomplished by introducing exterior balconies, porches, wide roof overhangs, awnings and shade trees. In addition, many of these buildings were designed with the living spaces on the second floor to catch breezes and to escape the radiant heat from the earth's surface. Also, exterior walls were often painted light colors to reflect the hot summer sun, resulting in cooler interior living spaces (see figure 3).

Winter heat loss from buildings in the northern climates was reduced by using heavy masonry walls, minimizing the number and size of windows, and often using dark paint colors for the exterior walls. The heavy masonry walls used so typically in the late 19th century and early 20th century, exhibit characteristics that improve their thermal performance beyond that formerly recognized (see figure 4). It has been determined that walls of large mass and weight (thick brick or stone) have the advantage of *high thermal inertia*, also known as the "M factor." This inertia modifies the thermal resistance (R factor)* of the wall by lengthening the time scale of heat transmission. For instance, a wall with high thermal inertia, subjected to solar radiation for an hour, will absorb the heat at its outside surface, but transfer it to the interior over a period as long as 6 hours. Conversely, a wall having the same R factor, but low thermal inertia, will transfer the heat in perhaps 2 hours. High thermal inertia is the reason many older public and commercial buildings, without modern air conditioning, still feel cool on the inside throughout the summer. The heat from the midday sun does not penetrate the buildings until late afternoon and evening, when it is unoccupied.

*R factor is the measure of the ability of insulation to decrease heat flow. The higher the factor, the better the thermal performance of the material.

Although these characteristics may not typify all historic buildings, the point is that historic buildings often have thermal properties that need little improvement. One must understand the inherent energy-saving qualities of a building, and assure, by re-opening the windows for instance, that the building functions as it was intended.

To reduce heating and cooling expenditures there are two broad courses of action that may be taken. First, begin **passive measures** to assure that a building and its existing components function as efficiently as possible without the necessity of making alterations or adding new materials. The second course of action is **preservation retrofitting**, which includes altering the building by making appropriate weatherization measures to improve thermal performance. Undertaking the passive measures and the preservation retrofitting recommended here could result in a 50% decrease in energy expenditures in historic buildings.

Passive Measures

The first passive measures to utilize are **operational controls**; that is, controlling *how* and *when* a building is used. These controls incorporate programmatic planning and scheduling efforts by the owner to minimize usage of energy-consuming equipment. A building owner should survey and quantify all aspects of energy usage, by evaluating the monies expended for electricity, gas, and fuel oil for a year, and by surveying how and when each room is used. This will identify ways of conserving energy by initiating operational controls such as:

- lowering the thermostat in the winter, raising it in the summer
- controlling the temperature in those rooms actually used
- reducing the level of illumination and number of lights (maximize natural light)
- using operable windows, shutters, awnings and vents as originally intended to control interior environment (maximize fresh air)
- having mechanical equipment serviced regularly to ensure maximum efficiency
- cleaning radiators and forced air registers to ensure proper operation

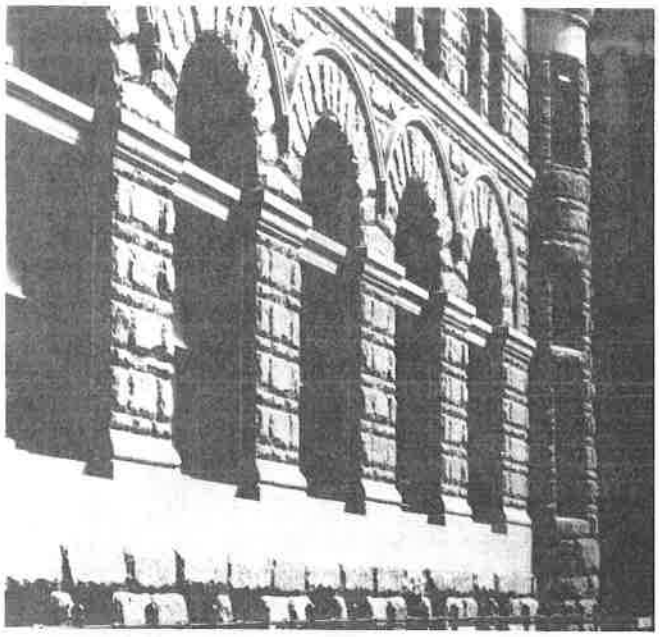
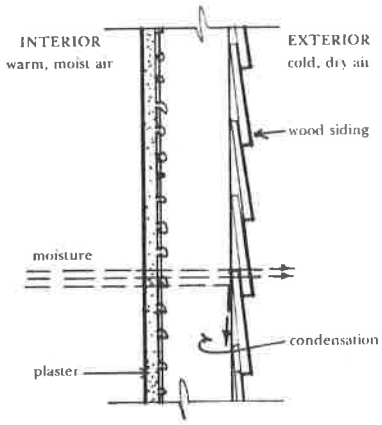


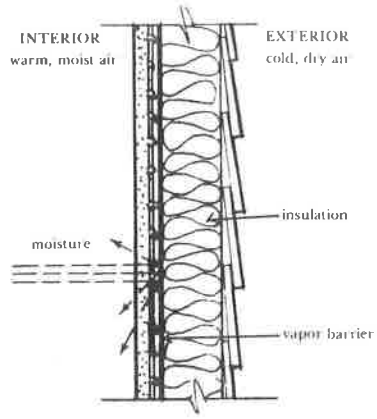
Figure 4. Heavy masonry walls in office buildings dramatically reduce the need for summer cooling because the thermal inertia (M factor) of the massive wall increases its thermal resistance (R factor), thus delaying the heat transfer into the building until late afternoon when the office workers have gone home. (Photo: Baird Smith)

Figure 5. Moisture migration through walls and roofing occurs as a matter of course in northern winter climates. Problems occur if there is no vapor barrier because the moisture may saturate the insulation and greatly reduce its thermal performance, as well as creating the potential for deterioration of the adjacent materials.

a. Typical wood frame wall where moist inside air freely migrates to the outside. Moisture may condense in the wall cavity and be absorbed into the adjacent materials and evaporate as the wall is heated by the sun.



b. Typical wall condition with insulation and a vapor barrier facing in (toward the heated side of the wall). The vapor barrier prevents moisture migration, thus keeping the insulation dry.



The passive measures outlined above can save as much as 30% of the energy used in a building. They should be the first undertakings to save energy in any existing building and are particularly appropriate for historic buildings because they do not necessitate building alterations or the introduction of new materials that may cause damage. Passive measures make energy sense, common sense, and preservation sense!

Preservation Retrofitting

In addition to passive measures, building owners may undertake certain retrofitting measures that will not jeopardize the historic character of the building and can be accomplished at a reasonable cost. Preservation retrofitting improves the thermal performance of the building, resulting in another 20%–30% reduction in energy.

When considering retrofitting measures, historic building owners should keep in mind that there are no permanent solutions. One can only meet the standards being applied today with today's materials and techniques. In the future, it is likely that the standards and the technologies will change and a whole new retrofitting plan may be necessary. Thus, owners of historic buildings should limit retrofitting measures to those that achieve reasonable energy savings, at reasonable costs, with the least intrusion or impact on the character of the building. Overzealous retrofitting, which introduces the risk of damage to historic building materials, should not be undertaken.

The preservation retrofitting measures presented here, were developed to address the three most common problems in historic structures caused by some retrofitting actions. The first problem concerns retrofitting actions that necessitated inappropriate building alterations, such as the wholesale removal of historic windows, or the addition of insulating

The Secretary of the Interior's Standards for Historic Preservation Projects

The Standards for Historic Preservation were developed for the Historic Preservation Fund Grants-in-Aid Program and authorized by the National Historic Preservation Act of 1966. The standards are also used for determining whether a rehabilitation project qualifies as a "certified rehabilitation" pursuant to Section 2124 of the Tax Reform Act of 1976. There are eight "General Standards" (listed below), and additional specific standards and guidelines for the various categories of historic preservation projects. Building owners and architects may obtain a copy of the entire document by writing the Technical Preservation Services Division, Heritage Conservation and Recreation Service, Washington, DC 20240.

General Standards

(Those shown in bold print are most applicable to preservation retrofitting.)

1. **Every reasonable effort shall be made to provide a compatible use for a property that requires minimal alteration of the building structure, or site and its environment, or to use a property for its originally intended purpose.**
2. **The distinguishing original qualities or character of a building, structure, or site and its environment shall not be destroyed. The removal or alteration of any historic material or distinctive architectural features should be avoided when possible.**
3. **All buildings, structures, and sites shall be recognized as products of their own time. Alterations, which have no historical basis and which seek to create an earlier appearance, shall be discouraged.**
4. Changes, which may have taken place in the course of time, are evidence of the history and development of a building, structure, or site and its environment. These changes may have acquired significance in their own right, and this significance shall be recognized and respected.
5. **Distinctive stylistic features or examples of skilled craftsmanship, which characterize a building, structure, or site, shall be treated with sensitivity.**
6. **Deteriorated architectural features shall be repaired rather than replaced, wherever possible. In the event replacement is necessary, the new material should match the material being replaced in composition, design, color, texture, and other visual qualities. Repair or replacement of missing architectural features should be based on accurate duplications of features, substantiated by historical, physical, or pictorial evidence rather than on conjectural designs or the availability of different architectural elements from other buildings or structures.**
7. The surface cleaning of structures shall be undertaken with the gentlest means possible. Sandblasting and other cleaning methods that will damage the historic building materials shall not be undertaken.
8. Every reasonable effort shall be made to protect and preserve archeological resources affected by, or adjacent to any acquisition, protection, stabilization, preservation, rehabilitation, restoration, or reconstruction project.

aluminum siding, or installing dropped ceilings in significant interior spaces. To avoid such alterations, refer to the Secretary of the Interior's "Standards for Historic Preservation Projects" which provide the philosophical and practical basis for all preservation retrofitting measures.

The second problem area is to assure that retrofitting measures do not create moisture-related deterioration problems. One must recognize that large quantities of moisture are present on the interior of buildings.

In northern climates, the moisture may be a problem during the winter when it condenses on cold surfaces such as windows. As the moisture passes through the walls and roof it may condense within these materials, creating the potential for deterioration. The problem is avoided if a vapor barrier is added *facing in* (see figure 5).

In southern climates, insulation and vapor barriers are handled quite differently because moisture problems occur in the summer when the moist outside air is migrating to the interior of the building. In these cases, the insulation is installed with the vapor barrier *facing out* (opposite the treatment of northern climates). Expert advice should be sought to avoid moisture-related problems to insulation and building materials in southern climates.

The third problem area involves the avoidance of those materials that are chemically or physically incompatible with existing materials, or that are improperly installed. A serious problem exists with certain cellulose insulations that use ammonium or aluminum sulfate as a fire retardant, rather than boric acid which causes no problems. The sulfates react with moisture in the air forming sulfuric acid which can cause damage to most metals (including plumbing and wiring), building stones, brick and wood. In one instance, a metal building insulated with cellulose of this type collapsed when the sulfuric acid weakened the structural connections! To avoid problems such as these, refer to the recommendations provided here, and consult with local officials, such as a building inspector, the better business bureau, or a consumer protection agency.

Before a building owner or architect can plan retrofitting measures, some of the existing physical conditions of the building should be investigated. The basic building components (attic, roof, walls and basement) should be checked to determine the methods of construction used and the presence of insulation. Check the insulation for full coverage and whether there is a vapor barrier. This inspection will aid in determining the need for additional insulation, what type of insulation to use (batt, blown-in, or poured), and where to install it. In addition, sources of air infiltration should be checked at doors, windows, or where floor and ceiling systems meet the walls. Lastly, it is important to check the condition of the exterior wall materials, such as painted wooden siding or brick, and the condition of the roof, to determine the weather tightness of the building. A building owner must assure that rain and snow are kept out of the building before expending money for weatherization improvements.

Retrofitting Measures

The following listing includes the most common retrofitting measures; some measures are highly recommended for a preservation retrofitting plan, but, as will be explained, others are less beneficial or even harmful to the historic building:

- Air Infiltration
- Attic Insulation
- Storm Windows
- Basement and Crawl Space Insulation
- Duct and Pipe Insulation
- Awnings and Shading Devices
- Doors and Storm Doors
- Vestibules
- Replacement Windows
- Wall Insulation—Wood Frame
- Wall Insulation—Masonry Cavity Walls
- Wall Insulation—Installed on the Inside
- Wall Insulation—Installed on the Outside
- Waterproof Coatings for Masonry

The recommended measures to preservation retrofitting begin with those at the top of the list. The first ones are the simplest, least expensive, and offer the highest potential for saving energy. The remaining measures are not recommended for general use either because of potential technical and preservation problems, or because of the costs outweighing the anticipated energy savings. Specific solutions must be determined based on the facts and circumstances of the particular problem; therefore, advice from professionals experienced in historic preservation, such as, architects, engineers and mechanical contractors should be solicited.

Air Infiltration: Substantial heat loss occurs because cold outside air infiltrates the building through loose windows, doors, and cracks in the outside shell of the building. Adding weatherstripping to doors and windows, and caulking of open cracks and joints will substantially reduce this infiltration. Care should be taken not to reduce infiltration to the point where the building is completely sealed and moisture migration is prevented. Without some infiltration, condensation problems could occur throughout the building. Avoid caulking and weatherstripping materials that, when applied, introduce inappropriate colors or otherwise visually impair the architectural character of the building. Reducing air infiltration should be the first priority of a preservation retrofitting plan. The cost is low, little skill is required, and the benefits are substantial.

Attic Insulation: Heat rising through the attic and roof is a major source of heat loss, and reducing this heat loss should be one of the highest priorities in preservation retrofitting. Adding insulation in accessible attic spaces is very effective in saving energy and is generally accomplished at a reasonable cost, requiring little skill to install. The most common attic insulations include blankets of fiberglass and mineral wool, blown-in cellulose (treated with boric acid only), blowing wool, vermiculite, and blown fiberglass. If the attic is unheated (not used for habitation), then the insulation is placed between the floor joists with the **vapor barrier facing down.** If flooring is present, or if the attic is heated, the insulation is generally placed between the roof rafters with the **vapor barrier facing in**. All should be installed according to the manufacturer's recommendations. A weatherization manual entitled, "In the Bank . . . or Up the Chimney" (see the bibliography) provides detailed descriptions about a variety of installation methods used for attic insulation. The manual also recommends the amount of attic insulation used in various parts of the country. If the attic has some insulation, add more (but *without* a vapor barrier) to reach the total depth recommended.

Problems occur if the attic space is not properly ventilated. This lack of ventilation will cause the insulation to become saturated and lose its thermal effectiveness. The attic is adequately ventilated when the net area of ventilation (free area of a louver or vent) equals approximately 1/300 of the attic floor area. With adequate attic ventilation, the addition of attic insulation should be one of the highest priorities of a preservation retrofitting plan.

If the attic floor is inaccessible, or if it is impossible to add insulation along the roof rafters, consider attaching insulation to the ceilings of the rooms immediately below the attic. Some insulations are manufactured specifically for these cases and include a durable surface which becomes the new ceiling. This option should not be considered if it causes irreparable damage to historic or architectural spaces or features; however, in other cases, it could be a recommended measure of a preservation retrofitting plan.

Storm Windows: Windows are a primary source of heat loss because they are both a poor thermal barrier (R factor of only 0.89) and often a source of air infiltration. Adding storm windows greatly improves these poor characteristics. If a building has existing storm windows (either wood or metal framed), they should be retained. Assure they are tight fitting and in good working condition. If they are not in place, it is a recommended measure of a preservation retrofitting plan to add new metal framed windows on the exterior. This will result in a window assembly (historic window plus storm window) with an R factor of 1.79 which outperforms a double paned window assembly (with an air space up to ½") that only has an R factor of 1.72. When installing the storm windows, be careful not to damage the historic window frame. If the metal frames visually impair the appearance of the building, it may be necessary to paint them to match the color of the historic frame (see figure 6).

Triple-track metal storm windows are recommended because they are readily available, in numerous sizes, and at a reasonable cost. If a pre-assembled storm window is not available for a particular window size, and a custom-made storm window is required, the cost can be very high. In this case, compare the cost of manufacture and installation with the expected cost savings resulting from the increased thermal efficiency. Generally, custom-made storm windows, of either wood or metal frames, are not cost effective, and would not be recommended in a preservation retrofitting plan.

Interior storm window installations can be as thermally effective as exterior storm windows; however, there is high potential for damage to the historic window and sill from condensation. With storm windows on the interior, the outer sash (in this case the historic sash) will be cold in the winter, and hence moisture may condense there. This condensation often collects on the flat surface of the sash or window sill causing paint to blister and the wood to begin to deteriorate.

Rigid plastic sheets are used as interior storm windows by attaching them directly to the historic sash. They are not quire as effective as the storm windows described previously because of the possibility of air infiltration around the historic sash. If the rigid plastic sheets are used, assure that they are installed with minimum damage to the historic sash, removed periodically to allow the historic sash to dry, and that the historic frame and sash are completely caulked and weatherstripped.

In most cases, interior storm windows of either metal frames or of plastic sheets are not recommended for preservation retrofitting because of the potential for damage to the historic window. If interior storm windows are in place, the potential for moisture deterioration can be lessened by opening (or removing, depending on the type) the storm windows during the mild months allowing the historic window to dry thoroughly.

Basement and Crawl Space Insulation: Substantial heat is lost through cold basements and crawl spaces. Adding insulation in these locations is an effective preservation retrofitting measure and should be a high priority action. It is complicated, however, because of the excessive moisture that is often present. One must be aware of this and assure that insulation is properly installed for the specific location. For instance, in crawl spaces and certain unheated basements, the insulation is generally placed between the first floor joists (the ceiling of the basement) with the **vapor barrier facing up**. Do not staple the insulation in place, because the staples often rust away. Use special anchors developed for insulation in moist areas such as these.

In heated basements, or where the basement contains the heating plant (furnace), or where there are exposed water and sewer pipes, insulation should be installed against foundation walls. Begin the insulation within the first floor joists, and proceed down the wall to a point at least 3 feet below the exterior ground level if possible, with the **vapor barrier facing in**. Use either batt or rigid insulation.

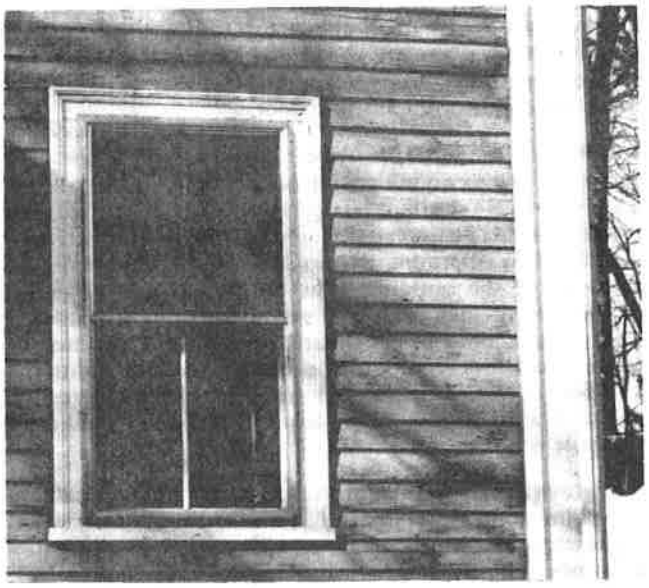


Figure 6. The addition of triple track storm windows, as shown here, greatly improves the thermal performance of existing window assemblies, with a minimal impact on the appearance of the building. (Photo: Baird Smith)

Installing insulation in the basement or crawl space should be a high priority of a preservation retrofitting plan, as long as adequate provision is made to ventilate the unheated space, perhaps even by installing an exhaust fan.

Duct and Pipe Insulation: Wrapping insulation around heating and cooling ducts and hot water pipes, is a recommended preservation retrofitting measure. Use insulation which is intended for this use and install it according to manufacturer's recommendations. Note that air conditioning ducts will be cold in the summer, and hence moisture will condense there. Use insulation with the **vapor barrier facing out**, away from the duct. These measures are inexpensive and have little potential for damage to the historic building.

Awnings and Shading Devices: In the past, awnings and trees were used extensively to provide shade to keep buildings cooler in the summer. If awnings or trees are in place, keep them in good condition, and take advantage of their energy-saving contribution. Building owners may consider adding awnings or trees if the summer cooling load is substantial. If awnings are added, assure that they are installed without damaging the building or visually impairing its architectural character (see figure 7). If trees are added, select deciduous trees that provide shade in the summer but, after dropping their leaves, would allow the sun to warm the building in the winter. When planting trees, assure that they are no closer than 10 feet to the building to avoid damage to the foundations. Adding either awnings or shade trees may be expensive, but in hot climates, the benefits can justify the costs.

Doors and Storm Doors: Most historic wooden doors, if they are solid wood or paneled, have fairly good thermal properties and should not be replaced, especially if they are important architectural features. Assure that the frames and doors have proper maintenance, regular painting, and that caulking and weatherstripping is applied as necessary.

A storm door would improve the thermal performance of the historic door; however, recent studies indicate that installing a storm door is not normally cost effective in residential settings. The costs are high compared to the anticipated savings. Therefore, storm doors should only be added to

buildings in cold climates, and added in such a way to minimize the visual impact on the building's appearance. The storm door design should be compatible with the architectural character of the building and may be painted to match the colors of the historic door.

Vestibules: Vestibules create a secondary air space at a doorway to reduce air infiltration occurring while the primary door is open. If a vestibule is in place, retain it. If not, adding a vestibule, either on the exterior or interior, should be carefully considered to determine the possible visual impact on the character of the building. The energy savings would be comparatively small compared to construction costs. Adding a vestibule should be considered in very cold climates, or where door use is very high, but in either case, the additional question of visual intrusion must be resolved before it is added. For most cases with historic buildings, adding a vestibule is not recommended.

Replacement Windows: Unfortunately, a common weatherization measure, especially in larger buildings, has been the replacement of historic windows with modern double paned windows. The intention was to improve the thermal performance of the existing windows and to reduce long-term maintenance costs. The evidence is clear that adding exterior storm windows is a viable alternative to replacing the historic windows and it is the recommended approach in preservation retrofitting. However, if the historic windows are severely deteriorated and their repair would be impractical, or economically infeasible, then replacement windows may be warranted. The new windows, of either wood or metal, should closely match the historic windows in size, number of panes, muntin shape, frame, color and reflective qualities of the glass.

Wall Insulation—Wood Frame: The addition of wall insulation in a wood frame building is generally not recommended as a preservation retrofitting measure because the costs are high, and the potential for damage to historic building materials is even higher. Also, wall insulation is not particularly effective for small frame buildings (one story) because the heat loss from the uninsulated walls is a relatively small percentage of the total, and part of that can be attributed to infiltration. If, however, the historic building is two or more stories, and is located in a cold climate, wall insulation may be considered if extreme care (as explained later) is exercised with its installation.

The installation of wall insulation in historic frame buildings can result in serious technical and preservation problems. As discussed before, insulation must be kept dry to function properly, and requires a vapor barrier and some provision for air movement. Introducing insulation in wall cavities, without a vapor barrier and some ventilation can be disastrous. The insulation would become saturated, losing its thermal properties, and in fact, actually increasing the heat loss through the wall. Additionally, the moisture (in vapor form) may condense into water droplets and begin serious deterioration of adjacent building materials such as sills, window frames, framing and bracing. The situation is greatly complicated, because correcting such problems could necessitate the complete (and costly) dismantling of the exterior or interior wall surfaces. It should be clear that adding wall insulation has the potential for causing serious damage to historic building materials.

If adding wall insulation to frame buildings is determined to be absolutely necessary, the first approach should be to consider the careful removal of the exterior siding so that it may later be reinstalled. Then introduce batt insulation with the **vapor barrier facing in** into the now accessible wall cavity. The first step in this approach is an investigation to determine if the siding can be removed without causing serious damage.

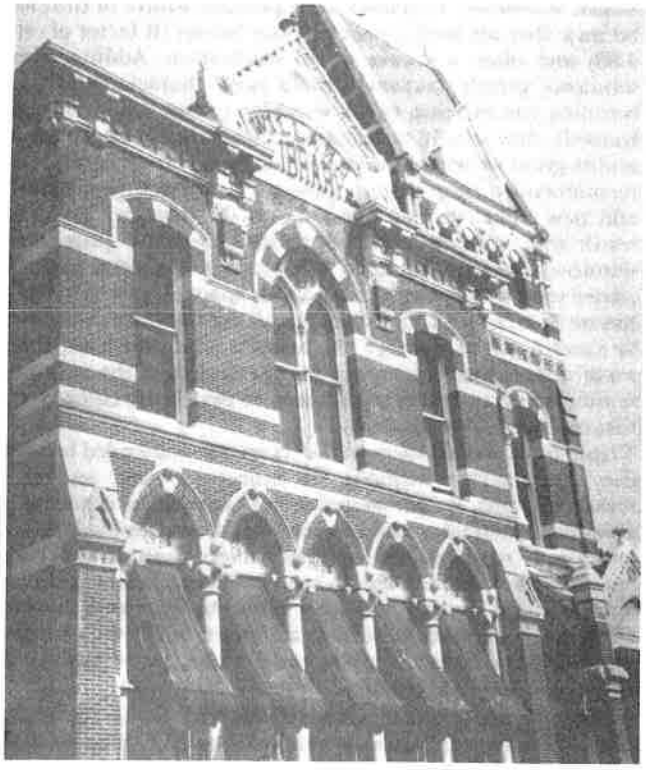


Figure 7. The awnings on the Willard Library in Evansville, Indiana, reduce heat gain in the summer and, when they are raised in the winter, radiant heat from the sun provides free supplementary heat. (Photo: Lee H. Nelson)

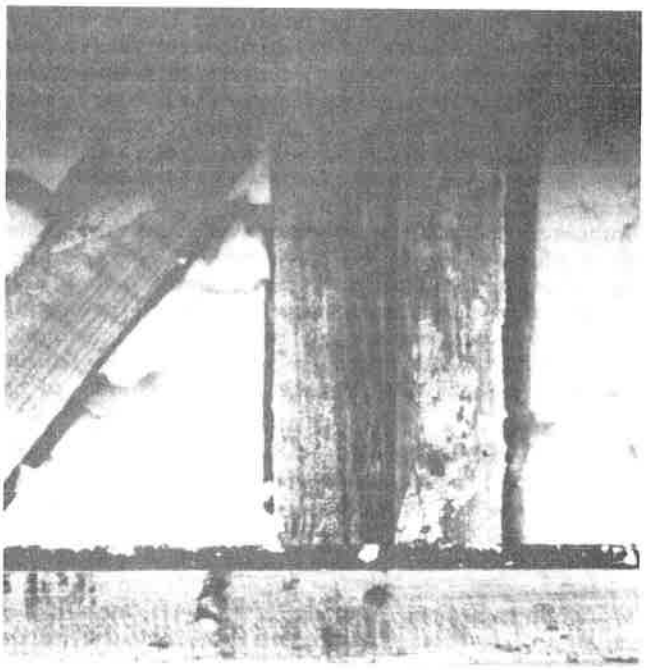


Figure 8. The white material seen between the wooden wall studs is urea-formaldehyde foam. It is injected into the wall cavity wet, and as it cures, large quantities of moisture are given off creating the potential for serious deterioration of adjacent materials and may cause paint to blister on interior and exterior wall surfaces. Additionally, foam can shrink as much as that shown here (about 7% by volume), thus reducing the predicted insulating performance. Until some of the technical problems are corrected, its use is not recommended in historic structures. (Photo: Baird Smith)

If it is feasible, introducing insulation in this fashion provides the best possible solution to insulating a wall, and provides an excellent opportunity to view most of the structural system for possible hidden structural problems or insect infestations. A building owner should not consider this approach if it would result in substantial damage to or loss of historic wooden siding. Most siding, however, would probably withstand this method if reasonable care is exercised.

The second possible approach for wall insulation involves injecting or blowing insulation into the wall cavity. The common insulations are the loose fill types that can be blown into the cavity, the poured types, or the injected types such as foam. Obviously a vapor barrier cannot be simultaneously blown into the space. However, an equivalent vapor barrier can be created by assuring that the interior wall surfaces are covered with an impermeable paint layer. Two layers of oil base paint or one layer of impermeable latex paint constitute an acceptable vapor barrier. Naturally, for this to work, the paint layer must cover all interior surfaces adjacent to the newly installed wall insulation. Special attention should be given to rooms that are major sources of interior moisture—the laundry room, the bathrooms and the kitchen.

In addition to providing a vapor barrier, make provisions for some air to circulate in the wall cavity to help ventilate the insulation and the wall materials. This can be accomplished in several ways. One method is to install small screened vents (about 2 inches in diameter) at the base of each stud cavity. If this option is taken, the vents should be as inconspicuous as possible. A second venting method can be used where the exterior siding is horizontally lapped. Assure that each piece of siding is separated from the other, allowing some air to pass between them. Successive exterior paint layers often seal the joint between each piece of siding. Break the paint seal (carefully insert a chisel and twist) between the sections of exterior siding to provide the necessary ventilation for the insulation and wall materials.

With provisions for a vapor barrier (interior paint layer) and wall ventilation (exterior vents) satisfied, the appropriate type of wall insulation may then be selected. There are three recommended types to consider: blown cellulose (with boric acid as the fire retardant), vermiculite, or perlite. Cellulose is the preferred wall insulation because of its higher R factor and its capability to flow well into the various spaces within a wall cavity.

There are two insulation types that are not recommended for wall insulation: urea-formaldehyde foams, and cellulose which uses aluminum or ammonium sulfate instead of boric acid as a fire retardant. The cellulose treated with the sulfates reacts with moisture in the air and forms sulfuric acid which corrodes many metals and causes building stones to slowly disintegrate. This insulation is not appropriate for use in historic buildings.

Although urea-formaldehyde foams appear to have potential as retrofit materials (they flow into any wall cavity space and have a high R factor) their use is not recommended for preservation retrofitting until some serious problems are corrected. The major problem is that the injected material carries large quantities of moisture into the wall system. As the foam cures, this moisture must be absorbed into the adjacent materials. This process has caused interior and exterior paint to blister, and caused water to actually puddle at the base of a wall, creating the likelihood of serious deterioration to the historic building materials. There are other problems that affect both historic buildings and other existing buildings. Foams are a two-part chemical installed by franchised contractors. To obtain the exact proportion of the two parts, the foam must be mixed and installed under controlled conditions of temperature and humidity. There are cases where the controls were not followed and the foam either cured improperly, not attaining the desired R factor, or the foam continued to emit a formaldehyde smell. In addition, the advertised maximum shrinkage after curing (3%) has been tested and found to be twice as high (see figure 8). Until this material is further developed and the risks eliminated, it is clearly not an appropriate material for preservation retrofitting.

Wall Insulation — Masonry Cavity Walls: Some owners of historic buildings with masonry cavity wall construction have attempted to introduce insulation into the cavity. This is not good practice because it ignores the fact that masonry cavity walls normally have acceptable thermal performance, needing no improvement. Additionally, introducing insulation into the cavity will most likely result in condensation problems and alter the intended function of the cavity. The air cavity acts as a vapor barrier in that moist air passing through the inner wythe of masonry meets the cold face of the outer wythe and condenses. Water droplets form and fall to the bottom of the wall cavity where they are channeled to the outside through weep holes. The air cavity also improves the thermal performance of the wall because it slows the transfer of heat or cold between the two wythes, causing the two wall masses to function independently with a thermal cushion between them.

Adding insulation to this cavity alters the vapor barrier and thermal cushion functions of the air space and will likely clog the weep holes, causing the moisture to puddle at the base of the wall. Also, the addition of insulation creates a situation where the moisture dew point (where moisture condenses) moves from the inner face of the outer wythe, into the outer wythe itself. Thus, during a freeze this condensation will freeze, causing spalling and severe deterioration. The evidence is clear that introducing insulation, of any type, into a masonry cavity wall is not recommended in a preservation retrofitting plan.

Wall Insulation—Installed on the Inside: Insulation could be added to a wall whether it be wooden or masonry, by attaching the insulation to furring strips mounted on the interior wall faces. Both rigid insulation, usually 1 or 2 inches thick, and batt insulation, generally 3½ inches thick, can be added in this fashion, with the **vapor barrier facing in**. Extra caution must be exercised if polyurethane rigid insulation is used because it gives off toxic gases when burned. Therefore, it must be installed with a fireproof covering, usually ½ inch gypsum wallboard. Insulation should not be installed on the inside if it necessitates relocation or destruction of important architectural decoration, such as cornices, chair rails, or window trims, or causes the destruction of historic plaster or other wall finishes. Insulation installed in this fashion would be expensive and could only be a recommended preservation retrofitting measure if it is a large building, located in a cold climate, and if the interior spaces and features have little or no architectural significance.

Wall Insulation—Installed on the Outside: There is a growing use of aluminum or vinyl siding installed directly over historic wooden sidings, supposedly to reduce long-term maintenance and to improve the thermal performance of the wall. From a preservation viewpoint, this is a poor practice for several reasons. New siding covers from view existing or potential deterioration problems or insect infestations. Additionally, installation often results in damage or alteration to existing decorative features such as beaded weatherboarding, window and door trim, corner boards, cornices, or roof trim. The cost of installing the artificial sidings, compared with the modest increase, if any, in the thermal performance of the wall does not add up to an effective energy-saving measure. The use of artificial siding is not recommended in a preservation retrofitting plan.

Good preservation practice would assure regular mainte-

nance of the existing siding through periodic painting and caulking. Where deterioration is present, individual pieces of siding should be removed and replaced with matching new ones. Refer to the earlier sections of this brief for recommended retrofitting measures to improve the thermal performance of wood frame walls.

Waterproof Coatings for Masonry: Some owners of historic buildings use waterproof coatings on masonry believing it would improve the thermal performance of the wall by keeping it dry (dry masonry would have a better R factor than when wet). Application of waterproof coatings is not recommended because the coatings actually trap moisture within the masonry, and can cause spalling and severe deterioration during a freezing cycle.

In cases where exterior brick is painted, consider continued periodic painting and maintenance, since paints are an excellent preservation treatment for brick. When repainting, a building owner might consider choosing a light paint color in warm climates, or a dark color in cold climates, to gain some advantage over the summer heat gain or winter heat loss, whichever the case may be. These colors should match those used historically on the building or should match colors available historically.

Mechanical Equipment

A detailed treatise of recommended or not recommended heating or air conditioning equipment, or of alternative energy sources such as solar energy or wind power, is beyond the scope of this brief. The best advice concerning mechanical equipment in historic buildings is to assure that the existing equipment works as efficiently as possible. If the best professional advice recommends replacement of existing equipment, a building owner should keep the following considerations in mind. First, as technology advances in the coming years, the equipment installed now will be outdated rapidly relative to the life of the historic building. Therefore, it may be best to wait and watch, until new technologies (such as solar energy) become more feasible, efficient, and inexpensive. Secondly, do not install new equipment and ductwork in such a way that its installation, or possible later removal, will cause irreversible damage to significant historic building materials. The concept of complete invisibility, which necessitates hiding piping and ductwork within wall and floor systems, may not always be appropriate for historic buildings because of the damage that often results. Every effort should be made to select a mechanical system that will require the least intrusion into the historic fabric of the building and that can be updated or altered without major intervention into the wall and floor systems. These points should be considered when weighing the decision to replace a less than efficient exiting system with a costly new system, which may cause substantial damage to the historic building materials and in turn may prove inefficient in the future.

SUMMARY

The primary focus of this brief has been to describe ways to achieve the maximum energy savings in historic buildings without jeopardizing the architectural, cultural and historical qualities for which the properties have been recognized. This can be accomplished through undertaking the passive measures and the "recommended" preservation retrofitting. Secondly, this brief has emphasized the benefits of undertaking the retrofitting measures in phases so that the actual energy savings anticipated from each retrofitting measure can be realized. Thus, the "not recommended" retrofitting measures, with potential for damage or alteration of historic building materials, would not have to be undertaken, because the maximum feasible savings would have already been accomplished.

Lastly, and perhaps most important, we must recognize that the technologies of retrofitting and weatherization are relatively new. Unfortunately, most current research and product development is directed toward *new construction*. It is hoped that reports such as this, and the realization that fully 30% of all construction in the United States now involves work on existing buildings, will stimulate the development of new products that can be used with little hesitation in historic buildings. Until that time, owners of historic buildings can undertake the preservation retrofitting measures recommended here and greatly reduce the energy used for heating and cooling, without destroying those historic and architectural qualities that make the building worthy of preservation.

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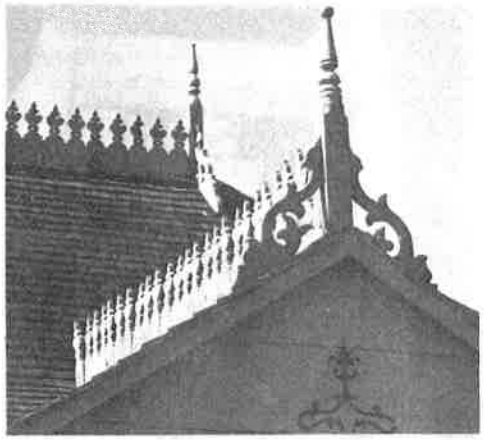
4 PRESERVATION BRIEFS



HABS

Roofing for Historic Buildings

Sarah M. Sweetser

Technical Preservation Services Division
Office of Archeology and Historic Preservation/
Heritage Conservation and Recreation Service

Significance of the Roof

A weather-tight roof is basic in the preservation of a structure, regardless of its age, size, or design. In the system that allows a building to work as a shelter, the roof sheds the rain, shades from the sun, and buffers the weather.

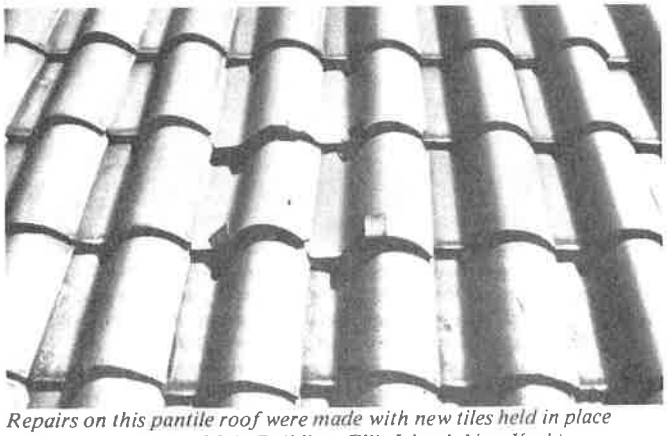
During some periods in the history of architecture, the roof imparts much of the architectural character. It defines the style and contributes to the building's aesthetics. The hipped roofs of Georgian architecture, the turrets of Queen Anne, the Mansard roofs, and the graceful slopes of the Shingle Style and Bungalow designs are examples of the use of roofing as a major design feature.

But no matter how decorative the patterning or how compelling the form, the roof is a highly vulnerable element of a shelter that will inevitable fail. A poor roof will permit the accelerated deterioration of historic building materials—masonry, wood, plaster, paint—and will cause general disintegration of the basic structure. Furthermore, there is an urgency involved in repairing a leaky roof since such repair costs will quickly become prohibitive. Although such action is desirable as soon as a failure is discovered, temporary patching methods should be carefully chosen to prevent inadvertent damage to sound or historic roofing materials and related features. Before any repair work is performed, the historic value of the materials used on the roof should be understood. Then a complete internal and external inspection of the roof should be planned to determine all the causes of failure and to identify the alternatives for repair or replacement of the roofing.

Historic Roofing Materials in America

Clay Tile: European settlers used clay tile for roofing as early as the mid-17th century; many pantiles (S-curved tiles), as well as flat roofing tiles, were used in Jamestown, Virginia. In some cities such as New York and Boston, clay was popularly used as a precaution against such fire as those that engulfed London in 1666 and scorched Boston in 1679.

Tiles roofs found in the mid-18th century Moravian settlements in Pennsylvania closely resembled those found in Germany. Typically, the tiles were 14–15″ long, 6–7″ wide with a curved butt. A lug on the back allowed the tiles to hang on the lathing without nails or pegs. The tile surface was usually scored with finger marks to promote drainage. In the Southwest, the tile roofs of the Spanish missionaries (mission tiles) were first manufactured (ca. 1780) at the Mission San Antonio de Padua in California. These semicircular tiles were made by molding clay over sections of logs, and they were generally 22″ long and tapered in width.



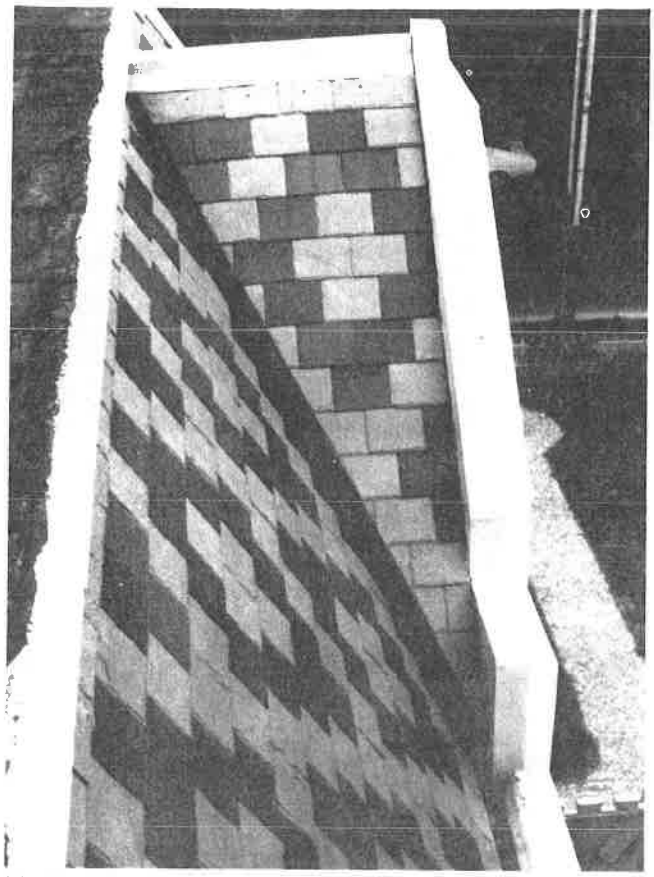
Repairs on this pantile roof were made with new tiles held in place with metal hangers. (Main Building, Ellis Island, New York)

The plain or flat rectangular tiles most commonly used from the 17th through the beginning of the 19th century measured about 10″ by 6″ by ½″, and had two holes at one end for a nail or peg fastener. Sometimes mortar was applied between the courses to secure the tiles in a heavy wind.

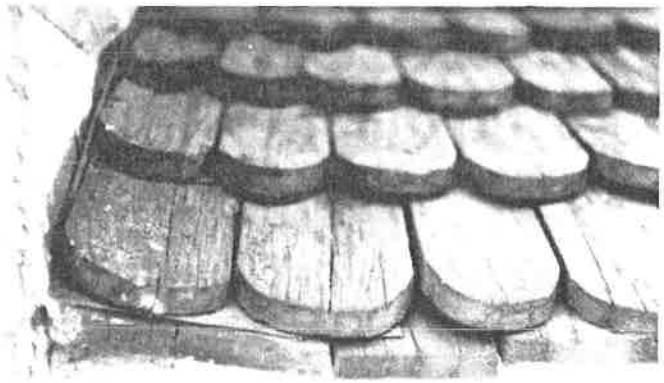
In the mid-19th century, tile roofs were often replaced by sheet-metal roofs, which were lighter and easier to install and maintain. However, by the turn of the century, the Romanesque Revival and Mission style buildings created a new demand and popularity for this picturesque roofing material.

Slate: Another practice settlers brought to the New World was slate roofing. Evidence of roofing slates have been found also among the ruins of mid-17th-century Jamestown. But because of the cost and the time required to obtain the material, which was mostly imported from Wales, the use of slate was initially limited. Even in Philadelphia (the second largest city in the English-speaking world at the time of the Revolution) slates were so rare that "The Slate Roof House" distinctly referred to William Penn's home built late in the 1600s. Sources of native slate were known to exist along the eastern seaboard from Maine to Virginia, but difficulties in inland transportation limited its availability to the cities, and contributed to its expense. Welsh slate continued to be imported until the development of canals and railroads in the mid-19th century made American slate more accessible and economical.

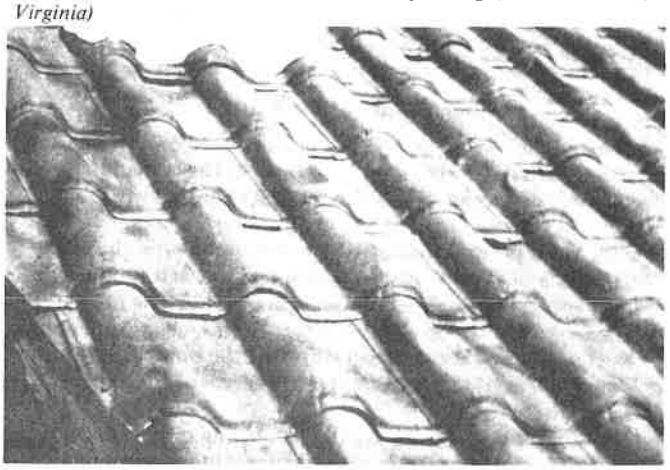
Slate was popular for its durability, fireproof qualities, and



The Victorians loved to used different colored slates to create decorative patterns on their roofs, an effect which cannot be easily duplicated by substitute materials. Before any repair work on a roof such as this, the slate sizes, colors, and position of the patterning should be carefully recorded to assure proper replacement. (Ebenezer Maxwell Mansion, Philadelphia, Pennsylvania, photo courtesy of William D. Hershey)



Replacement of particular historic details is important to the individual historic character of a roof, such as the treatment at the eaves of this rounded butt wood shingle roof. Also note that the surface of the roof was carefully sloped to drain water away from the side of the dormer. In the restoration, this function was augmented with the addition of carefully concealed modern metal flashing. (Mount Vernon, Virginia)



Galvanized sheet-metal shingles imitating the appearance of pantiles remained popular from the second half of the 19th century into the 20th century. (Episcopal Church, now the Jerome Historical Society Building, Jerome, Arizona, 1927)

aesthetic potential. Because slate was available in different colors (red, green, purple, and blue-gray), it was an effective material for decorative patterns on many 19th-century roofs (Gothic and Mansard styles). Slate continued to be used well into the 20th century, notably on many Tudor revival style buildings of the 1920s.

Shingles: Wood shingles were popular throughout the country in all periods of building history. The size and shape of the shingles as well as the detailing of the shingle roof differed according to regional craft practices. People within particular regions developed preferences for the local species of wood that most suited their purposes. In New England and the Delaware Valley, white pine was frequently used: in the South, cypress and oak; in the far west, red cedar or redwood. Sometimes a protective coating was applied to increase the durability of the shingle such as a mixture of brick dust and fish oil, or a paint made of red iron oxide and linseed oil.

Commonly in urban areas, wooden roofs were replaced with more fire resistant materials, but in rural areas this was not a major concern. On many Victorian country houses, the practice of wood shingling survived the technological advances of metal roofing in the 19th century, and near the turn of the century enjoyed a full revival in its namesake, the Shingle Style. Colonial revival and the Bungalow styles in the 20th century assured wood shingles a place as one of the most fashionable, domestic roofing materials.

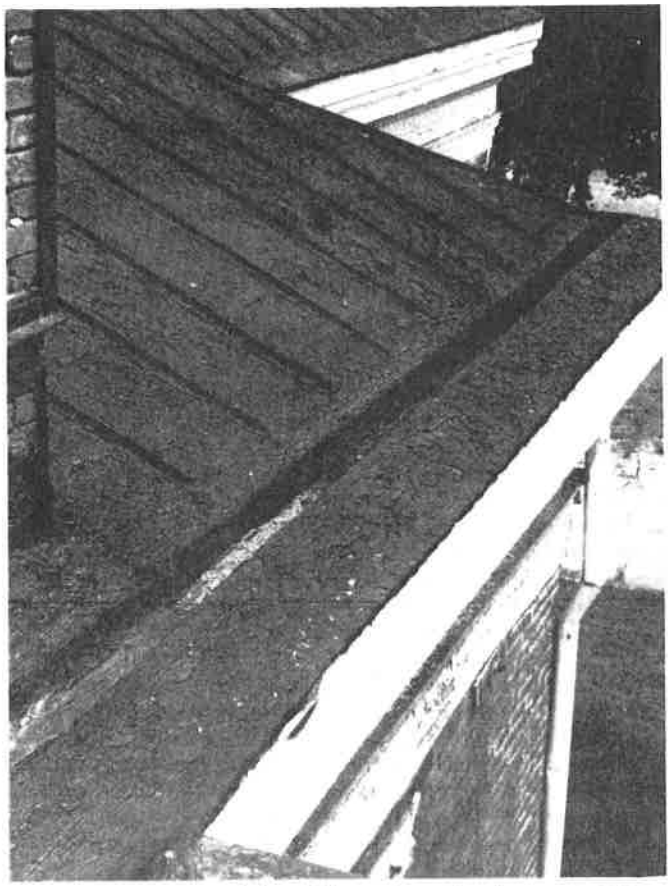
Metal: Metal roofing in America is principally a 19th-century phenomenon. Before then the only metals commonly used were lead and copper. For example, a lead roof covered "Rosewell," one of the grandest mansions in 18th-century Virginia. But more often, lead was used for protective flashing. Lead, as well as copper, covered roof surfaces where wood, tile, or slate shingles were inappropriate because of the roof's pitch or shape.

Copper with standing seams covered some of the more notable early American roofs including that of Christ Church (1727–1744) in Philadelphia. Flat-seamed copper was used on many domes and cupolas. The copper sheets were imported from England until the end of the 18th century when facilities for rolling sheet metal were developed in America.

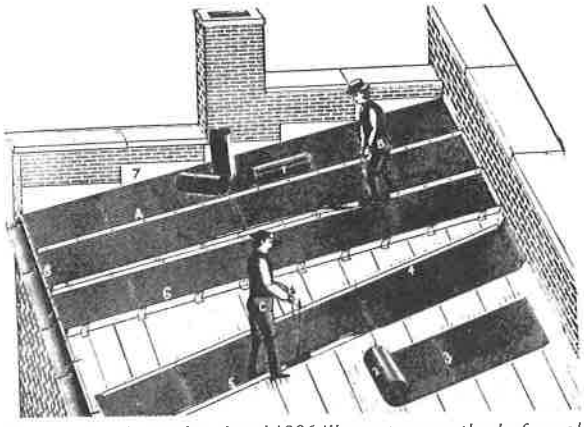
Sheet iron was first known to have been manufactured here by the Revolutionary War financier, Robert Morris, who had a rolling mill near Trenton, New Jersey. At his mill Morris produced the roof of his own Philadelphia mansion, which he started in 1794. The architect Benjamin H. Latrobe used sheet iron to replace the roof on Princeton's "Nassau Hall," which had been gutted by fire in 1802.

The method for corrugating iron was originally patented in England in 1829. Corrugating stiffened the sheets, and allowed greater span over a lighter framework, as well as reduced installation time and labor. In 1834 the American architect William Strickland proposed corrugated iron to cover his design for the market place in Philadelphia.

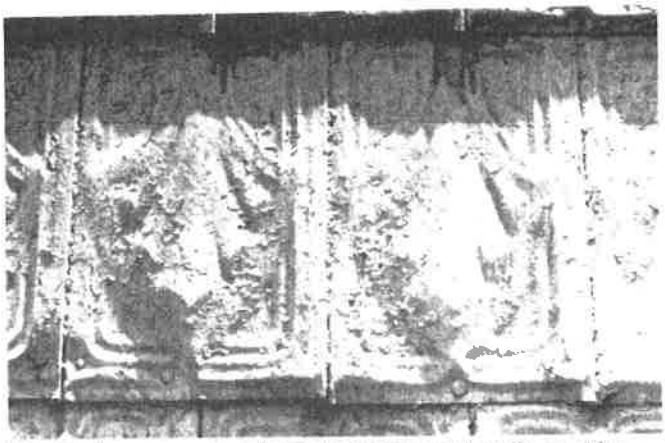
Galvanizing with zinc to protect the base metal from rust was developed in France in 1837. By the 1850s the material was used on post offices and customhouses, as well as on train sheds and factories. In 1857 one of the first metal roofs in the



Repeated repair with asphalt, which cracks as it hardens, has created a blistered surface on this sheet-metal roof and built-in gutter, which will retain water. Repairs could be made by carefully heating and scraping the surface clean, repairing the holes in the metal with a flexible mastic compound or a metal patch, and coating the surface with a fibre paint. (Roane County Courthouse, Kingston, Tennessee, photo courtesy of Building Conservation Technology, Inc.)



A Chicago firm's catalog dated 1896 illustrates a method of unrolling, turning the edges, and finishing the standing seam on a metal roof.



Tin shingles, commonly embossed to imitate wood or tile, or with a decorative design, were popular as an inexpensive, textured roofing material. These shingles $8^3/_8$ inch by $12^1/_2$ inch on the exposed surface) were designed with interlocking edges, but they have been repaired by surface nailing, which may cause future leakage. (Ballard House, Yorktown, Virgina, photo by Gordie Whittington, National Park Service)

South was installed on the U.S. Mint in New Orleans. The Mint was thereby "fireproofed" with a 20-gauge galvanized, corrugated iron roof on iron trusses.

Tin-plate iron, commonly called "tin roofing," was used extensively in Canada in the 18th century, but it was not as common in the United States until later. Thomas Jefferson was an early advocate of tin roofing, and he installed a standing-seam tin roof on "Monticello" (ca. 1770–1802). The Arch Street Meetinghouse (1804) in Philadelphia had tin shingles laid in a herringbone pattern on a "piazza" roof.

However, once rolling mills were established in this country, the low cost, light weight, and low maintenance of tin plate made it the most common roofing material. Embossed tin shingles, whose surfaces created interesting patterns, were popular throughout the country in the late 19th century. Tin roofs were kept well-painted, usually red; or, as the architect A. J. Davis suggested, in a color to imitate the green patina of copper.

Terne plate differed from tin plate in that the iron was dipped in an alloy of lead and tin, giving it a duller finish. Historic, as well as modern, documentation often confuses the two, so much that it is difficult to determine how often actual "terne" was used.

Zinc came into use in the 1820s, at the same time tin plate was becoming popular. Although a less expensive substitute for lead, its advantages were controversial, and it was never widely used in this country.

Other Materials: Asphalt shingles and roll roofing were used in the 1890s. Many roofs of asbestos, aluminum, stainless steel, galvinized steel, and lead-coated copper may soon have historic values as well. Awareness of these and other traditions of roofing materials and their detailing will contribute to more sensitive preservation treatments.

Locating the Problem

Failures of Surface Materials

When trouble occurs, it is important to contact a professional, either an architect, a reputable roofing contractor, or a craftsman familiar with the inherent characteristics of the particular historic roofing system involved. These professionals may be able to advise on immediate patching procedures and help plan more permanent repairs. A thorough examination of the roof should start with an appraisal of the existing condition and quality of the roofing material itself. Particular attention should be given to any southern slope because year-round exposure to direct sun may cause it to break down first.

Wood: Some historic roofing materials have limited life expectancies because of normal organic decay and "wear." For example, the flat surfaces of wood shingles erode from exposure to rain and ultraviolet rays. Some species are more hardy than others, and heartwood, for example, is stronger and more durable than sapwood.

Ideally, shingles are split with the grain perpendicular to

the surface. This is because if shingles are sawn across the grain, moisture may enter the grain and cause the wood to deteriorate. Prolonged moisture on or in the wood allows moss or fungi to grow, which will further hold the moisture and cause rot.

Metal: Of the inorganic roofing materials used on historic buildings, the most common are perhaps the sheet metals: lead, copper, zinc, tin plate, terne plate, and galvanized iron. In varying degrees each of these sheet metals are likely to deteriorate from chemical action by pitting or streaking. This can be caused by airborn pollutants; acid rainwater; acids from lichen or moss; alkalis found in lime mortars or portland cement, which might be on adjoining features and washes down on the roof surface; or tannic acids from adjacent wood sheathings or shingles made of red cedar or oak.

Corrosion from "galvanic action" occurs when dissimilar metals, such as copper and iron, are used in direct contact. Corrosion may also occur even though the metals are physically separated; one of the metals will react chemically against the other in the presence of an electrolyte such as rainwater. In roofing, this situation might occur when either a copper roof is decorated with iron cresting, or when steel nails are used in copper sheets. In some instances the corrosion can be prevented by inserting a plastic insulator between the dissimilar materials. Ideally, the fasteners should be a metal sympathetic to those involved.

Iron rusts unless it is well-painted or plated. Historically this problem was avoided by use of tin plating or galvinizing. But this method is durable only as long as the coating remains intact. Once the plating is worn or damaged, the exposed iron will rust. Therefore, any iron-based roofing material needs to be undercoated, and its surface needs to be kept well-painted to prevent corrosion.

One cause of sheet metal deterioration is fatigue. Depending upon the size and the gauge of the metal sheets, wear and metal failure can occur at the joints or at any protrusions in the sheathing as a result from the metal's alternating movement to thermal changes. Lead will tear because of "creep," or the gravitational stress that causes the material to move down the roof slope.

Slate: Perhaps the most durable roofing materials are slate and tile. Seemingly indestructable, both vary in quality. Some slates are hard and tough without being brittle. Soft slates are more subject to erosion and to attack by airborne and rainwater chemicals, which cause the slates to wear at nail holes, to delaminate, or to break. In winter, slate is very susceptible to breakage by ice, or ice dams.

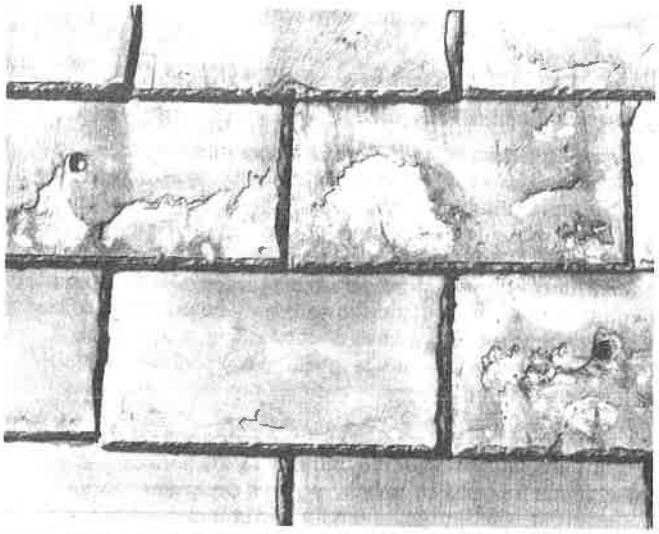
Tile: Tiles will weather well, but tend to crack or break if hit, as by tree branches, or if they are walked on improperly. Like slates, tiles cannot support much weight. Low quality tiles that have been insufficiently fired during manufacture, will craze and spall under the effects of freeze and thaw cycles on their porous surfaces.

Failures of Support Systems

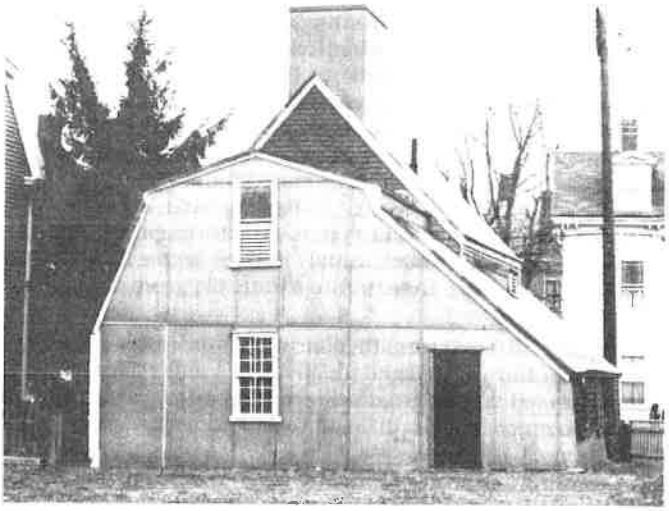
Once the condition of the roofing material has been determined, the related features and support systems should be examined on the exterior and on the interior of the roof. The gutters and downspouts need periodic cleaning and maintenance since a variety of debris fill them, causing water to back up and seep under roofing units. Water will eventually cause fasteners, sheathing, and roofing structure to deteriorate. During winter, the daily freeze-thaw cycles can cause ice floes to develop under the roof surface. The pressure from these ice floes will dislodge the roofing material, especially slates, shingles, or tiles. Moreover, the buildup of ice dams above the gutters can trap enough moisture to rot the sheathing or the structural members.

Many large public buildings have built-in gutters set within the perimeter of the roof. The downspouts for these gutters may run within the walls of the building, or drainage may be through the roof surface or through a parapet to exterior downspouts. These systems can be effective if properly maintained; however, if the roof slope is inadequate for good runoff, or if the traps are allowed to clog, rainwater will form pools on the roof surface. Interior downspouts can collect debris and thus back up, perhaps leaking water into the surrounding walls. Exterior downspouts may fill with water, which in cold weather may freeze and crack the pipes. Conduits from the built-in gutter to the exterior downspout may also leak water into the surrounding roof structure or walls.

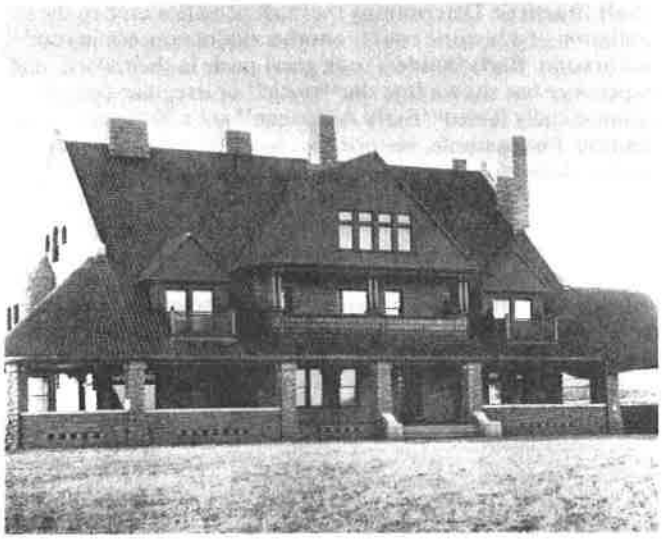
Failure of the flashing system is usually a major cause of roof deterioration. Flashing should be carefully inspected for failure caused by either poor workmanship, thermal stress, or metal deterioration (both of flashing material itself and of the fasteners). With many roofing materials, the replacement of flashing on an existing roof is a major operation, which may require taking up large sections of the roof surface. Therefore, the installation of top quality flashing material on

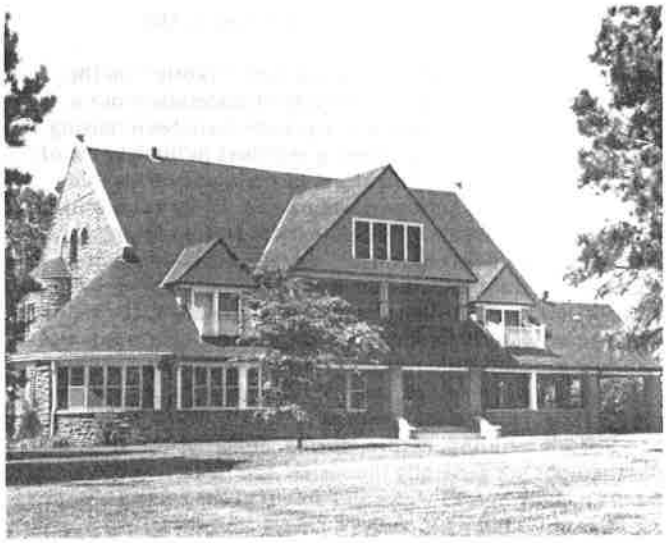


This detail shows slate delamination caused by a combination of weathering and pollution. In addition, the slates have eroded around the repair nails, incorrectly placed in the exposed surface of the slates. (Lower Pontalba Building, New Orleans, photo courtesy of Building Conservation Technology, Inc.)



Temporary stabilization or "mothballing" with materials such as plywood and building paper can protect the roof of a project until it can be properly repaired or replaced. (Narbonne House, Salem, Massachusetts)





These two views of the same house demonstrate how the use of a substitute material can drastically affect the overall character of a structure. The textural interest of the original tile roof was lost with the use of asphalt shingles. Recent preservation efforts are replacing the tile roof. (Frank House, Kearney, Nebraska, photo courtesy of the Nebraska State Historical Society, Lincoln, Nebraska)

a new or replaced roof should be a primary consideration. *Remember, some roofing and flashing materials are not compatible.*

Roof fasteners and clips should also be made of a material compatible with all other materials used, or coated to prevent rust. For example, the tannic acid in oak will corrode iron nails. Some roofs such as slate and sheet metals may fail if nailed too rigidly.

If the roof structure appears sound and nothing indicates recent movement, the area to be examined most closely is the roof substrate—the sheathing or the battens. The danger spots would be near the roof plates, under any exterior patches, at the intersections of the roof planes, or at vertical surfaces such as dormers. Water penetration, indicating a breach in the roofing surface or flashing, should be readily apparent, usually as a damp spot or stain. Probing with a small pen knife may reveal any rot which may indicate previously undetected damage to the roofing membrane. Insect infestation evident by small exit holes and frass (a sawdust-like debris) should also be noted. Condensation on the underside of the roofing is undesirable and indicates improper ventilation. Moisture will have an adverse effect on any roofing material; a good roof stays dry inside and out.

Repair or Replace

Understanding potential weaknesses of roofing material also requires knowledge of repair difficulties. Individual slates can be replaced normally without major disruption to the rest of the roof, but replacing flashing on a slate roof can require substantial removal of surrounding slates. If it is the substrate or a support material that has deteriorated, many surface materials such as slate or tile can be reused if handled carefully during the repair. Such problems should be evaluated at the outset of any project to determine if the roof can be effectively patched, or if it should be completely replaced.

Will the repairs be effective? Maintenance costs tend to multiply once trouble starts. As the cost of labor escalates, repeated repairs could soon equal the cost of a new roof.

The more durable the surface is initially, the easier it will be to maintain. Some roofing materials such as slate are expensive to install, but if top quality slate and flashing are used, it will last 40–60 years with minimal maintenance. Although the installation cost of the roof will be high, low maintenance needs will make the lifetime cost of the roof less expensive.

Historical Research

In a restoration project, research of documents and physical investigation of the building usually will establish the roof's history. Documentary research should include any original plans or building specifications, early insurance surveys, newspaper descriptions, or the personal papers and files of people who owned or were involved in the history of the building. Old photographs of the building might provide evidence of missing details.

Along with a thorough understanding of any written history of the building, a physical investigation of the roofing and its structure may reveal information about the roof's construction history. Starting with an overall impression of the structure, are there any changes in the roof slope, its configuration, or roofing materials? Perhaps there are obvious patches or changes in patterning of exterior brickwork where a gable roof was changed to a gambrel, or where a whole upper story was added. Perhaps there are obvious stylistic changes in the roof line, dormers, or ornamentation. These observations could help one understand any important alteration, and could help establish the direction of further investigation.

Because most roofs are physically out of the range of careful scrutiny, the "principle of least effort" has probably limited the extent and quality of previous patching or replacing, and usually considerable evidence of an earlier roof surface remains. Sometimes the older roof will be found as an underlayment of the current exposed roof. Original roofing may still be intact in awkward places under later features on a roof. Often if there is any unfinished attic space, remnants of roofing may have been dropped and left when the roof was being built or repaired. If the configuration of the roof has been changed, some of the original material might still be in place under the existing roof. Sometimes whole sections of the roof and roof framing will have been left intact under the higher roof. The profile and/or flashing of the earlier roof may be apparent on the interior of the walls at the level of the alteration. If the sheathing or lathing appears to have survived changes in the roofing surface, they may contain evidence of the roofing systems. These may appear either as dirt marks, which provide "shadows" of a roofing material, or as nails broken or driven down into the wood, rather than pulled out during previous alterations or repairs. Wooden headers in the roof framing may indicate that earlier chimneys or skylights have been removed. Any metal ornamentation that might have existed may be indicated by anchors or unusual markings along the ridge or at other edges of the roof. This primary

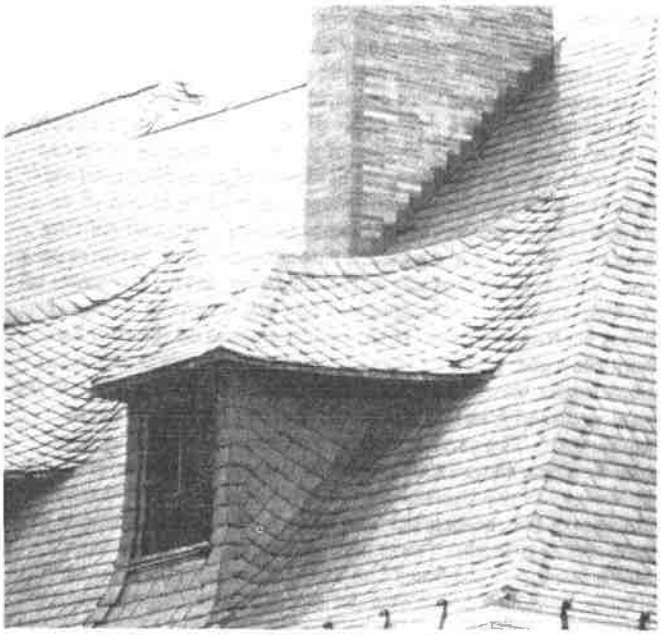
evidence is essential for a full understanding of the roof's history.

Caution should be taken in dating early "fabric" on the evidence of a single item, as recycling of materials is not a mid-20th-century innovation. Carpenters have been reusing materials, sheathing, and framing members in the interest of economy for centuries. Therefore, any analysis of the materials found, such as nails or sawmarks on the wood, requires an accurate knowledge of the history of local building practices before any final conclusion can be accurately reached. It is helpful to establish a sequence of construction history for the roof and roofing materials; any historic fabric or pertinent evidence in the roof should be photographed, measured, and recorded for future reference.

During the repair work, useful evidence might unexpectedly appear. It is essential that records be kept of any type of work on a historic building, before, during, and after the project. Photographs are generally the easiest and fastest method, and should include overall views and details at the gutters, flashing, dormers, chimneys, valleys, ridges, and eaves. All photographs should be immediately labeled to insure accurate identification at a later date. Any patterning or design on the roofing deserves particular attention. For example, slate roofs are often decorative and have subtle changes in size, color, and texture, such as a gradually decreasing coursing length from the eave to the peak. If not carefully noted before a project begins, there may be problems in replacing the surface. The standard reference for this phase of the work is *Recording Historic Buildings,* compiled by Harley J. McKee for the Historic American Buildings Survey, National Park Service, Washington, D.C., 1970.

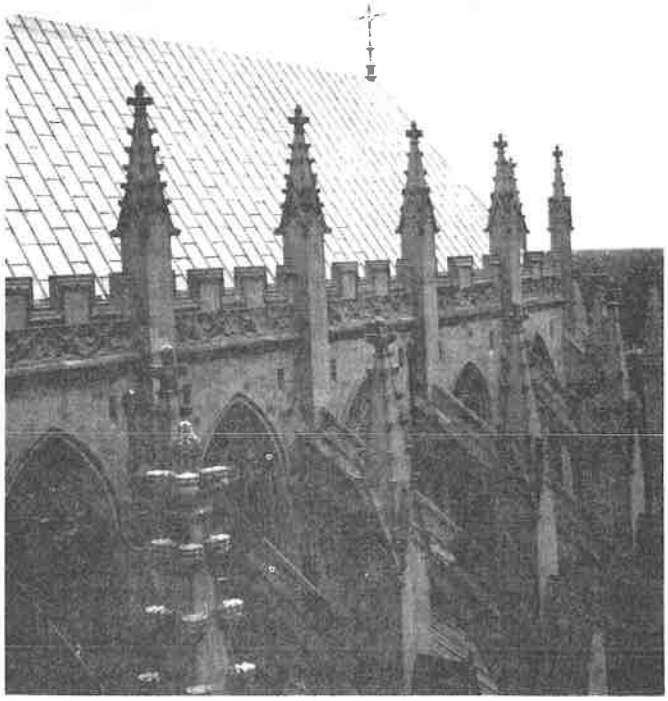
Replacing the Historic Roofing Material

Professional advice will be needed to assess the various aspects of replacing a historic roof. With some exceptions, most historic roofing materials are available today. If not, an architect or preservation group who has previously worked with the same type material may be able to recommend suppliers. Special roofing materials, such as tile or embossed metal shingles, can be produced by manufacturers of related products that are commonly used elsewhere, either on the exterior or interior of a structure. With some creative thinking and research, the historic materials usually can be found.



Because of the roof's visibility, the slate detailing around the dormers is important to the character of this structure. Note how the slates swirl from a horizontal pattern on the main roof to a diamond pattern on the dormer roofs and side walls. (18th and Que Streets, NW, Washington, D.C.)

Craft Practices: Determining the craft practices used in the installation of a historic roof is another major concern in roof restoration. Early builders took great pride in their work, and experience has shown that the "rustic" or irregular designs commercially labled "Early American" are a 20th-century invention. For example, historically, wood shingles underwent several distinct operations in their manufacture including splitting by hand, and smoothing the surface with a draw knife. In modern nomenclature, the same item would be a "tapersplit" shingle which has been dressed. Unfortunately, the rustic appearance of today's commercially available "handsplit" and re-sawn shingle bears no resemblance to the hand-made roofing materials used on early American buildings.



Good design and quality materials for the roof surface, fastenings, and flashing minimize roofing failures. This is essential on roofs such as on the National Cathedral where a thorough maintenance inspection and minor repairs cannot be done easily without special scaffolding. However, the success of the roof on any structure depends on frequent cleaning and repair of the gutter system. (Washington, D.C., photo courtesy of John Burns, A.I.A.)

Early craftsmen worked with a great deal of common sense; they understood their materials. For example they knew that wood shingles should be relatively narrow; shingles much wider than about 6" would split when walked on, or they may curl or crack from varying temperature and moisture. It is important to understand these aspects of craftsmanship, remembering that people wanted their roofs to be weather-tight and to last a long time. The recent use of "mother-goose" shingles on historic structures is a gross underestimation of the early craftsman's skills.

Supervision: Finding a modern craftsman to reproduce historic details may take some effort. It may even involve some special instruction to raise his understanding of certain historic craft practices. At the same time, it may be pointless (and expensive) to follow historic craft practices in any construction that will not be visible on the finished product. But if the roofing details are readily visible, their appearance should be based on architectural evidence or on historic prototypes. For instance, the spacing of the seams on a standing-seam metal roof will affect the building's overall scale and should therefore match the original dimensions of the seams.

Many older roofing practices are no longer performed because of modern improvements. Research and review of specific detailing in the roof with the contractor before beginning the project is highly recommended. For example, one early craft practice was to finish the ridge of a wood shingle roof with a roof "comb"—that is, the top course of one slope of the roof was extended uniformly beyond the peak to shield the ridge, and to provide some weather protection for the raw horizontal edges of the shingles on the other slope. If the "comb" is known to have been the correct detail, it should be used. Though this method leaves the top course vulnerable to the weather, a disguised strip of flashing will strengthen this weak point.

Detail drawings or a sample mock-up will help ensure that the contractor or craftsman understands the scope and special requirements of the project. It should never be assumed that the modern carpenter, slater, sheet metal worker, or roofer will know all the historic details. Supervision is as important as any other stage of the process.

Special problems inherent in the design of an elaborate historic roof can be controlled through the use of good materials and regular maintenance. The shape and detailing are essential elements of the building's historic character, and should not be modified, despite the use of alternative surface materials. (Gamwell House, Bellingham, Washington)

Alternative Materials

The use of the historic roofing material on a structure may be restricted by building codes or by the availability of the materials, in which case an appropriate alternative will have to be found.

Some municipal building codes allow variances for roofing materials in historic districts. In other instances, individual variances may be obtained. Most modern heating and cooking is fueled by gas, electricity, or oil—none of which emit the hot embers that historically have been the cause of roof fires. Where wood burning fireplaces or stoves are used, spark arrestor screens at the top of the chimneys help to prevent flaming material from escaping, thus reducing the number of fires that start at the roof. In most states, insurance rates have been equalized to reflect revised considerations for the risks involved with various roofing materials.

In a rehabilitation project, there may be valid reasons for replacing the roof with a material other than the original. The historic roofing may no longer be available, or the cost of obtaining specially fabricated materials may be prohibitive. But the decision to use an alternative material should be weighed carefully against the primary concern to keep the historic character of the building. If the roof is flat and is not visible from any elevation of the building, and if there are advantages to substituting a modern built-up composition roof for what might have been a flat metal roof, then it may make better economic and construction sense to use a modern roofing method. But if the roof is readily visible, the alternative material should match as closely as possible the scale, texture, and coloration of the historic roofing material.

Asphalt shingles or ceramic tiles are common substitute materials intended to duplicate the appearance of wood shingles, slates, or tiles. Fire-retardant, treated wood shingles are currently available. The treated wood tends, however, to be brittle, and may require extra care (and expense) to install. In some instances, shingles laid with an interlay of fire-retardent building paper may be an acceptable alternative.

Lead-coated copper, terne-coated steel, and aluminum/zinc-coated steel can successfully replace tin, terne plate, zinc, or lead. Copper-coated steel is a less expensive (and less durable) substitute for sheet copper.

The search for alternative roofing materials is not new. As early as the 18th century, fear of fire cause many wood shingle or board roofs to be replaced by sheet metal or clay tile. Some historic roofs were failures from the start, based on over-ambitious and naive use of materials as they were first developed. Research on a structure may reveal that an inadequately designed or a highly combustible roof was replaced early in its history, and therefore restoration of a later roof material would have a valid precedent. In some cities, the substitution of sheet metal on early row houses occurred as soon as the rolled material became available.

Cost and ease of maintenance may dictate the substitution of a material wholly different in appearance from the original. The practical problems (wind, weather, and roof pitch) should be weighed against the historical consideration of scale, texture, and color. Sometimes the effect of the alternative material will be minimal. But on roofs with a high degree of visibility and patterning or texture, the substitution may seriously alter the architectural character of the building.

Temporary Stabilization

It may be necessary to carry out an immediate and temporary stabilization to prevent further deterioration until research can determine how the roof should be restored or rehabilitated, or until funding can be provided to do a proper job. A simple covering of exterior plywood or roll roofing might provide adequate protection, but any temporary covering should be applied with caution. One should be careful not to overload the roof structure, or to damage or destroy historic evidence or fabric that might be incorporated into a new roof at a later date. In this sense, repairs with caulking or bituminous patching compounds should be recognized as potentially harmful, since they are difficult to remove, and at their best, are very temporary.

Precautions

The architect or contractor should warn the owner of any precautions to be taken against the specific hazards in installing the roofing material. Soldering of sheet metals, for instance, can be a fire hazard, either from the open flame or from overheating and undected smoldering of the wooden substrate materials.

Thought should be given to the design and placement of any modern roof appurtenances such as plumbing stacks, air vents, or TV antennas. Consideration should begin with the placement of modern plumbing on the interior of the building, otherwise a series of vent stacks may pierce the roof membrane at various spots creating maintenance problems as well as aesthetic ones. Air handling units placed in the attic space will require vents which, in turn, require sensitive design. Incorporating these in unused chimneys has been very successful

in the past.

Whenever gutters and downspouts are needed that were not on the building historically, the additions should be made as unobtrusively as possible, perhaps by painting them out with a color compatible with the nearby wall or trim.

Maintenance

Although a new roof can be an object of beauty, it will not be protective for long without proper maintenance. At least twice a year, the roof should be inspected against a checklist. All changes should be recorded and reported. Guidelines should be established for any foot traffic that may be required for the maintenance of the roof. Many roofing materials should not be walked on at all. For some—slate, asbestos, and clay tile—a self-supporting ladder might be hung over the ridge of the roof, or planks might be spanned across the roof surface. Such items should be specifically designed and kept in a storage space accessible to the roof. If exterior work ever requires hanging scaffolding, use caution to insure that the anchors do not penetrate, break, or wear the roofing surface, gutters, or flashing.

Any roofing system should be recognized as a membrane that is designed to be self-sustaining, but that can be easily damaged by intrusions such as pedestrian traffic or fallen tree branches. Certain items should be checked at specific times. For example, gutters tend to accumulate leaves and debris during the spring and fall and after heavy rain. Hidden gutter screening both at downspouts and over the full length of the gutter could help keep them clean. The surface material would require checking after a storm as well. Periodic checking of the underside of the roof from the attic after a storm or winter freezing may give early warning of any leaks. Generally, damage from water or ice is less likely on a roof that has good flashing on the outside and is well ventilated and insulated on the inside. Specific instructions for the maintenance of the different roof materials should be available from the architect or contractor.

Summary

The essential ingredients for replacing and maintaining a historic roof are:

- Understanding the historic character of the building and being sympathetic to it.
- Careful examination and recording of the existing roof and any evidence of earlier roofs.
- Consideration of the historic craftsmanship and detailing and implementing them in the renewal wherever visible.
- Supervision of the roofers or maintenance personnel to assure preservation of historic fabric and proper understanding of the scope and detailing of the project.
- Consideration of alternative materials where the original cannot be used.
- Cyclical maintenance program to assure that the staff understands how to take care of the roof and of the particular trouble spots to safeguard.

With these points in mind, it will be possible to preserve the architectural character and maintain the physical integrity of the roofing on a historic building.

This Preservation Brief was written by Sarah M. Sweetser, Architectural Historian, Technical Preservation Services Division. Much of the technical information was based upon an unpublished report prepared under contract for this office by John G. and Diana S. Waite. Some of the historical information was from Charles E. Peterson, FAIA, "American Notes," *Journal of the Society of Architectural Historians.*

The illustrations for this brief not specifically credited are from the files of the Technical Preservation Services Division.

The publication has been prepared pursuant to Executive Order 11593, "Protection and Enhancement of the Cultural Environment," which directs the Secretary of the Interior to ". . . develop and make available to Federal agencies and State and local governments information concerning professional methods and techniques for preserving, improving, restoring and maintaining historic properties." This brief was developed under the technical editorship of Lee H. Nelson, AIA, Technical Preservation Services Division, Office of Archeology and Historic Preservation, Heritage Conservation and Recreation Service, U.S. Department of the Interior, Washington, D.C. 20240. February 1978.

Decorative features such as cupolas require extra maintenance. The flashing is carefully detailed to promote run-off, and the wooden ribbing must be kept well-painted. This roof surface, which was originally tin plate, has been replaced with lead-coated copper for maintenance purposes. (Lyndhurst, Tarrytown, New York, photo courtesy of the National Trust for Historic Preservation)

Additional readings on the subject of roofing are listed below.

Boaz, Joseph N., ed. *Architectural Graphic Standards.* New York: John Wiley and Sons, Inc., 1970. (Modern roofing types and detailing)

Briggs, Martin S. *A Short History of the Building Crafts.* London: Oxford University Press, 1925. (Descriptions of historic roofing materials)

Bulletin of the Association for Preservation Technology. Vol. 2 (nos. 1-2) 1970. (Entirely on roofing)

Holstrom, Ingmar; and Sandstrom, Christina. *Maintenance of Old Buildings: Preservation from the Technical and Antiquarian Standpoint.* Stockholm: National Swedish Building Research, 1972. (Contains a section on roof maintenance problems)

Insall, Donald. *The Care of Old Buildings Today.* London: The Architectural Press, 1972. (Excellent guide to some problems and solutions for historic roofs)

Labine, R.A. Clem. "Repairing Slate Roofs." *The Old House Journal* 3 (no. 12, Dec. 1975): 6-7.

Lefer, Henry. "A Birds-eye View." *Progressive Architecture.* (Mar. 1977), pp. 88-92. (Article on contemporary sheet metal)

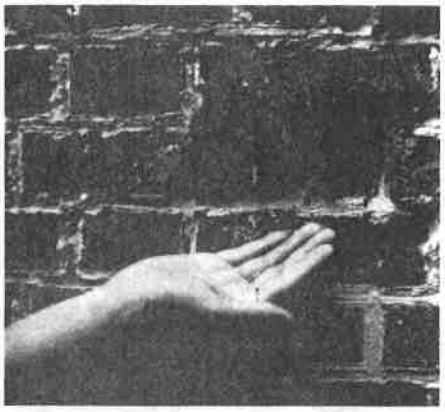
National Slate Association. *Slate Roofs.* Reprint of 1926 edition, now available from the Vermont Structural Slate Co., Inc., Fairhaven, VT 05743. (An excellent reference for the many designs and details of slate roofs)

Peterson, Charles E. "Iron in Early American Roofs." *The Smithsonian Journal of History* 3 (no. 3). Edited by Peter C. Welsh. Washington, D.C.: Smithsonian Institution, 1968, pp. 41-76.

Waite, Diana S. *Nineteenth Century Tin Roofing and its Use at Hyde Hall.* Albany: New York State Historic Trust, 1971.

——. "Roofing for Early America." *Building Early America.* Edited by Charles E. Peterson. Radnor, Penn.: Chilton Book Co., 1976.

6 PRESERVATION BRIEFS



Dangers of Abrasive Cleaning to Historic Buildings

Anne E. Grimmer

Technical Preservation Services Division

Heritage Conservation and Recreation Service

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

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

What is Abrasive Cleaning?

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

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

Why Are Abrasive Cleaning Methods Used?

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

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

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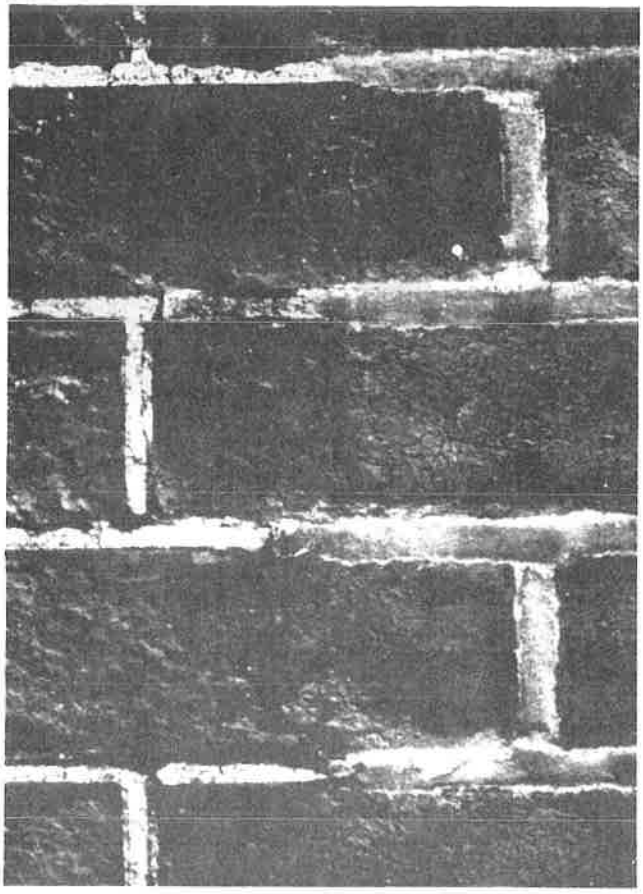
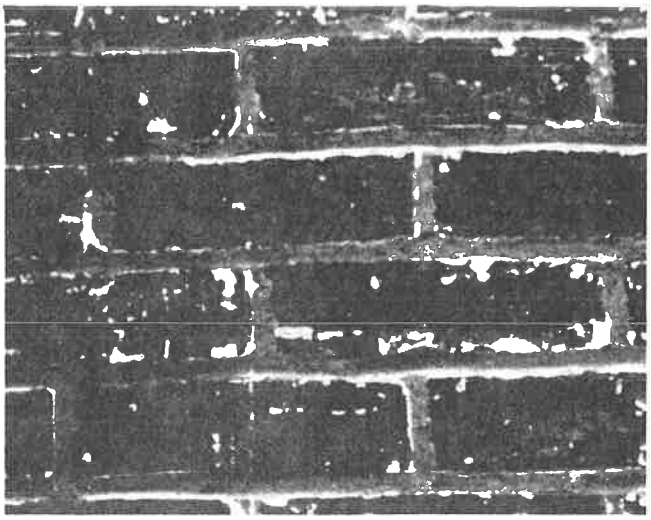


Abrasively Cleaned vs. Untouched Brick. *Two brick rowhouses with a common façade provide an excellent point of comparison when only one of the houses has been sandblasted. It is clear that abrasive blasting, by removing the outer surface, has left the brickwork on the left rough and pitted, while that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

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

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

Another reason for paint removal, particularly in rehabilitation projects, is to give the building a "new image" in response to contemporary design trends and to attract investors or tenants. Thus, it is necessary to consider the purpose of the intended cleaning. While it is clearly important to remove unsightly stains, heavy encrustations of dirt, peeling paint or other surface coatings, it may not be equally desirable to remove paint from a building which originally was painted. Many historic buildings which show only a slight amount of soil or discoloration are much better left as they are. A thin layer of soil is more often protective of the building fabric than it is harmful, and seldom detracts from the building's



Abrading the Surface without Removing the Paint. *Even though the entire outer surface layer of the brick has been sandblasted off, spots of paint still cling to the masonry. Sandblasting or other similarly abrasive methods are not always a successful means of removing paint.*

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

Problems of Abrasive Cleaning

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

Abrasive cleaning can destroy, or substantially diminish, decorative detailing on buildings such as a molded brickwork or architectural terra-cotta, ornamental carving on wood or stone, and evidence of historic craft techniques, such as tool marks and other surface textures. In addition, perfectly sound and/or "tooled" mortar joints can be worn away by abrasive techniques. This not only results in the loss of historic craft detailing but also requires repointing, a step involving con-

siderable time, skill and expense, and which might not have been necessary had a gentler method been chosen. Erosion and pitting of the building material by abrasive cleaning creates a greater surface area on which dirt and pollutants collect. In this sense, the building fabric "attracts" more dirt, and will require more frequent cleaning in the future.

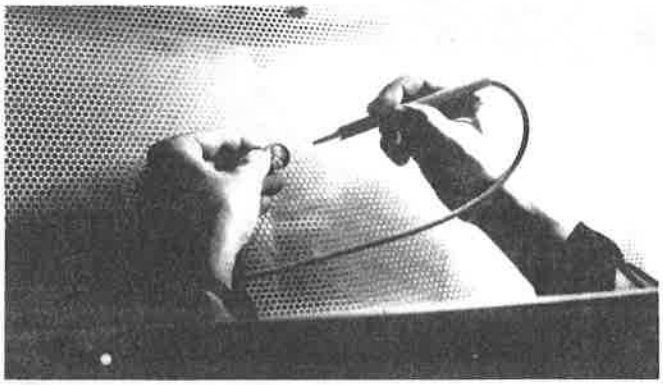
In addition to causing physical and aesthetic harm to the historic fabric, there are several adverse environmental effects of dry abrasive cleaning methods. Because of the friction caused by the abrasive medium hitting the building fabric, these techniques usually create a considerable amount of dust,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

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

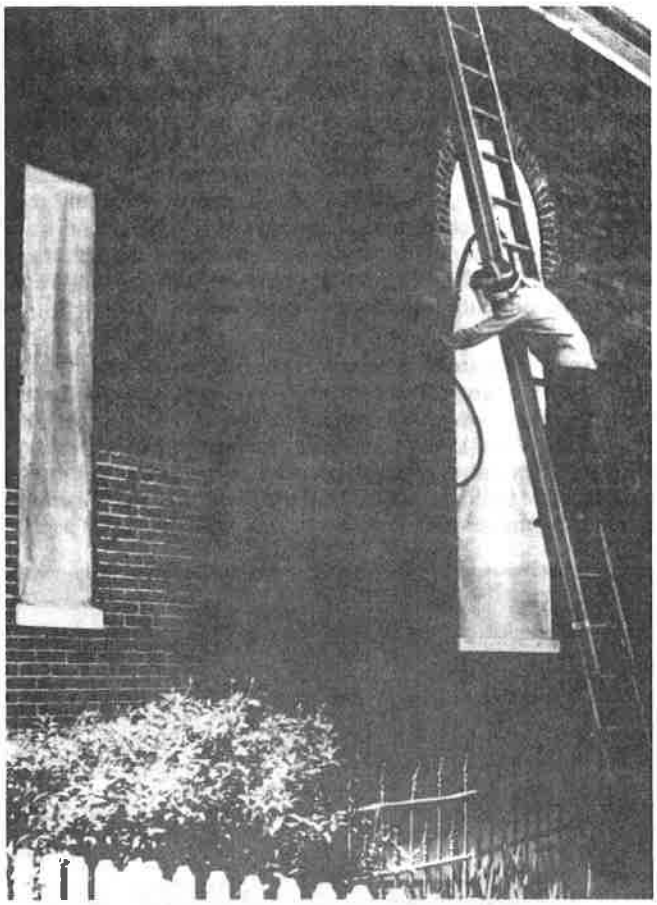
Variable Factors

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

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



Micro-Abrasive Cleaning. *This small, pencil-sized micro-abrasive unit is used by some museum conservators to clean small objects. This particular micro-abrasive unit is operated within the confines of a box (approximately 2 cubic feet of space), but a similar and slightly larger unit may be used for cleaning larger pieces of sculpture, or areas of architectural detailing on a building. Even a pressure cleaning unit this small is capable of eroding a surface, and must be carefully controlled.*



"Line Drop." *Even though the operator of the sandblasting equipment is standing on a ladder to reach the higher sections of the wall, it is still almost impossible to have total control over the pressure. The pressure of the sand hitting the lower portion of the wall will still be greater than that above, because of the "line drop" in the distance from the pressure source to the nozzle. (Hugh Miller)*

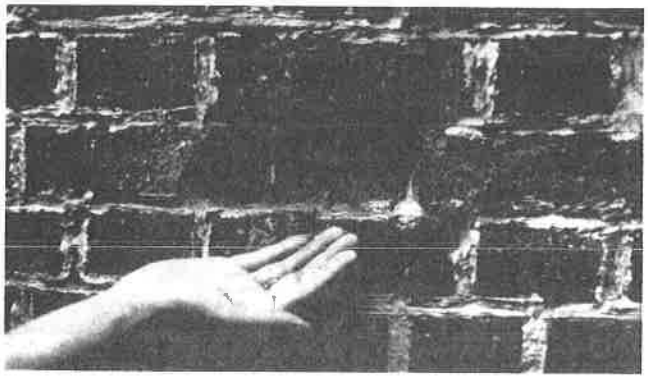
Pressure: The damaging effects of most of the variable factors involved in abrasive cleaning are self evident. However, the matter of pressure requires further explanation. In cleaning specifications, pressure is generally abbreviated as "psi" (pounds per square inch), which technically refers to the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

Despite the apparent care taken by most architects and building cleaning contractors to prepare specifications for pressure cleaning which will not cause harm to the delicate fabric of a historic building, it is very difficult to ensure that the same amount of pressure is applied to all parts of the building. For example, if the operator of the pressure equipment stands on the ground while cleaning a two-story structure, the amount of force reaching the first story will be greater than that hitting the second story, even if the operator stands on scaffolding or in a cherry picker, because of the "line drop" in the distance from the pressure source to the nozzle. Although technically it may be possible to prepare cleaning specifications with tight controls that would eliminate all but a small margin of error, it may not be easy to find professional cleaning firms willing to work under such restrictive conditions. The fact is that many professional building cleaning firms do not really understand the extreme delicacy of historic building fabric, and how it differs from modern construction materials. Consequently, they may ac-

cept building cleaning projects for which they have no experience.

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

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



Spalling Brick. *This soft, early 19th-century brick was sandblasted in the 1960s; consequently, severe spalling has resulted. Some bricks have almost totally disintegrated, and will eventually have to be replaced. (Robert S. Gamble)*

Historic: By contrast, conscientious dry or wet abrasive cleaning of a historic structure would be conducted within the range of 20 to 100 psi at a range of 3 to 12 inches. Cleaning at this low pressure requires the use of a very fine 00 or 0 mesh grit forced through a nozzle with a ¼ inch opening. A similar, even more delicate method being adopted by architectural conservators uses a micro-abrasive grit on small, hard-to-clean areas of carved, cut or molded ornament on a building façade. Originally developed by museum conservators for cleaning sculpture, this technique may employ glass beads, micro-balloons, or another type of micro-abrasive gently powered at approximately 40 psi by a very small, almost pencil-like pressure instrument. Although a slightly larger pressure instrument may be used on historic buildings, this technique still has limited practical applicability on a large scale building cleaning project because of the cost and the relatively few technicians competent to handle the task. In general, architectural conservators have determined that only through very controlled conditions can most historic building material be abrasively cleaned of soil or paint without measurable damage to the surface or profile of the substrate.

Yet some professional cleaning companies which sepcialize in cleaning historic masonry buildings use chemicals and water at a pressure of approximately 1,500 psi, while other cleaning firms recommend lower pressures ranging from 200 to 800 psi for a similar project. An architectural conservator might decide, *after testing*, that some historic structures could be cleaned properly using a moderate pressure (200–600 psi), or even a high pressure (600–1800 psi) water rinse. However, cleaning historic buildings under such high pressure should be considered an exception rather than the rule, and would require *very careful* testing and supervision to assure that the historic surface materials could withstand the pressure without gouging, pitting or loosening.

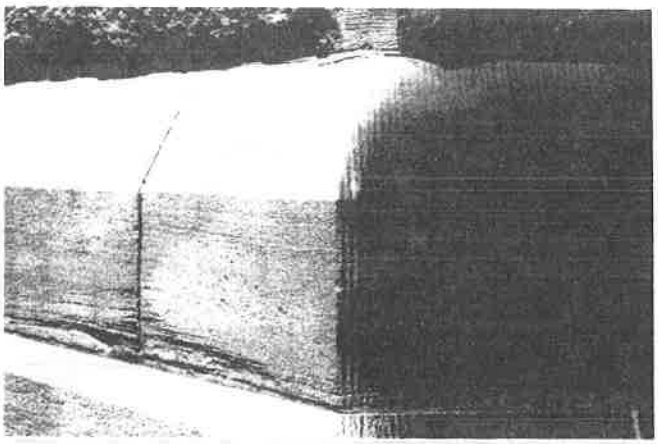
These differences in the amount of pressure used by commercial or industrial building cleaners and architectural conservators point to one of the main problems in using abrasive means to clean historic buildings: misunderstanding of the potentially fragile nature of historic building materials. There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

How Building Materials React to Abrasive Cleaning Methods

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

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

Building Stones: Building stones are cut from the three main categories of natural rock: dense, igneous rock such as granite; sandy, sedimentary rock such as limestone or sandstone; and crystalline, metamorphic rock such as marble. As op-

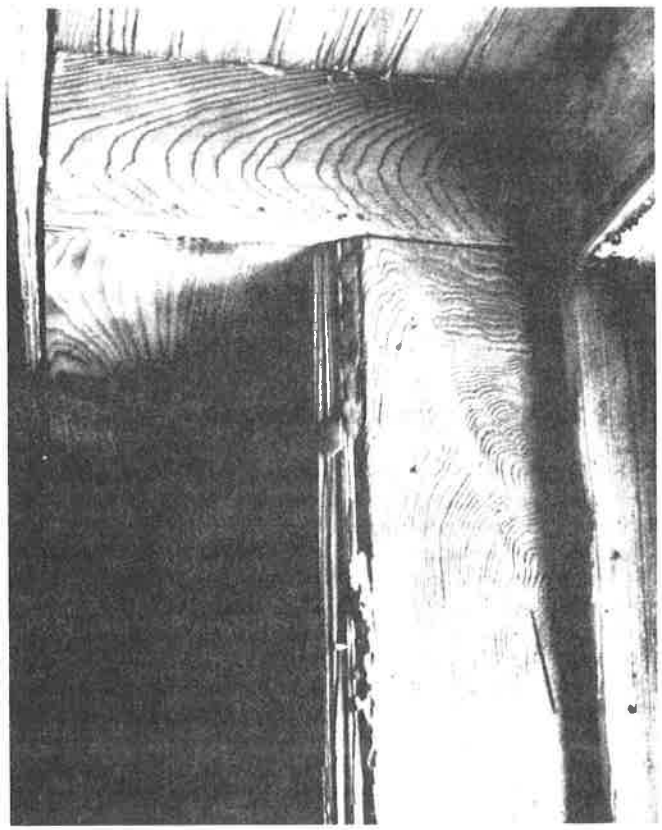


Abrasive Cleaning of Tooled Granite. *Even this carefully controlled "wet grit" blasting has erased vertical tooling marks in the cut granite blocks on the left. Not only has the tooling been destroyed, but the damaged stone surface is now more susceptible to accelerated weathering.*

posed to kiln-dried masonry materials such as brick and architectural terra-cotta, building stones are generally homogeneous in character at the time of a building's construction. However, as the stone is exposed to weathering and environmental pollutants, the surface may become friable, or may develop a protective skin or patina. These outer surfaces are very susceptible to damage by abrasive or improper chemical cleaning.

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

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



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

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

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

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

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

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

Cast and wrought iron architectural elements may be gently sandblasted or abrasively cleaned using a wire brush to remove layers of paint, rust and corrosion. Sandblasting was, in fact, developed originally as an efficient maintenance procedure for engineering and industrial structures and heavy machinery—iron and steel bridges, machine tool frames, engine frames, and railroad rolling stock—in order to clean and prepare them for repainting. Because iron is hard, its surface,

which is naturally somewhat uneven, will not be noticeably damaged by controlled abrasion. Such treatment will, however, result in a small amount of pitting. But this slight abrasion creates a good surface for paint, since the iron must be repainted immediately to prevent corrosion. Any abrasive cleaning of metal building components will also remove the caulking from joints and around other openings. Such areas must be recaulked quickly to prevent moisture from entering and rusting the metal, or causing deterioration of other building fabric inside the structure.

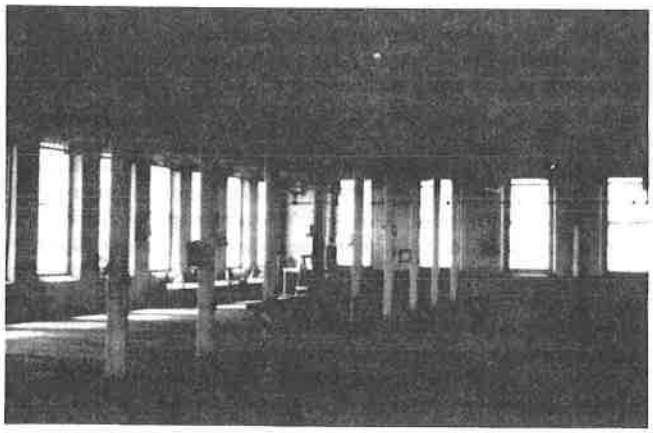
When is Abrasive Cleaning Permissible?

For the most part, abrasive cleaning is destructive to historic building materials. A limited number of special cases have been explained when it may be appropriate, if supervised by a skilled conservator, to use a delicate abrasive technique on some historic building materials. The type of "wet grit" cleaning which involves a small amount of grit injected into a stream of low pressure water may be used on small areas of stone masonry (i.e., rough cut limestone, sandstone or unpolished granite), where milder cleaning methods have not been totally successful in removing harmful deposits of dirt and pollutants. Such areas may include stone window sills, the tops of cornices or column capitals, or other detailed areas of the façade.

This is still an abrasive technique, and without proper caution in handling, it can be *just as harmful to the building surface as any other abrasive cleaning method.* Thus, the decision to use this type of "wet grit" process should be made only after consultation with an experienced building conservator. Remember that *it is very time consuming and expensive to use any abrasive technique on a historic building in such a manner that it does not cause harm to the often fragile and friable building materials.*

At this time, and only under certain circumstances, abrasive cleaning methods may be used in the rehabilitation of interior spaces of warehouse or industrial buildings for contemporary uses.

Interior spaces of factories or warehouse structures in which the masonry or plaster surfaces do not have significant design, detailing, tooling or finish, and in which wooden architectural features are not finished, molded, beaded or worked by hand, may be cleaned abrasively in order to remove layers of paint and industrial discolorations such as smoke, soot, etc. It is expected after such treatment that brick surfaces will be rough and pitted, and wood will be somewhat frayed or "fuzzy" with raised wood grain. These nonsignificant surfaces will be damaged and have a roughened texture, but because they are interior elements, they will not be subject to further deterioration caused by weathering.



Permissible Abrasive Cleaning. *In accordance with the Secretary of the Interior's* Guidelines for Rehabilitation Projects, *it may be acceptable to use abrasive techniques to clean an industrial interior space such as that illustrated here, because the masonry surfaces* do not *have significant design, detailing, tooling or finish, and the wooden architectural features are not finished, molded, beaded or worked by hand.*

Historic Interiors that Should Not Be Cleaned Abrasively

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

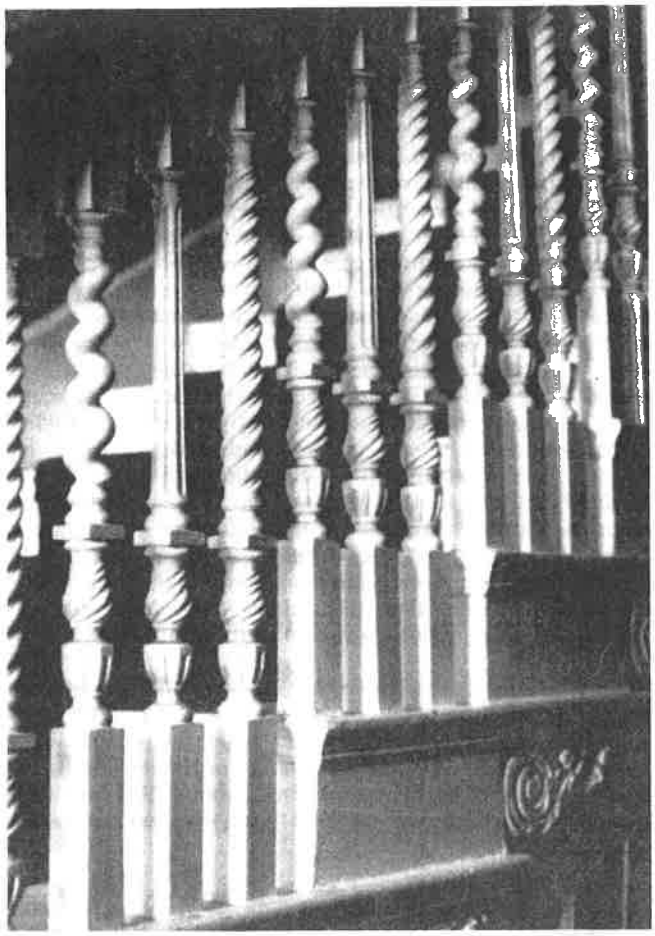
Thus, it is not acceptable to clean abrasively interiors of historic residential and commercial properties which have *finished* interior spaces featuring milled woodwork such as doors, window and door moldings, wainscoting, stair balustrades and mantelpieces. Even the most modest historic *house* interior,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

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

"Gentlest Means Possible"

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

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



Do not Abrasively Clean these Interiors. *Most historic residential and some commercial interior spaces contain finished plaster and wooden elements such as this stair balustrade and paneling which contribute to the historic and architectural character of the structure. Such interiors should not be subjected to abrasive techniques for the purpose of removing paint, dirt, discoloration or plaster.*

useful in removing thick encrustations of soot. A limewash or absorbent talc, whiting or clay poultice with a solvent can be used effectively to draw out salts or stains from the surface of the selected areas of a building façade. It is almost impossible to remove paint from masonry surfaces without causing some damage to the masonry, and it is best to leave the surfaces as they are or repaint them if necessary.

Some physicists are experimenting with the use of pulsed laser beams and xenon flash lamps for cleaning historic masonry surfaces. At this time it is a slow, expensive cleaning method, but its initial success indicates that it may have an increasingly important role in the future.

There are many chemical paint removers which, when applied to painted wood, soften and dissolve the paint so that it can be scraped off by hand. Peeling paint can be removed from wood by hand scraping and sanding. Particularly thick layers of paint may be softened with a heat gun or heat plate, providing appropriate precautions are taken, and the paint film scraped off by hand. Too much heat applied to the same spot can burn the wood, and the fumes caused by burning paint are dangerous to inhale, and can be explosive. Furthermore, the hot air from heat guns can start fires in the building cavity. Thus, adequate ventilation is important when using a heat gun or heat plate, as well as when using a chemical stripper. A torch or open flame should never be used.

Preparations for Cleaning: It cannot be overemphasized that all of these cleaning methods must be approached with caution. When using any of these procedures which involve water or other liquid cleaning agents on masonry, it is imperative that *all* openings be tightly covered, and all cracks or joints be well pointed in order to avoid the danger of water penetrating the building's façade, a circumstance which might result in serious moisture related problems such as efflorescence and/or subflorescence. Any time water is used on masonry as a cleaning agent, either in its pure state or in combination with chemical cleaners, it is very important that the work be done in warm weather when there is no danger of frost for several months. Otherwise water which has penetrated the masonry may freeze, eventually causing the surface of the building to crack and spall, which may create another conservation problem more serious to the health of the building than dirt.

Each kind of masonry has a unique composition and reacts differently with various chemical cleaning substances. Water and/or chemicals may interact with minerals in stone and cause new types of stains to leach out to the surface immediately, or more gradually in a delayed reaction. What may be a safe and effective cleaner for certain stain on one type of stone, may leave unattractive discolorations on another stone, or totally dissolve a third type.

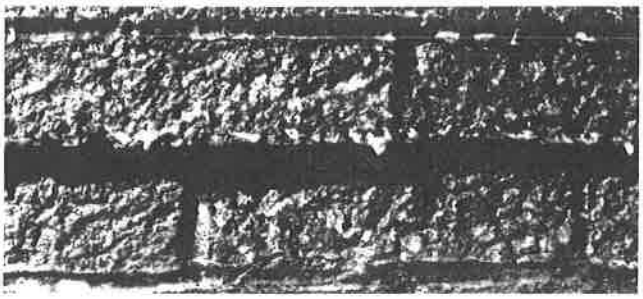
Testing: Cleaning historic building materials, particularly masonry, is a technically complex subject, and thus, should never be done without expert consultation and testing. No cleaning project should be undertaken without first applying the intended cleaning agent to a representative test patch area in an inconspicuous location on the building surface. The test patch or patches should be allowed to weather for a period of time, preferably through a complete seasonal cycle, in order to determine that the cleaned area will not be adversely affected by wet or freezing weather or any by-products of the cleaning process.

Mitigating the Effects of Abrasive Cleaning

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

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

Softer types of masonry, particularly brick and architectural terra-cotta, are the most likely to require some remedial treatment if they have been abrasively cleaned. Old brick, being essentially a soft, baked clay product, is greatly susceptible to increased deterioration when its hard, outer skin is removed through abrasive techniques. This problem can be minimized by painting the brick. An alternative is to treat it with a clear sealer or surface coating but this will give the masonry a glossy or shiny look. It is usually preferable to paint the brick rather than to apply a transparent sealer since



Hazards of Sandblasting and Surface Coating. *In order to "protect" this heavily sandblasted brick, a clear surface coating or sealer was applied. Because the air temperature was too cold at the time of application, the sealer failed to dry properly, dripping in places, and giving the brick surface a cloudy appearance.*

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

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

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

Summary

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

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

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

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

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7 PRESERVATION BRIEFS

The Preservation of Historic Glazed Architectural Terra-Cotta

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Glazed architectural terra-cotta was significant in the development of important architectural idioms in this country—specifically, the "Chicago School," the High Rise and the Historic or Beaux Arts styles. In fact, glazed architectural terra-cotta is one of the most prevalent masonry building materials found in the urban environment today (Fig. 1). Popular between the late 19th century and the 1930s, glazed architectural terra-cotta offered a modular, varied and relatively inexpensive approach to wall and floor construction. It was particularly adaptable to vigorous and rich ornamental detailing. However, with changing vogues in materials and architectural styles and rising production costs, glazed architectural terra-cotta fell into disfavor and disuse by the mid-20th century.

Today, information on the maintenance, rehabilitation and replacement of glazed architectural terra-cotta is limited, as are sources of new glazed architectural terra-cotta. This report, then, will discuss some of the major deterioration problems that commonly occur in historic glazed architectural terra-cotta, methods of determining the extent of that deterioration and recommendations for the maintenance, repair and replacement of the deteriorated historic material.

What is Terra-Cotta?

Generically, the broadest definition of terra-cotta refers to a high grade of weathered or aged clay which, when mixed with sand or with pulverized fired clay, can be molded and fired at high temperatures to a hardness and compactness not obtainable with brick. Simply put, terra-cotta is an enriched molded clay brick or block. The word *terra-cotta* is derived from the Latin word *terra-cocta*—literally, "cooked earth." Terra-cotta clays vary widely in color according to geography and types, ranging from red and brown to white.

Terra-cotta was usually hollow cast in blocks which were open to the back, like boxes, with internal compartment-like stiffeners called webbing (Fig. 2). Webbing substantially strengthened the load-bearing capacity of the hollow terra-cotta block without greatly increasing its weight.

Terra-cotta blocks were often finished with a glaze; that is, a slip glaze (clay wash) or an aqueous solution of metal salts was brushed or sprayed on the air-dried block before firing. Glazing changed the color, imitated different finishes, and produced a relatively impervious surface on the weather face of the final product. The glaze on the terra-cotta unit possessed excellent weathering properties when properly maintained. It had rich color and provided a hard surface that was not easily chipped off. Glazing offered unlimited and fade-resistant colors to the designer. Even today, few building materials can match the glazes on terra-cotta for the range and, most importantly, the durability of colors.

Types of Terra-Cotta

Historically there are four types or categories of terra-cotta which have enjoyed wide use in the history of the American building arts: 1) brownstone, 2) fireproof construction, 3) ceramic veneer, and 4) glazed architectural.

Brownstone terra-cotta is the variety of this masonry material used earliest in American buildings (mid- to late 19th century). The brownstone type is a dark red or brown block either glazed (usually a slip glaze) or unglazed. It was hollow cast and was generally used in conjunction with other masonry in imitation of sandstone, brick or real brownstone. It is often found in the architecture of Richard Upjohn, James Renwick, H. H. Richardson and is associated with the Gothic and Romanesque Revival movements through such ornamental detailing as moldings, finials and capitals.

Fireproof construction terra-cotta was extensively developed as a direct result of the growth of the High Rise building in America. Inexpensive, lightweight and fireproof, these rough-finished hollow building blocks were ideally suited to span the I-beam members in floor, wall and ceiling construction (Fig. 3). Certain varieties are still in production today, although fireproof construction terra-cotta is no longer widely employed in the building industry.

Ceramic veneer was developed during the 1930s and is still used extensively in building construction today. Unlike traditional architectural terra-cotta, ceramic veneer is not hollow cast, but is as its name implies: a veneer of glazed ceramic tile which is ribbed on the back in much the same fashion as bathroom tile. Ceramic veneer is frequently attached to a grid of metal ties which has been anchored to the building.

Glazed architectural terra-cotta was the most complex development of terra-cotta as a masonry building material in this country. The hollow units were hand cast in molds or carved in clay and heavily glazed (often in imitation of stone) and fired. Sometimes called "architectural ceramics," glazed architectural terra-cotta was developed and refined throughout the first third of the 20th century and has been closely associated with the architecture of Cass Gilbert, Louis Sullivan, and Daniel H. Burnham, among others. Significant examples in this country include the Woolworth Building (1913) in New York City and the Wrigley Building (1921) in Chicago.

Late 19th and early 20th century advertising promoted the durable, impervious and adaptable nature of glazed archi-

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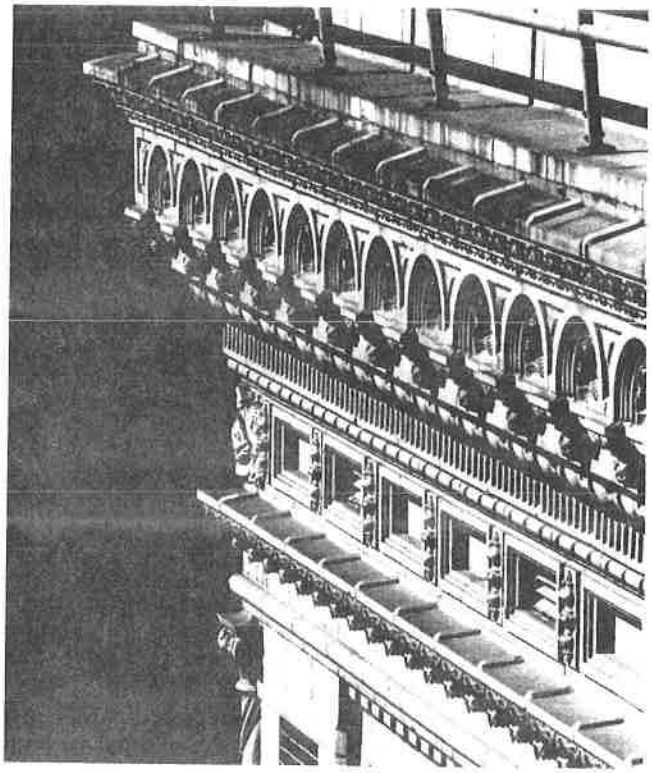


Figure 1. Terra-Cotta Detailing. *Adaptable to every nuance of color, texture, and modeling, glazed architectural terra-cotta was ideally suited to satisfy the tastes of an eclectic age. Its popularity was, however, short lived; it endured only 30 or 40 years after its introduction as a building material late in the 19th century.* (Larry Payne, Houston, Texas)

tectural terra-cotta. It provided for crisp, vigorous modeling of architectural details as the molds were cast directly from clay prototypes without loss of refinement. Glazed architectural terra-cotta could accommodate subtle nuances of modeling, texture and color. Compared to stone, it was easier to handle, quickly set and more affordable to use. Thought to be fireproof and waterproof, it was readily adaptable to structures of almost any height. The cost of molding the clay, glazing and firing the blocks, when compared to carving stone, represented a considerable savings, especially when casts were used in a modular fashion—that is, repeated over and over again. Maintenance of the fired and glazed surface was easy; it never needed paint and periodic washings restored its original appearance.

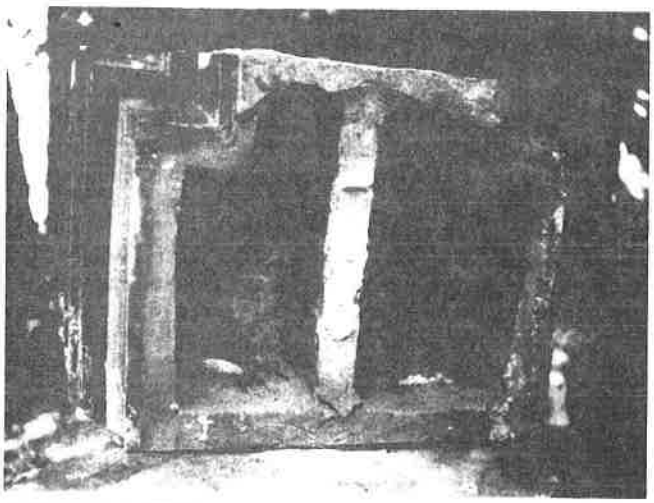


Figure 2. Webbing. *Webbing, or the hollow internal compartment construction of glazed architectural terra-cotta blocks, made them inexpensive to produce, easy to handle and light in construction; these were significant factors in the popularity of the material in the first decades of this century.*

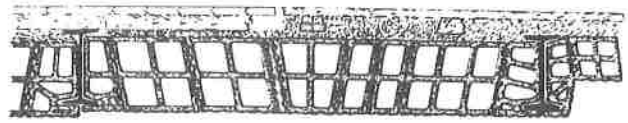
With the passage of time, many of the phenomenal claims of the early proponents of glazed architectural terra-cotta have proven true. There are many examples throughout this country that attest to the durability and permanence of this material. Yet present-day deterioration of other significant glazed architectural terra-cotta resources ultimately belie those claims. Why? Historically, the lack of foresight or understanding about the nature and limitations of the material has, in many instances, allowed serious deterioration problems to occur that are only now becoming apparent.

Characteristics of Glazed Architectural Terra-Cotta as a Building Material

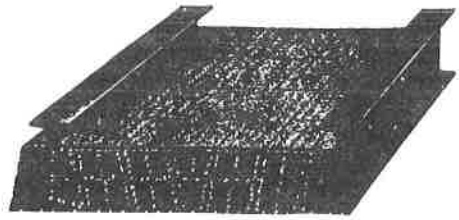
Glazed architectural terra-cotta has many material properties similar to brick or stone. It also has many material properties radically different from those traditional masonry materials. It is those differences which must be considered for a better understanding of some of the material characteristics of glazed architectural terra-cotta when it is used as a building material.

Difficult to identify: Glazed architectural terra-cotta probably comprises one of the largest if not the largest constituent material in some of our urban environments today. However, the infinite varieties of glazing have hidden this fact from the casual observer. One of the attractive features of glazed architectural terra-cotta in its time was that it could be finished (glazed) in exact imitation of stone. In fact, many building owners and architects alike are often surprised to discover that what they presumed to be a granite or limestone building is glazed architectural terra-cotta instead.

Two separate systems: Historically, glazed architectural terra-cotta has been used in association with two specific and very different types of building systems: as part of a traditional *load-bearing* masonry wall in buildings of modest height, and as a *cladding material* in High Rise construction. As cladding, glazed architectural terra-cotta often utilized an extensive metal anchoring system to attach it or to "hang it" onto a wall framing system or superstructure (Fig. 4). In the first instance the anchoring was limited; in the second, the anchoring was often extensive and complex. Likewise, in the first instance, deterioration has generally been limited. However, where glazed architectural terra-cotta was used as clad-



Section Through Typical Arch



Perspective of Typical Arch

Figure 3. Fireproof construction terra-cotta. *Perspective and section through fireproof construction terra-cotta and I-beam detailing in industrial floor construction.* (*Detail,* "Sweets" Industrial Catalogue of Building Construction, *1906*)

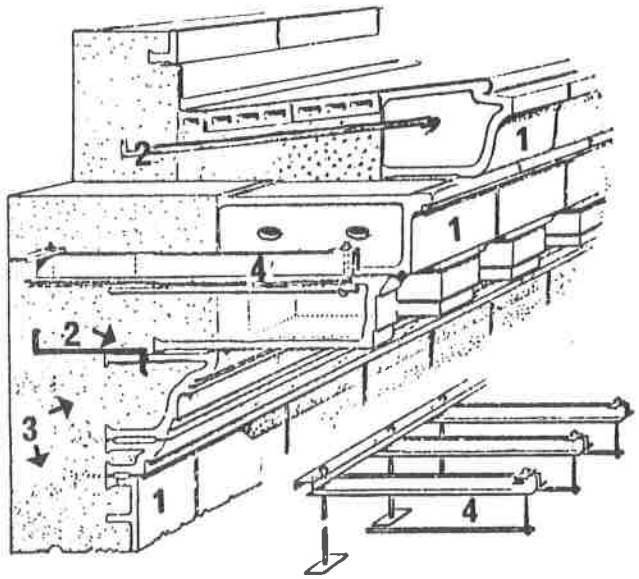


Figure 4. Typical Construction Detail of Glazed Architectural Terra-Cotta Ornament. *Construction detailing was often complex. The terra-cotta units (1) which were laid in mortar were fitted with holes or slots to receive the metal anchors (2) (often called "Z" straps or "light iron") which were often fitted directly to the building frame. Masonry backfill (3)(either brick or poured cement) was laid between the terra-cotta units, with the building frame encasing the metal anchor. Overhanging or protruding elements were further secured by metal dowels or outriggers (4). (Detail,* Architectural Terra Cotta, *Charles E. White, Jr., 1920)*

ding, particularly in high rise construction, present-day deterioration and failure are often severe.

Complexity of deterioration: Deterioration is, by nature of the design, infinitely complex—particularly when glazed architectural terra-cotta has been used as a cladding material. Deterioration creates a "domino"-like breakdown of the whole system: glazed units, mortar, metal anchors, and masonry backfill. In no other masonry system is material failure potentially so complicated.

Poor original design: The root of deterioration in glazed architectural terra-cotta systems often lies in a misapplication of the material. Historically, glazed architectural terra-cotta was viewed as a highly waterproof system needing neither flashing, weep holes nor drips. This supposition, however, has proved to be untrue, as serious water-related failure was evident early in the life of many glazed architectural terra-cotta clad or detailed buildings.

Common Deterioration Problems

No one case of deterioration in glazed architectural terra-cotta is ever identical to another owing to the infinite number of variations with the material: original manufacture, original installation inconsistencies, number of component parts, ongoing repairs or the various types and sources of deterioration. However, certain general statements may be made on the nature of glazed architectural terra-cotta deterioration.

Material failure can most commonly be attributed to water-related problems. However, less frequent though no less severe causes may include: faulty original craftsmanship, which is often cited but hard to determine; stress-related deterioration; damage caused by later alterations and additions; or inappropriate repairs.

Water-related deterioration: As with most building conservation and rehabilitation problems, water is a principal source of deterioration in glazed architectural terra-cotta. Terra-cotta systems are highly susceptible to such complex water-related deterioration problems as glaze crazing, glaze spalling and material loss, missing masonry units and deteriorated metal anchoring, among others.

Crazing, or the formation of small random cracks in the glaze, is a common form of water-related deterioration in glazed architectural terra-cotta. When the new terra-cotta unit first comes from the kiln after firing, it has shrunken (dried) to its smallest possible size. With the passage of time, however, it expands as it absorbs moisture from the air, a process which may continue for many years. The glaze then goes into tension because it has a lesser capacity for expansion than the porous tile body; it no longer "fits" the expanding unit onto which it was originally fired. If the strength of the glaze is exceeded, it will crack (craze) (Fig. 5). Crazing is a process not unlike the random hairline cracking on the surface of an old oil painting. Both may occur as a normal process in the aging of the material. Unless the cracks visibly extend into the porous tile body beneath the glaze, crazing should not be regarded as highly serious material failure. It does, however, tend to increase the water absorption capability of the glazed architectural terra-cotta unit.

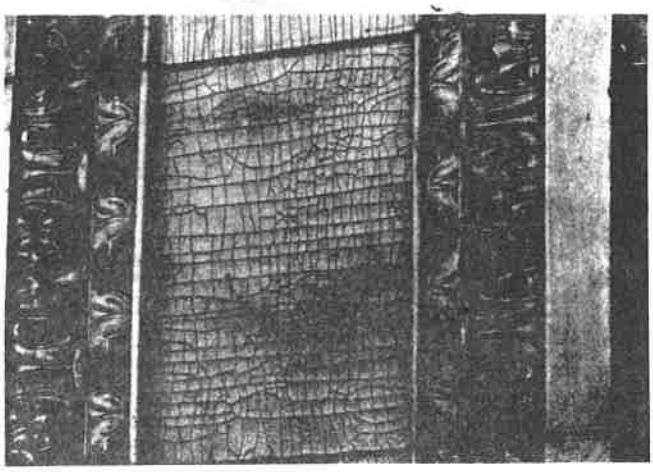


Figure 5. Crazing. *Water and air-borne moisture entering the glazed architectural terra-cotta causes expansion of the porous clay body which increases its volume. This, in turn, is sufficient to upset the "fit" of the glaze and to make it shatter, commonly called crazing.*

Spalling, the partial loss of the masonry material itself, is, like crazing, caused by water and is usually a result not only of air-borne water but more commonly of water trapped within the masonry system itself. Trapped water is often caused by poor water detailing in the original design, insufficient maintenance, rising damp or a leaking roof. In most cases, trapped water tends to migrate outward through masonry walls where it eventually evaporates. In glazed architectural terra-cotta, the water is impeded in its journey by the relatively impervious glaze on the surface of the unit which acts as a water barrier. The water is stopped at the glaze until it builds up sufficient pressure (particularly in the presence of widely fluctuating temperatures) to pop off sections of the glaze (glaze spalling) or to cause the wholesale destruction of portions of the glazed architectural terra-cotta unit itself (material spalling).

Glaze spalling may appear as small coin-size blisters where the glaze has ruptured and exposed the porous tile body beneath (Fig. 6). This may occur as several spots on the surface or, in more advanced cases of deterioration, it may result in the wholesale disappearance of the glaze. Spalling of the glaze may also be symptomatic of deterioration (rusting) of the internal metal anchoring system which holds the terra-cotta units together and to the larger building structure. The increase in volume of the metal created by rusting creates increased internal pressures in the terra-cotta unit which, in

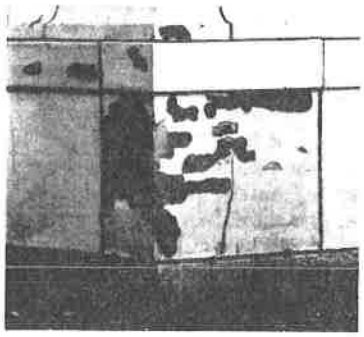


Figure 6. Glaze Spalling. *Blistering of the glaze, like crazing, is the result of the increase in water in the porous clay body and the subsequent destruction of the glaze as a result of water migration and pressure. Glaze spalling may also be caused by deterioration of metal anchors behind the terra-cotta unit.*

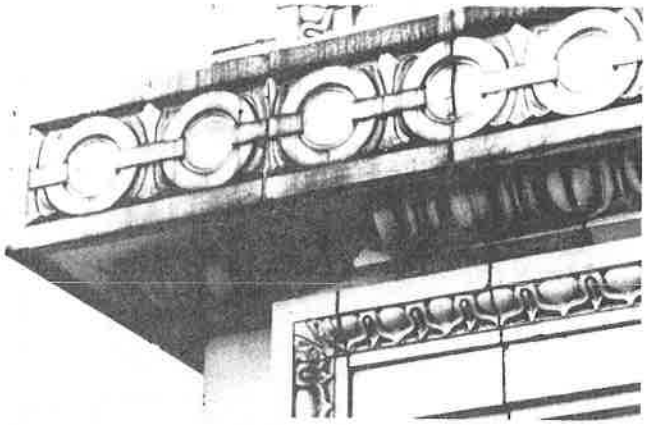


Figure 7. Material Spalling. *Excessive expansion of the porous tile body caused by water and freezing temperatures produces major material spalling, a situation often difficult to repair.*

turn, may spall the glaze, or in more extreme cases, cause material spalling.

Material spalling is a particularily severe situation. Not only is the visual integrity of the detailing impaired, but a large area of the porous underbody, webbing and metal anchoring is exposed to the destructive effects of further water entry and deterioration (Fig. 7). Both glaze and material spalling must be dealt with as soon as possible.

Figure 8. Deterioration of Exposed Detailing. *Exposed or freestanding terra-cotta detailing (parapets, urns, balusters, etc.) have traditionally been subject to the most severe vicissitudes of deterioration as a result of freezing temperatures and water.* (Colorado State Historic Preservation Office)

Missing units is a serious situation which particularly plagues architectural terra-cotta systems. Unlike brick or stone, damaged glazed architectural terra-cotta is exceedingly difficult to replace. New production is extremely limited. Missing units create gaps which increase the structural load on the remaining pieces and also permit water to enter the system. Exposed or freestanding glazed architectural terra-cotta detailing (balusters, urns, parapet walls, etc.) are particularly susceptible to extensive loss of material (Fig. 8). These elements face the most severe vicissitudes of water- and temperature-related deterioration in direct proportion to the extent of their exposure. The replacement of missing units should be a high priority work item in the rehabilitation of glazed architectural terra-cotta.

Deterioration of metal anchoring: Deteriorated anchoring systems are perhaps the most difficult form of glazed architectural terra-cotta deterioration to locate or diagnose. Often, the damage must be severe and irreparable before it is noticed on even the most intense "prima facie" examination. Water which enters the glazed architectural terra-cotta system can rust the anchoring system and substantially weaken or completely disintegrate those elements. Where water has been permitted to enter the system, some deterioration has more than likely taken place. Partial deterioration results in staining and material spalling. Total deterioration and the lack of any anchoring system may result in the loosening of the units themselves, threatening the architectural or structural integrity of the building. Recently, falling glazed architectural terra-cotta units have become a serious safety concern to many building owners and municipal governments (Fig. 9). Early detection of failing anchoring systems is exceedingly difficult.

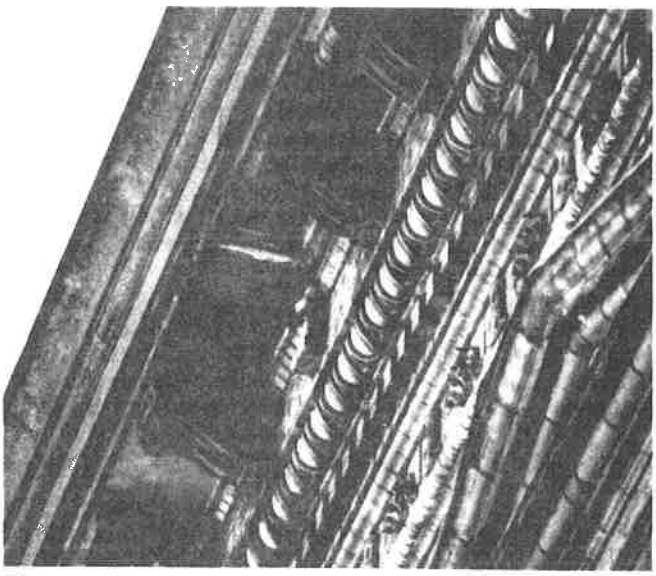


Figure 9. Deterioration of Metal Anchoring and Masonry Backfill. *Trapped water may deteriorate masonry backfill or rust metal anchoring causing overhanging architectural elements to loosen and drop from the building. This is particularly true when unmaintained roof drainage systems fail and soak the masonry system. Note the exposed metal anchoring.*

Deterioration of mortar and other adjacent materials: Deteriorated mortar has always been a key to the survival or failure of any masonry system. This is particularly true with glazed architectural terra-cotta. In recognition of the fragile nature of the system, the need for insuring a relatively dry internal system is important. Sound mortar is the "first line" of defense in terra-cotta systems. It is a maintenance "must." Deteriorated mortar joints are a singularly culpable source of water and, therefore, of deterioration. Mortar deterioration may result from improper original craftsmanship or air-

and water-borne pollution. More often, however, lack of ongoing maintenance is mainly responsible. Deteriorated mortar should not be overlooked as a major source of glazed architectural terra-cotta failure.

The deterioration of materials adjoining the glazed architectural terra-cotta (flashing, capping, roofing, caulking around windows and doors) bears significant responsibility in its deterioration. When these adjoining materials fail, largely as a result of lack of maintenance, water-related deterioration results. For instance, it is not uncommon to find wholesale terra-cotta spalling in close proximity to a window or doorway where the caulking has deteriorated.

Stress-related deterioration: Stress-related deterioration of glazed architectural terra-cotta frequently occurs in high rise buildings. The evolution of stress relieving details (flexible joints, shelf angles, etc.) occurred late in the development of American building construction. Consequently, most early continuously clad High Rise buildings (c.1900–1920s) had little or no provisions for normal material and building movement in their original design. The development of large stress-related cracks or wholesale material deterioration is often caused by unaccommodated building-frame shortening under load, thermal expansion and contraction of the façade and moisture expansion of the glazed architectural terra-cotta units themselves (Fig. 10). Cracks running through many units or stories or large areas of material deterioration often indicate stress-related problems. This sort of deterioration, in turn, permits significant water entry into the terra-cotta system.

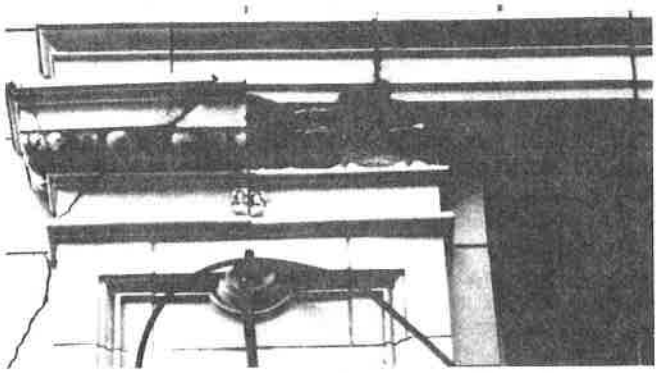


Figure 10. Structural Cracking. *Structural cracking, whether static (nonmoving) or dynamic (moving or active), should be caulked to prevent water entry into the glazed architectural terra-cotta system. Note the exposed webbing.*

Inappropriate repairs: Inappropriate repairs result because using new terra-cotta for replacement of deteriorated or missing glazed architectural terra-cotta has generally been impractical. Repairs, therefore, have traditionally been made in brick or cementitious build ups of numerous materials such as stucco or fiberglass. Some materials *are appropriate* temporary or permanent replacements, while others are not. (These issues are discussed at a later point in this report.) However, improper anchoring or bonding of the repair work or visual incompatibility of repairs have themselves, with the passage of time, become rehabilitation problems: replacement brick that is pulling free, cement stucco that is cracking and spalling, or a cement or bituminous repairs that are not visually compatible with the original material.

Alteration damage: Alteration damage has occurred as a result of the installation of such building additions as signs, screens, marquees or bird proofing. These installations often necessitated the boring of holes or cutting of the glazed architectural terra-cotta to anchor these additions to the building frame beneath. As the anchoring or caulking deteriorated, or as these elements were removed in subsequent renovation work, these holes have become significant sources of water-related damage to the glazed architectural terra-cotta system.

Deterioration Inspection and Analysis

Certain deterioration in glazed architectural terra-cotta may be on the building surface and patently obvious to the casual observer—crazing, spalling, deterioration of mortar joints. Other deterioration may be internal or within the masonry system and hard to determine—deterioration of anchoring, deterioration behind the glaze, crumbling of internal webbing. Prima facie, "first inspection," examination may indicate surface deterioration problems while not revealing others. This demonstrates one of the most frustrating aspects of dealing with deteriorated glazed architectural terra-cotta: that there are two systems or levels of deterioration, one which is visible and the other which is not.

Material failure in glazed architectural terra-cotta is necessarily complex. For this reason, it is generally advised that the examination and repair of this material should be the responsibility of an experienced professional. Few restorationists have experience in the inspection, repair and replacement of glazed architectural terra-cotta. This is certainly never the province of the amateur or the most well-intentioned but inexperienced architect or engineer. There are some methods of internal and external inspection and analysis which are relatively simple to the trained professional. Other methods, however, are expensive, time consuming, and only in the experimental stage at this writing. These all generally preclude the use of anyone but an experienced professional.

Preliminary cleaning: Before a terra-cotta building is analyzed for deterioration, it is often advisable, but not always necessary, to clean the surface of the material. This is particularly true when the material has been exposed to the vicissitudes of heavy urban pollution. While most building materials are cleaned for "cosmetic" purposes, the cleaning of glazed architectural terra-cotta for the purpose of inspection and analysis may be advised. Dirt on glazed architectural terra-cotta often hides a multitude of problems. It is only with cleaning that these problems become obvious. Recommended cleaning procedures are covered later in the report.

Methods of inspection:

Prima facie analysis is the unit by unit, first-hand, external inspection of the glazed architectural terra-cotta building surface. Special note of all visible surface deterioration (staining, crazing, spalling, cracking, etc.) should be made on elevation drawings. Binoculars are often used where cost, height, or inaccessibility prevent easy inspection. However, much deterioration may go unnoticed unless scaffolding or window-washing apparatus is used in a true "hands on" inspection of each unit of the façade.

Tapping, a somewhat inexact method of detection of internal deterioration is, nevertheless, the most reliable inspection procedure presently available. Quite simply, tapping is the striking of each unit with a wooden mallet. When struck, an undamaged glazed architectural terra-cotta unit gives a pronounced ring, indicating its sound internal condition. Conversely, deteriorated units (i.e., units which are failing internally) produce a flat, hollow sound. Metal hammers are never to be used, as they may damage the glazed surface of the unit. Extensive experience is the best teacher with this inspection method.

Infrared scanning is only in the experimental stage at this time, but its use seems to hold great promise in locating deteriorated internal material in terra-cotta. All materials emit heat—heat which can be measured in terms of infrared light. While infrared light cannot be seen by the human eye, it can be measured by infrared scanning. Infrared photography, a kind of infrared scanning, has been of particular use in detecting sources of heat loss in buildings in recent years.

Broken or loose internal terra-cotta pieces have a less firm attachment to the surrounding firm or attached pieces and, therefore, have different thermal properties, i.e., temperatures. These temperature differences become evident on the infrared scan and may serve as a fair indication of internal material deterioration in terra-cotta.

Sonic testing has been successfully used for some time to detect internal cracking of concrete members. In the hands of an experienced operator, there are conditions where it can detect internal failure in glazed architectural terra-cotta. Sonic testing registers the internal configuration of materials by penetrating the material with sound waves and reading the patterns that "bounce back" from the originating source of the sound. Readings at variance with those from undeteriorated material might indicate collapsed webbing or pools of water in the interior of the terra-cotta unit.

Metal detection is a nondestructive and generally useful way of locating the position of internal metal anchoring. Metal detectors indicate the presence of metals by electro-magnetic impulses. These impulses are transmitted onto an oscilloscope where they may be seen or they are converted to sound patterns which may be heard by the operator. Original drawings are eminently useful in predicting where internal metal anchoring should be. Metal detectors can confirm that indeed they are still there. Without original drawings, the contractor or architect can still locate the metal anchoring, however. No reading where an anchor would be expected could indicate a missing anchor or one that has seriously deteriorated. The information produced by metal detection is, at best, only rough. However, it is the most viable way of locating the internal metal anchoring without physically removing, thus irreparably damaging, the glazed architectural terra-cotta units themselves.

Laboratory analysis may be carried out on samples of removed original material to find glaze absorption, permeability or glaze adhesion, or to evaluate material for porosity. These tests are useful in determining the present material characteristics of the historic glazed architectural terra-cotta and how they may be expected to perform in the future.

Maintenance, Repair and Replacement

Deterioration in glazed architectural terra-cotta is, by definition, insidious in that the outward signs of decay do not always indicate the more serious problems within. It is, therefore, of paramount importance that the repair and replacement of deteriorated glazed architectural terra-cotta not be undertaken unless the causes of that deterioration have been determined and repaired. As mentioned before, one of the primary agents of deterioration in glazed architectural terra-cotta is water. Therefore, water-related damage can be repaired only when the sources of that water have been eliminated. Repointing, caulking and replacement of missing masonry pieces are also of primary concern. Where detailing to conduct water in the original design has been insufficient, the installation of new flashing or weep holes might be considered.

Where stress-related or structural problems have caused the deterioration of glazed architectural terra-cotta, the services of a structural engineer should be sought to mitigate these problems. This may include the installation of relieving joints, shelf angles or flexible joints. In any case, stress-related and structural deterioration, like water-related deterioration, must be stopped before effective consolidation or replacement efforts may begin.

Cleaning: The successful cleaning of glazed architectural terra-cotta removes excessive soil from the glazed surface without damaging the masonry unit itself. Of the many cleaning materials available, the most widely recommended are water, detergent, and a natural or nylon bristle brush. More stubborn pollution or fire-related dirt or bird droppings can be cleaned with steam or weak solutions of muriatic or oxalic acid.

A note of caution: Any acids, when used in strong enough solutions, may themselves deteriorate mortar and "liberate" salts within the masonry system, producing a situation called efflorescence. For further information on this situation, refer to: "Preservation Briefs 1: The Cleaning and Waterproof Coating of Masonry Buildings," Heritage Conservation and Recreation Service, Department of the Interior, Washington, D.C.

Commercial cleaning solutions may be appropriate but probably are not necessary when water and detergent will suffice. There are, however, certain cleaning techniques for glazed architectural terra-cotta which are definitely *not* recommended and which would damage the surface of the material. These include: all abrasive cleaning measures (especially sandblasting), the use of strong acids (particularly fluoride-based acids), high-pressure water cleaning and the use of metal bristle brushes. All of these techniques will irreparably harm the glaze in one fashion or another and subsequently expose the porous tile body to the damaging effects of water.

It is important to remember that glazed architectural terra-cotta was designed to be cleaned cheaply and easily. This, in fact, was one of its major assets and was much advertised in the selling of the material early in this century.

Waterproofing: The covering of crazed glazing (see Fig. 5) with waterproof coatings is the subject of an on-going controversy today. The question involves whether or not the micro-cracks conduct substantial amounts of water into the porous tile body. Tests indicate that the glaze on new unexposed terra-cotta is itself not completely waterproof. Some testing also indicates that most crazing on historic glazed terra-cotta does not substantially increase the flow of moisture into the porous tile body when compared to new material. Excessive and serious crazing is, however, an exception and the coating of those areas on a limited scale may be wholly appropriate.

In an effort to stem water-related deterioration, architects and building owners often erroneously attribute water-related damage to glaze crazing when the source of the deterioration is, in fact, elsewhere: deteriorated caulking, flashing, etc. The waterproof coating of glazed architectural terra-cotta walls may cause problems on its own. Outward migration of water vapor normally occurs through the mortar joints in these systems. The inadvertent sealing of these joints in the wholesale coating of the wall may exacerbate an already serious situation. Spalling of the glaze, mortar, or porous body will, more than likely, result.

Repointing: Repointing of mortar which is severely deteriorated or improperly or infrequently maintained is one of the most useful preservation activities that can be performed on historic glazed architectural terra-cotta buildings. On-going and cyclical repointing guarantees the long life of this material. Repointing should always be carried out with a mortar which has a compressive strength (measured in p.s.i.) *lower* than the adjacent masonry unit. Hard (Portland cement) or coarsely screened mortars may cause point loading and/or prevent the outward migration of the water through the mortar joints, both of which ultimately damage the terra-cotta unit. Repointing with waterproof caulking compounds or similar waterproof materials should never be undertaken because, like waterproof coatings, they impede the normal outward migration of moisture through the masonry joints. Moisture then may build sufficient pressure behind the waterproof caulk and the glaze on the terra-cotta to cause damage to the unit itself.

Repair of glaze spalling: Glaze spalling is also a highly culpable source of water-related deterioration in glazed archi-

tectural terra-cotta. It is important to coat or seal these blistered areas (see Fig. 6) and to prevent further entry of water into the system by this route. All loose or friable material should be removed. This may be done easily by hand; chisels or similar small tools are most effective. The exposed material is then painted over. At this time, no permanently effective reglazing materials are available. However, there are several acrylic-based proprietary products and masonry paints which can be used effectively to protect these exposed areas, thus preventing the entry of water. These materials are effective for 5 to 7 years and can be reapplied. They also can be tinted to approximate closely the original glaze color.

Repair of minor material spalling: Minor material spalling, where visual or cosmetic considerations are negligible, should be treated in a manner similar to glaze spalling damage. That is, areas where small portions of the body and glaze have spalled and which are far removed from close scrutiny (i.e., detailing on entablatures, upper story windows, etc.) are best remedied by painting with a masonry paint or an acrylic-based proprietary product. Units on which material spalling is easily observed (on the street level, door surrounds, etc.), and on which visual integrity is a consideration, may be better replaced. Patching is not appropriate. Stucco-like or cementitious build-ups are difficult to form satisfactorily, safely and compatibly in situ to replace missing pieces of glazed architectural terra-cotta. Cementitious repairs never satisfactorily bond to the original material. The differential expansion coefficients of the two materials (the repair and the original) preclude a safe, effective and long-term attachment.

Repair of major spalling: Glazed architectural terra-cotta units, which have spalled severely thereby losing much of their material and structural integrity in the wall, should be replaced. Partial in situ repair will not be long lasting and may, in fact, cause complicated restoration problems at a later date. Appropriate methods of replacement are discussed at a later point in this report.

Temporary stabilization: Stabilization measures are necessary when deterioration is so severe as to create a situation where pieces of glazed architectural terra-cotta may fall from the building. This is a particular concern with greatly exposed detailing: cornices, balconies, balustrades, urns, columns, buttresses, etc. Restoration work on these pieces is expensive and often must be carried on over a period of time. Unstable terra-cotta pieces are often removed or destroyed in lieu of such measures. This is particularly true in areas of heavy traffic-related vibrations or in earthquake zones. There are, however, less severe measures which may be employed on a temporary basis. Substantial success has been achieved in securing unstable glazed architectural terra-cotta pieces with metal strapping and nylon net (Fig. 11). While these measures should not be seen as permanent preservation solutions, they do offer temporary alternatives to the wanton destruction of significant glazed architectural terra-cotta detailing in the name of public safety and local code compliance.

Repair of addition and structural damage: Holes, sign anchors, slots for channel steel, or structural cracking in the surface of glazed architectural terra-cotta cladding should be permanently sealed with a material that will expand with the normal dynamics of the surrounding material, yet effectively keep water out of the system. Any one of a number of commercially available waterproof caulking compounds would be appropriate for this work. Holes and static (nonmoving) cracks may be caulked with butyl sealants or acrylic latex caulks. For dynamic (moving or active) cracks, the polysulfide caulks are most often used, although others may be safely employed. It is, however, important to remember that these waterproof caulking compounds are not viable repointing materials and should not be used as such.

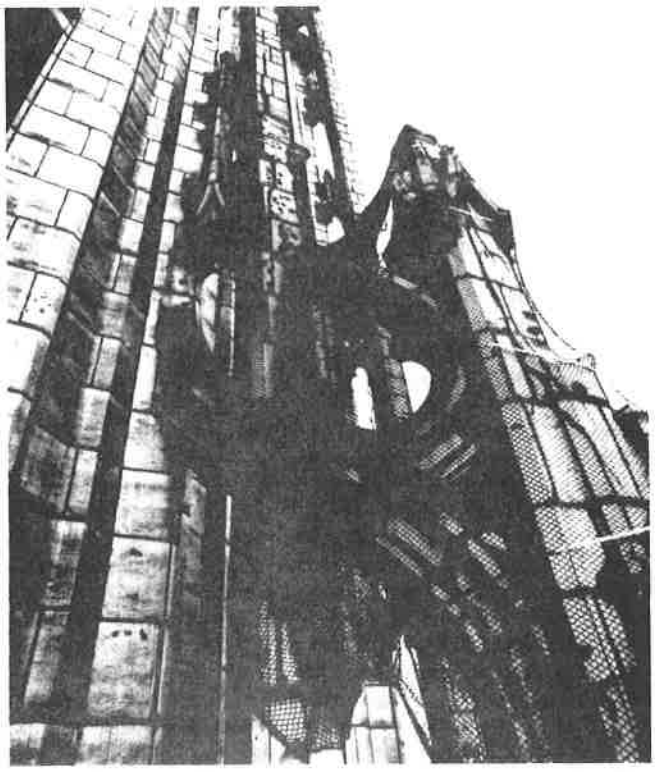


Figure 11. Temporary Stabilization Measures. *Falling glazed architectural terra-cotta detailing has become a source of concern, particularly in dense urban areas and locations of high seismic activity. Nylon netting and metal strapping, while not seen as permanent preservation measures, do offer a temporary alternative to the removal of these elements.*

Temporary replacement: Temporary replacement measures should be implemented when missing units are scheduled to be replaced but work cannot be undertaken immediately. Lengthy delivery time, prorating of work or seasonal considerations may postpone replacement work. Severe deterioration should at least be ameliorated until work can begin. Temporary repointing, removal and saving of undamaged units to be reset later, or the temporary installation of brick infill to retard further deterioration might be considered.

Removing earlier repairs: Removing earlier repairs may be necessary when the work has either deteriorated or has become visually incompatible. Cementitious stucco, caulkings with black bituminous compounds or brick repair work may become structurally or visually unstable or incompatible and should be removed and properly rehabilitated.

Replacement of glazed architectural terra-cotta: Replacement of severely spalled, damaged, or missing glazed architectural terra-cotta elements is always difficult. Certainly, in-kind replacement is advisable, but it has a number of drawbacks. Stone, fiberglass, and precast concrete are also viable choices, but like in-kind replacement, also have their inherent problems.

Several notes on replacement: When replacing glazed architectural terra-cotta, all of the original deteriorated material should be completely removed. Half bricks or similar cosmetic replacement techniques are not advised.

—When possible and where applicable, replacement units should be anchored in a manner similar to the original. Both structural and visual compatibility are major considerations when choosing replacement materials.

—Removing and reanchoring damaged glazed architectural terra-cotta is an extremely difficult if not impossible task. The complexity of the interlocking system of masonry units, back-

fill, and metal anchoring system precludes the removal of the glazed architectural terra-cotta unit without destroying it. Reanchoring deteriorated units is likewise impossible. Therefore, if the terra-cotta in question is loose, severely deteriorated, or its structural integrity in serious question, it is best removed and replaced.

In-kind replacement is possible today, but only on a limited basis. Most new glazed architectural terra-cotta is machine made, not hand made as the original. Thus, the porous tile body of the new material tends to be more uniform but less dense and often not as durable. The glaze on the new glazed architectural terra-cotta tends to be thinner than that on the older material and subsequently more brittle. Machine processing has also produced a glaze that is uniform in color as opposed to historic glazes which were slightly mottled and, therefore, richer. Visual compatibility *is* an important consideration when replacing in-kind.

Only a fairly limited inventory of in-kind pieces is presently available for replacement such as plain ashlar blocks and the simpler details such as cappings and sills. When deterioration severely damages the more ornate pieces (urns, cartouche work, balusters, etc.) either expensive hand casting or alternative materials must be sought. There is a tendency today to replace damaged ornamental work with simpler, cheaper and more readily available units. This decision *cannot*, however, be supported, as the removal of this work inevitably diminishes the character and integrity of the building. Another major consideration in choosing in-kind replacement is the question of delivery time, which is often quite lengthy. If new glazed architectural terra-cotta is chosen as a replacement material, the architect or building owner should plan far in advance.

Stone may be a suitable replacement material for damaged glazed architectural terra-cotta. Its durability makes it highly appropriate, although the increase in weight over the original hollow units may be of some concern. The fact that historic glazed architectural terra-cotta was glazed in imitation of stone, however, may make the choice of stone as a replacement material a fortuitous one. Metal anchoring may be accommodated easily in the carving. Cost, however, is the major drawback in stone replacement, particularly where rich detailing must be carved to match the original.

Fiberglass replacement is a viable alternative, particularly when rich and elaborate ornamentation has to be duplicated. Casting from original intact pieces can produce numerous sharp copies of entablatures, moldings, balusters, voussoirs, etc. Anchoring is easily included in casting.

Significant drawbacks in using fiberglass replacement are color compatibility, fire code violations and poor weathering and aging properties. The appropriate coloring of fiberglass is exceedingly difficult in many instances. Painting is often unsatisfactory, as it discolors at a rate different than that of the historic glazed original. While fiberglass casting is lighter than the original units and, therefore, of great interest in the rehabilitation of buildings in areas of high seismic activity, many fire code requirements cannot be met with the use of this material.

Precast concrete units show great promise in replacing glazed architectural terra-cotta at this writing. Precast concrete units can, like fiberglass, replicate nuances of detail in a modular fashion; they can also be cast hollow, use light-weight aggregate and be made to accommodate metal anchoring when necessary. Concrete can be colored or tinted to match the original material with excellent results. It is cost effective and once production is in process, precast concrete can be produced quickly and easily.

Experience shows that it is advisable to use a clear masonry coating on the weather face of the precast concrete units to guarantee the visual compatibility of the new unit, to prevent moisture absorption, to obtain the proper reflectivity in imitation of the original glaze and to prevent weathering of the unit itself. Precast concrete replacement units are presently enjoying great use in replicating historic glazed architectural terra-cotta and show promise for future rehabilitation programs.

Once the replacement material is selected (new glazed architectural terra-cotta, stone, precast concrete, or fiberglass), it must be reanchored into the masonry system. Original metal anchoring came in numerous designs, materials and coatings ranging from bituminous-coated iron to bronze. While most of these anchors are no longer available, they may be easily replicated in large quantities either in the original material when appropriate or out of more durable and available metals such as stainless steel.

Since the masonry backfill is already in place in the historic building, the new replacement unit with anchoring may simply be fitted into the existing backfill by boring a hole or slot for anchor and bedding the anchor and the unit itself in mortar. When replacing historic glazed architectural terra-cotta which originally employed metal anchoring, it is important to replace that anchoring when replacing the unit. Serious problems may result if anchoring is omitted in restoration when it was used originally. It is erroneous to assume that mortar alone will be sufficient to hold these replacement pieces in place.

Summary

Today, many of this country's buildings are constructed of glazed architectural terra-cotta. However, many of these are in a state of serious deterioration and decay. Glazed architectural terra-cotta was, in many ways, the "wonder" material of the American building industry in the late 19th century and during the first decades of the 20th century. New technology and methods of rehabilitation now hold promise for the restoration and rehabilitation of these invaluable and significant resources. Restoration/rehabilitation work on glazed architectural terra-cotta is demanding and will not tolerate half-way measures. Today's preservation work should equal the spirit, attention to detail, pride in workmanship and care which characterized the craftsmanship associated with this widely used, historic masonry material.

Suggested Further Readings

"Recipes for Baked Earth." *Progressive Architecture*, (November, 1977).

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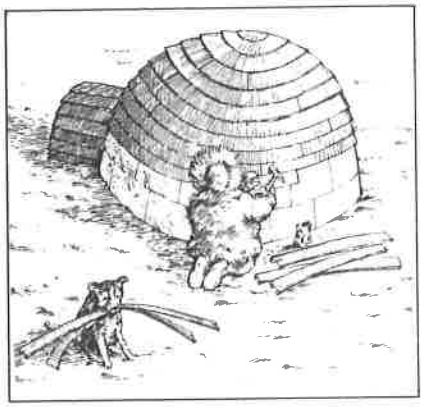
The illustrations for this brief not specifically credited are from the files of the Technical Preservation Services Division.

This Preservation Brief was written by de Teel Patterson Tiller, Architectural Historian, Technical Preservation Services Division. Information for this publication was based in part upon interviews and consultation with Theodore H.M. Prudon, The Ehrenkrantz Group, P.C., New York, New York. Additional comments and information were provided by Si A. Bortz, Illinois Institute of Technology Research Institute, Chicago, Illinois, and Jerry G. Stockbridge, Wiss, Janney, Elstner, and Associates, Northbrook, Illinois.

This publication has been prepared pursuant to Executive Order 11593, "Protection and Enhancement of the Cultural Environment," which directs the Secretary of the Interior to "develop and make available to Federal agencies and State and local governments information concerning professional methods and techniques for preserving, improving, restoring and maintaining historic properties." Preservation Briefs: No. 7 has been developed under the technical editorship of Lee H. Nelson, AIA, Technical Preservation Services Division, Heritage Conservation and Recreation Service, U.S. Department of the Interior, Washington, D.C. 20243, June 1979. Comments and suggestions are welcome.

8 PRESERVATION BRIEFS



Aluminum and Vinyl Sidings on Historic Buildings

John H. Myers

Technical Preservation Services Division

Heritage Conservation and Recreation Service

This brief, intended primarily for owners of historic properties, provides a discussion of issues surrounding the application of aluminum and vinyl sidings. The Secretary of Interior's Standards for Historic Preservation Projects (and their accompanying guidelines) recommend *against* resurfacing frame buildings with new material which is inappropriate, or was not available when the building was constructed.

The appearance of a historic building is a product of the cultural heritage of its region, the technology of its period, the skill and training of its builders and the materials used for its construction. The application of sidings which cover, or cause the removal of, original building features raises some of the fundamental issues of architectural conservation. This brief on the use of aluminum and vinyl sidings is an attempt to present in an objective manner the issues surrounding the use of these substitute materials on historic buildings. The information contained herein has been drawn from a variety of sources, many of which are listed in the bibliography. This brief is not an exhaustive examination of the subject; clearly there is a need for additional research on the physical consequences of siding installations. Readers are encouraged to advise us of their experiences with the siding materials discussed, particularly when those experiences involve historic architecture. As additional information is obtained and evaluated, there may be revisions to this brief.

Historic Character

The exterior character of a building is largely established by its "style" and by the degree of decorative detailing. It is also influenced by the choice of materials for the walls—by their dimensions, details, color and other surface characteristics. This is particularly true for wood sided, frame buildings which are the typical objects of aluminum or vinyl siding applications. Since wood has always been present in abundance in America, it has been a dominant building material in most parts of the country. Early craftsmen could harvest the wood and create both structural and finish members with their hand tools. The variety of tools used and regional differences in style resulted in the richness and diversity of wood textures. Later, as technology progressed, weatherboards produced by local mills continued to reflect regional traditions in material, style and dimensions. Although aluminum and vinyl siding materials seek to imitate wood sidings, they cannot capture the richness and variety of real wood because they are standardized, machine-made, mass produced materials.

Today, a number of communities are conserving the unique characteristics of their historic buildings and districts with

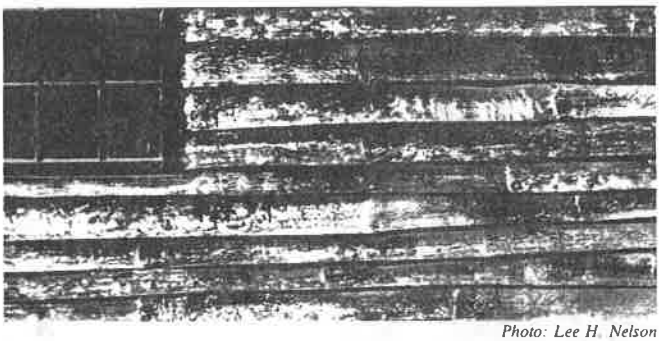


Photo: Lee H. Nelson

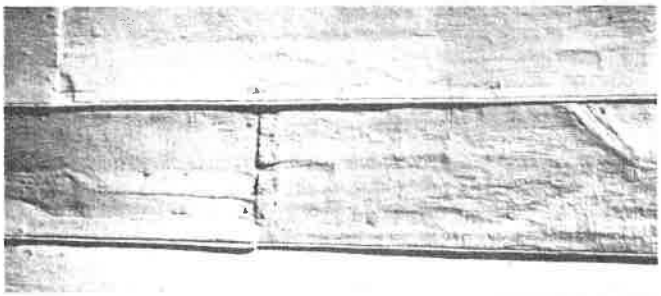


Photo: Hugh C. Miller

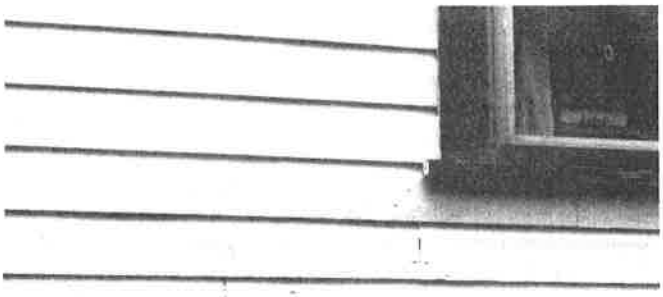


Photo: John H. Myers

Historic wood sidings exhibit rich and varied surface textures. They range from hand-split clapboards of short lengths with feather-edged ends, to pit or mill sawn boards which can be beveled, rabbeted, milled or beaded.

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Photo: Laurie Robin Hammel

When a building is in need of maintenance, such as the house on the right which needs painting, some owners consider installing aluminum or vinyl siding. The result, like the house on the left, can be a complete loss of architectural character due to the covering of details (cornice), the removal of features (window trim), and a change of scale due to inappropriate siding dimensions.

architectural controls, including the regulation of aluminum, vinyl and other siding materials. One of the reasons for such regulation is that the historic appearance of a building may be visually altered by changes in scale, texture, color and detailing which are inappropriate. The changes are especially dramatic where "clapboard" spacing is increased, shadow reveals are lost, trim is removed and windows are altered or replaced. Manufacturers and some applicators are attempting to reduce the negative visual impact of both the products and the installations. Among the more successful efforts is the manufacture of narrow panels which approximate the clapboard widths of some historic wood sidings. Among the least successful efforts are the panels with embossed wood graining, which is supposed to simulate the texture of wood. This exaggerated graining would have been undesirable on real wood sidings, and is generally found only after excessive weathering of raw wood or sandblasting. A technique of installation which is gaining some acceptance, and which ameliorates some of the visual impact, is the application of siding only, retaining original corner boards, sills, jambs and other trim. A related technique involves retaining the trim, but removing all existing siding. This technique is highly destructive of original fabric and irreversible, since it is unlikely that a property owner will conserve the removed material.

As products and applications become more sensitive and the visual impact is minimized, it becomes important to articulate the real issue of authenticity of materials and craftsmanship. A structure is historic because its materials and the craftsmanship reflected in its construction are tangible and irreplaceable evidence of our cultural heritage. To the degree that they conceal the original building fabric, substitute materials such as aluminum and vinyl sidings will always subtract from the basic integrity of historically and architecturally significant buildings.

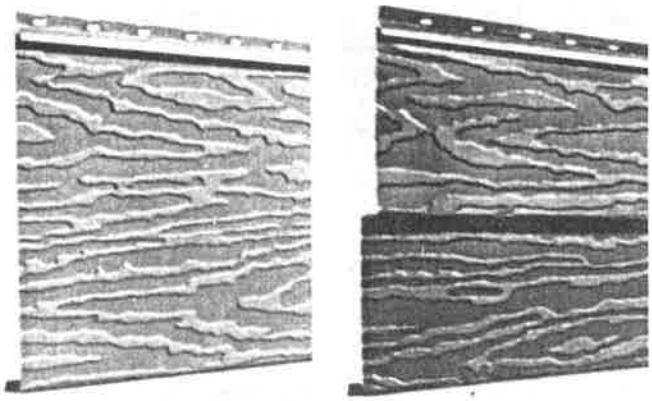


Photo. Technical Preservation Services

Aluminum and vinyl sidings are available in a variety of widths and colors, but the optional wood graining is not characteristic of real wood siding.

Products and Installation

The architectural products of aluminum and vinyl which are primarily used on older buildings are horizontal lap sidings. Horizontal aluminum and vinyl sidings are available in eight, five and four inch exposures to simulate clapboard widths, smooth and wood grained textures and a variety of colors. Trim pieces are produced to cover existing details at corners, doors, windows and eaves. With both materials the optional wood grain textures are exaggerated, and the colors are generally light to minimize fading problems which are inherent in the darker shades.

The siding materials are produced by manufacturers who conduct the major advertising and provide most of the product literature. The actual installations, however, are carried out by independent contractors or applicators, who are frequently called "home improvement" contractors, and are not affiliated with the manufacturers. Since the manufacturer has no control over the quality of the installation, both the quality of the work and the sensitivity of the application are highly variable (a fact recognized in that the manufacturer's warranties do not cover problems due to faulty installation). It is important that proper installation techniques be used to avoid sagging, bending, leaking and other appearance-related problems.

Application of the products is accomplished by nailing the siding panels, which are usually about twelve and one-half feet long, to the existing surface. Preparation consists of eliminating uneven areas, squaring up the starter strips and nailing furring strips where necessary to create a smooth and level surface. Generally there is little concern over damage or alteration to the surface of the building, since it is assumed that any damage to the substrate will remain hidden for many years. The siding panels are not nailed firmly to the surface, but are hung on nails, sixteen inches on center, to allow for expansion. Trim pieces are used to aid in attachment and connection, and to cover existing trim, but such pieces are usually quite different from historic trim. For aluminum siding, caulking is recommended to seal all intersections where metal meets wood.

Removal of Features

Although it is sometimes argued that a siding application is reversible since it can be removed, there is frequently irreversible damage to historic buildings when decorative and other trim is removed by applicators and discarded or destroyed. The installation process dictates that the existing surface be flat and free of "obstructions" so that the new siding will be smooth and even in appearance. Where projecting details appear, it is easier to pull them off or cut them back rather than to attempt the time consuming process of custom fitting the siding. Aluminum and vinyl siding can be installed around existing trim, but the application requires more labor and, therefore, will be more expensive. In addition, there may be greater potential for water to penetrate the siding at points where aluminum or vinyl meets existing trim. Caulking of these intersections would help keep water out but would also cut infiltration which allows some moisture vapor to escape from the wall.

The existing wall fabric is further damaged by the nailing necessary to apply siding. The panels may be nailed directly to the building fabric or furring strips may be nailed up as a base. Either technique will leave numerous holes in wood

Photo: Nancy J. Long

Two originally similar houses. When aluminum was installed on the house on the right, the barge boards, scrollwork, columns and railings were removed. The distinctive shingled gable and attic vent were covered, further compromising the building's architectural integrity.

Photo John H. Myers

This brick rowhouse was covered with vertical and horizontal aluminum siding. Such treatment is inappropriate for historic masonry buildings.

sidings and will cause irreversible cracking or spalling of masonry walls. Although this reference to the damage of masonry is included as a point of fact, the application of aluminum or vinyl siding is highly inappropriate to historic masonry buildings.

Moisture Problems

The walls of historic frame buildings are usually uninsulated so that moisture produced within the structure, (from cooking, cleaning, bathing or humidification), migrates through the wall cavity to the exterior, particularly in the winter. The amount of moisture generated may be significant. The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) reports that a typical family of four can produce up to twenty-five pounds of moisture per day through normal daily activity. If an impermeable layer of siding is applied to the exterior or cold side of a wall, moisture can be trapped within the wall cavity and create conditions favorable to deterioration due to wood rotting or staining fungi. There are three techniques which will prevent the accumulation of moisture within a wall that has an exterior (cold side) vapor barrier: (1) apply an interior (warm side) vapor barrier to keep moisture out of the wall, (2) ventilate the interior space to remove humid air and (3) ventilate the wall cavity to remove excess moisture. When humidity and climatic conditions indicate a need, the added expense of such preventative measures should be considered as part of the installation cost of impermeable siding over frame walls.

Some manufacturers have attempted to prevent moisture problems by venting their sidings. Typical venting techniques include perforated foil, weep holes, vent tubes into the wall cavity, recommendations to omit caulking or a combination of these methods. The success of these efforts is inconclusive since there are numerous variables affecting the moisture levels within any particular building. The Forest Products Laboratory of the U.S. Department of Agriculture conducted a study of the moisture content of frame walls during winter. Although they found that an interior vapor barrier was highly effective in reducing the moisture content of the test wall, they found that the exterior vents had little effect on reducing the moisture levels except where wind speeds were high enough to force ventilation. Such consistent winds are likely to occur only on a wall facing the prevailing winds and without adjacent obstructions to reduce the wind pressure. In addition, the small weep holes provided are subject to blockage by accumulations of dust and debris, insect activity and painting.

Another potential source of moisture problems results from the application of aluminum and vinyl sidings to buildings in need of repair. When leaking roofs, broken gutters and downspouts, or flashing problems are left unrepaired during a cosmetic application of an impermeable siding, quantities of water may be channeled into the wall behind the siding. In such cases the water admitted directly to the wall cavity can exceed the levels produced by moisture migration from the interior. Such excessive moisture levels within the wall can contribute to problems with interior finishes such as paint or wallpaper, causing peeling, blistering or staining of the finishes.

Prevention of Inspection

The application of aluminum or vinyl sidings prohibits periodic inspection of the underlying historic building fabric. Since these sidings are typically marketed as home improvement items, they are frequently applied to buildings in need of maintenance and repair. The result of this can be the concealing of problems which are the early warning signs of deterioration. Minor problems, concealed and uncorrected, can progress to the point where expensive, major repairs to the structure are necessary.

It cannot be overemphasized that a cosmetic treatment to hide difficulties such as peeling paint, stains or other deterioration is no substitute for proper care and maintenance. Aluminum and vinyl sidings are not directly at fault in this case since property owners should determine the nature and source of their problems, then make appropriate repairs. The difficulty arises when owners perceive the sidings as the total solution to their required maintenance and forego other remedial action.

Vulnerability

Aluminum and vinyl sidings are often marketed and purchased as maintenance saving alternatives; there are, however, certain types of damage to which these materials are susceptible. Aluminum siding scratches and dents easily, as a typical thickness is about .020 inches. The U.S. Navy suspended the use of aluminum siding on its housing facilities (non-historic) for several years after experiencing excessive damage due to the activities of children playing nearby. Now siding is permitted only above six feet so that the possibility of frequent impact is reduced. Other users have had similar experiences and it is now generally accepted that aluminum is a poor choice for applications where the chances for impact are high. The problem is recognized by manufacturers in that the backing on some sidings, which is now marketed as insulation, had its origin as a reinforcement to prevent denting.

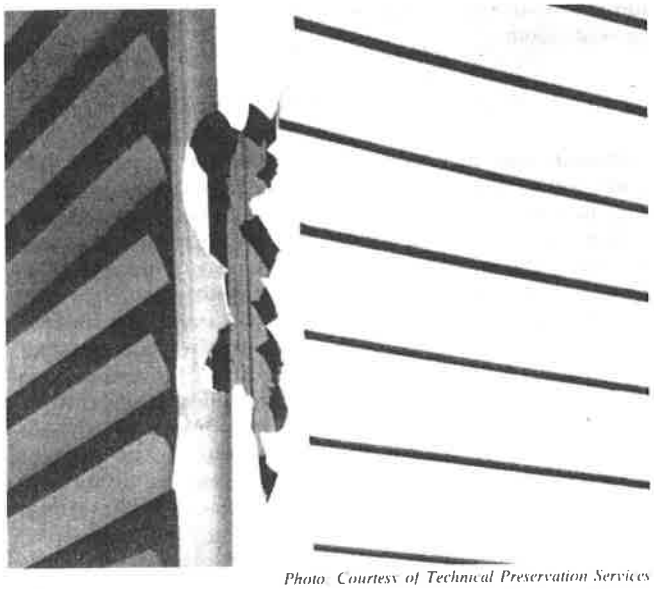


Photo: Courtesy of Technical Preservation Services

Vinyl siding tends to become brittle when cold, and is susceptible to cracking or shattering from impact. Damage like this may not be covered by warranty.

While there are some government agencies which use or permit vinyl siding, experience has shown that vinyl sidings become brittle and susceptible to shattering in very cold weather. Typical repairs are made by cutting out the damaged area and splicing in a new piece of vinyl, but new sections will probably not be an exact color match due to fading of the exposed surface and color variations in product runs.

If aluminum or vinyl sidings are damaged and later replacement is necessary, it may be difficult or impossible to obtain an exact replacement. Siding manufacturers can change products, styles, or colors in response to market factors without any advance notice to owners.

Durability and Cost

The questions of durability and relative costs of aluminum or vinyl sidings compared to the maintenance cost of original materials are complex, to say the least. It is important to carefully consider these questions because both sidings are marketed as long lasting, maintenance free alternatives. Assuming that the sidings are not damaged, and that they will weather and age normally, there will be inevitable changes in color and gloss as time passes. A normal application of aluminum or vinyl siding is likely to cost from two to three times as much as a good paint job on wood siding. A sensitive application, retaining existing trim, will cost more. Therefore, to break even on expense, the new siding should last as long as two or three paintings before requiring maintenance. On wood, two coats of good quality paint on a properly prepared surface can last from 8 to 10 years, according to the U.S. Department of Agriculture. If a conservative life of seven years is assumed for paint on wood, then aluminum and vinyl sidings should last 15 to 21 years before requiring additional maintenance, just to break even with the maintenance cost for painting wood siding. There are reports, however, that some painted aluminum sidings may chalk and fade and appear to need painting as early as 5 to 7 years. Once painted, they will require repainting with the same frequency as wood. A New England architectural firm compared the cost of applying vinyl siding with the projected cost of maintaining and repainting the existing wood siding of a church. For purposes of the study, they assumed a 20 year life for vinyl material, a six percent inflation rate, six percent interest on savings and a repainting cycle of six to seven years for the existing wood. They took the cost of the vinyl siding application as the total amount of money available for all options, and where an alternative was initially less expensive, they invested the difference or surplus at six percent interest. By using the surplus and the accrued interest, the figures showed that the church could be repainted every six to seven years up through the year in which the vinyl siding would be replaced. At that time the church would show a surplus in the painting fund, but a sizeable deficit with the vinyl siding due to the replacement cost. In this study the cost of aluminum siding was found to be similar to that of the vinyl.

Practically, very few property owners will set aside surplus money in the manner of the study, but the results of the study indicate that lower cost of the maintenance would allow the expense to be spread out over a longer time period. Conversely, the higher expense of a major application of aluminum or vinyl siding frequently will require financing so that the total cost to the property owner may include substantial interest in addition to the purchase price.

Fire Characteristics

Many questions have been raised about the performance of aluminum and vinyl sidings in fires. Because of the different natures of these two materials, their fire related characteristics should be discussed separately.

Concerns about aluminum siding in a fire may be divided into two areas. The first area consists of the normally tested

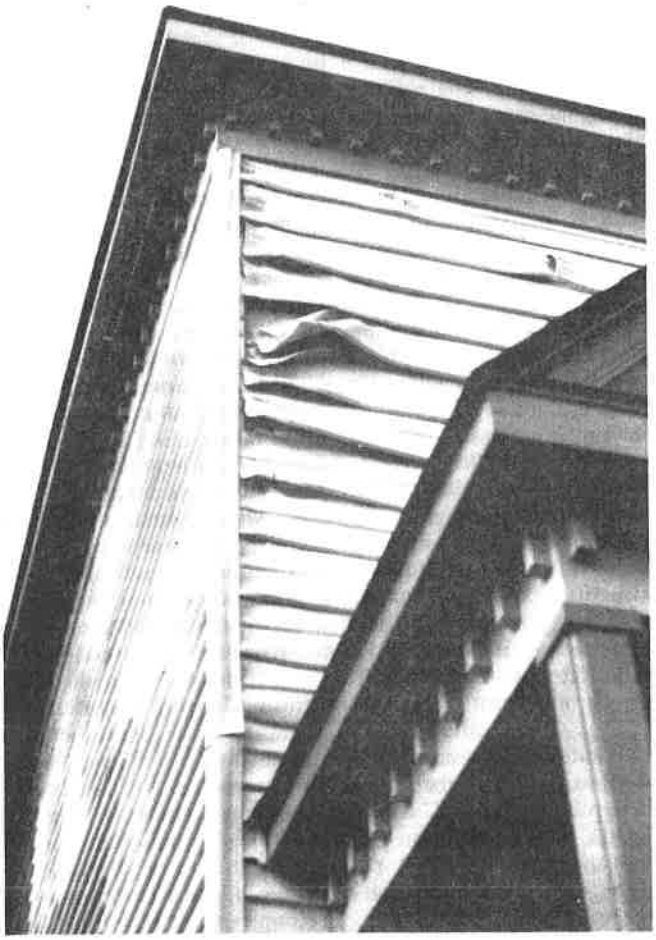


Photo: Linda J. Flint

Vinyl siding exposed to heat from a fire across the street.

characteristics such as flame spread, flame penetration and smoke accumulation. The National Bureau of Standards has tested aluminum lap siding for each of these factors and found that it performed very well compared to many other siding materials. In more practical tests, the New York City Fire Department conducted actual burn tests on frame rowhouses covered with aluminum siding. They discovered that the aluminum offers some protection from exterior fires, and that underlying original sidings sustain less damage from internal fires when covered by aluminum siding. The reason for the latter finding is that the aluminum is a barrier between the original siding and the lapping flames which emerge from window and door openings and extend upward.

Another concern about aluminum is the so-called "oven effect" which proposes that the siding contains and intensifies the heat of a fire. An oven consists of a metallic lining surrounded by insulation so that radiation is reflected back into the oven while the insulated shell prevents conductive heat losses. In reality, this phenomenon should not occur in an aluminum sided house. In a building with aluminum siding the metal is on the exterior and the "insulation," which consists of the wall components, is on the inside. The result is that the interior finishes of plaster or gypsum board, the studs and the original siding insulate the aluminum skin, preventing radiation from reaching the siding and being reflected inward.

When vinyl siding is subjected to fires on the exterior of the building, the siding will begin to sag and melt. In the case of internal fires, the vinyl material is shielded from the fire by the wall components so that occupants should have adequate time to exit the building before the siding becomes involved. The siding would probably melt off the building as the heat intensified thus reducing its involvement in the fire.

Energy

There is a growing concern for energy conservation, and aluminum and vinyl sidings are being promoted as energy saving measures. From a practical standpoint, aluminum and vinyl sidings are not good insulators because they are so thin. Any energy saving due to a siding application probably results from the creation of an air space between old and new siding, reduced infiltration due to the new impermeable skin, the installation of some insulating material behind the siding or a combination of these three factors.

The Federal Trade Commission filed suit against one manufacturer of aluminum siding and obtained a consent order from the company which agreed to refrain from making energy conservation claims. The FTC report claimed that both plain aluminum siding over aluminum foil and insulated aluminum siding have "little or no insulation value."

Preservation Briefs No. 3, "Conserving Energy In Historic Buildings," notes that the primary sources of energy loss in small frame buildings are the doors, windows and roof. It is, therefore, more cost effective to apply storm windows, storm doors and attic insulation than to treat the side walls of these structures. There are numerous publications on energy retrofitting which explain techniques of determining cost-effectiveness based on utility costs, R-factors of materials and initial cost of the treatment. Persons interested in this approach may wish to read "Retrofitting Existing Housing for Energy Conservation: An Economic Analysis" published by the National Bureau of Standards, or the U.S. Department of Housing and Urban Development booklet "In the Bank or Up the Chimney." One such study in Providence, Rhode Island, determined that for a two story house, twenty-five feet square, the payback period for twenty-three storm windows, two storm doors and six inches of attic insulation was 4.4 years while the payback for aluminum siding with an R-factor of 2.5 was 29.96 years. Most of the information which is available supports the position that plain aluminum or vinyl sidings will not have a reasonable payback on an energy saving basis alone.

Warranties

Aluminum and vinyl sidings frequently carry long term warranties which make them attractive to property owners; however, most of these warranties are limited and pro-rated, and contain very specific coverage. One technique used to make the warranties appear more comprehensive is to guarantee the products against defects which are not inherent in the materials, and therefore cannot possibly occur; for example both aluminum and vinyl sidings are usually guaranteed not to "red rust." Such rusting is the result of the oxidation of iron which is not a component of either siding product. Most warranties will exclude any change in color or gloss, damage due to accidents, vandalism and exposure to the weather, damage to the house and all problems resulting from faulty installation. Since the manufacturers do not install the sidings, the reliability of the applicator is very important in the event of future claims. The distinction between manufacturing defects and problems due to improper installation can confuse the issue of which party is responsible and leave the property owner with the difficult and expensive burden of proving liability.

The pro-rated warranties limit the liability of the manufacturer to a decreasing percentage of labor and material costs as the warranty period progresses. As an example, one forty year warranty covers all labor and material for only three years, and the liability decreases so that after twelve years no labor costs and only thirty percent of material costs are covered. It is probably safe to say that because of the profit margin in the material and the fact that the bulk of any repair cost would be for labor, the property owner would bear most of the expense of repairs for the last twenty-seven years of this warranty.

An additional consideration is that warranties cannot guarantee that exact replacement products will be available in the future, so responsibility is usually limited to providing the closest match in color, texture and dimension available at the time of repair. This is done because manufacturers can change their product lines due to market factors. Color can also vary from one production run to another, making exact replacement difficult.

The important point to remember concerning warranties is that property owners should obtain a copy in advance of any purchase and read it carefully to determine the extent of coverage and the degree of liability under any pro-rated terms. This recommendation also applies to any warranties given by local contractors or applicators since these will be important if problems occur with siding installations.

Property Values

There is little doubt that the application of aluminum or vinyl siding will affect property values. In the case of a non-historic house of modest cost and in need of repair, the effect will likely be to increase the property value. A different set of factors govern in the case of a historic building, particularly in a historic district where authenticity in materials and styles commands a premium. The application of a substitute material such as aluminum or vinyl siding would probably have a negative effect on the resale value of such a building. The degree to which property values are affected will vary widely due to the quality of the application, differences in local attitudes and tastes, the demand for housing and many other factors. There may be an added concern that the sidings, which prohibit inspection of the underlying fabric, may be concealing problems. Real estate appraisers and realtors gen-

erally evaluate each property individually, weighing both objective and subjective factors in order to determine a property value. The best method of establishing the effect of an aluminum or vinyl siding application on the value of a particular property is to consult qualified local real estate professionals.

Local Regulation

Local historic district officials face a dilemma on the siding issue. They are caught between their responsibility for preserving the character and integrity of the buildings and the often hostile resistance of property owners who resent architectural controls. Although policies vary considerably from one jurisdiction to another, such policies usually involve a combination of recommendations, prohibitions, negotiation and compromise. Most local historic district policies on artificial sidings fall into one of the following four categories:

1. Complete Prohibition—Artificial siding materials are not allowed in the district, but the commission can review special circumstances at its discretion.
2. Conditional Acceptance—If certain preset conditions apply, the sidings may be applied if they meet established design criteria involving dimension, texture, color and installation techniques. Conditions may allow for differences in the significance of buildings or the degree of exposure of walls to public view.
3. Standard Approval—Siding applications are routinely approved if they conform to established design criteria such as those mentioned in number two.
4. Advisory—Property owners and developers are advised on appropriate techniques of restoration and rehabilitation, but there is no enforcement authority.

When architectural controls are established for the protection of certain historic buildings or historic districts, controversy is inevitable as community needs conflict with individual rights. Communities with a significant architectural heritage frequently establish strict controls and successfully use the police power to enforce them. Various court cases have upheld the local decisions to control artificial siding applications. Communties which have review boards or which are establishing policies on the use of modern sidings in historic districts can contact their State Historic Preservation Offices or the Landmarks and Preservation Law Division of the National Trust for Historic Preservation for examples or information on design criteria, methods of enforcement or precedent setting court cases.

In some communities where original sidings have been covered by substitute materials, there are programs which give property owners financial assistance in removing the substitute materials. The most publicized program of this type is in Cambridge, Massachusetts where several non-profit community organizations make grants available for siding removal. Grants of this type are available in several other cities with redevelopment programs, and aid property owners and communities in recovering the earlier character and charm of their historic houses.

Summary

The intent of this brief has been to delineate issues which should be addressed when contemplating the use of aluminum or vinyl sidings on historic buildings. Many property owners are faced with decisions weighing the historic value of their building and its maintenance cost against the alleged benefit of aluminum and vinyl siding materials, and very little comprehensive information has been published to assist them in making those decisions.

As stated earlier, the application of aluminum and vinyl sidings is frequently considered as an alternative to the maintenance of the original historical material. The implication is that the new material is an economic and long-lasting alternative and that somehow the historic material is fragile, short-lived or problematic. In reality, historic building materials such as wood, brick and stone usually are not delicate or short-lived. Their existence, frequently in sound condition, after many decades during which they probably suffered periods of neglect, is proof that they are the original economic and long-lasting alternatives. All materials, including the new sidings discussed above, can fall into disrepair if abused or neglected; however the maintenance, repair and retention of "original materials" are always the most architecturally appropriate and usually the most economically sound measures for preserving the unique qualities of historic buildings.

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This Preservation Brief was written by John H. Myers, Historical Architect, Technical Preservation Services Division. Valuable information and comments were received from Clark J. Strickland, of the Connecticut Historical Commission, and Antoinette F. Downing and Edward F. Sanderson, of the Rhode Island Historical Preservation Commission. Editing and production were by the Publication Branch of the National Register Division.

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U.S. Department
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Technical Preservation
Services Division

Preservation Briefs: 9

The Repair of Historic Wooden Windows

John H. Myers

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

Figure 1. *Windows are frequently important visual focal points, especially on simple facades such as this mill building. Replacement of the multipane windows here with larger panes could dramatically change the appearance of the building. The areas of missing windows convey the impression of such a change. Photo: John T. Lowe*

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

Architectural or Historical Significance

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

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

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

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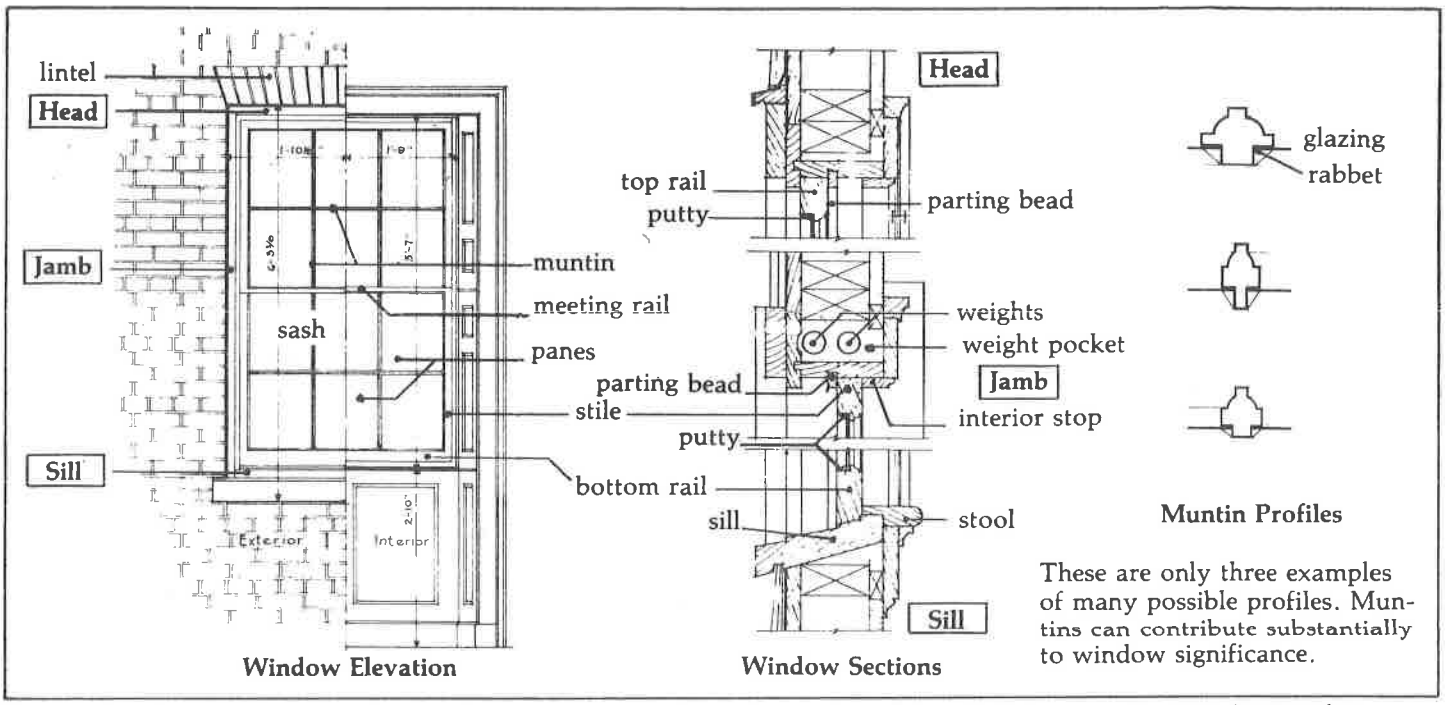

Figure 2. *These drawings of window details identify major components, terminology, and installation details for a wooden double-hung window.*

ceed with planning appropriate treatments, beginning with an investigation of the physical condition of the windows.

Physical Evaluation

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

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

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

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

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

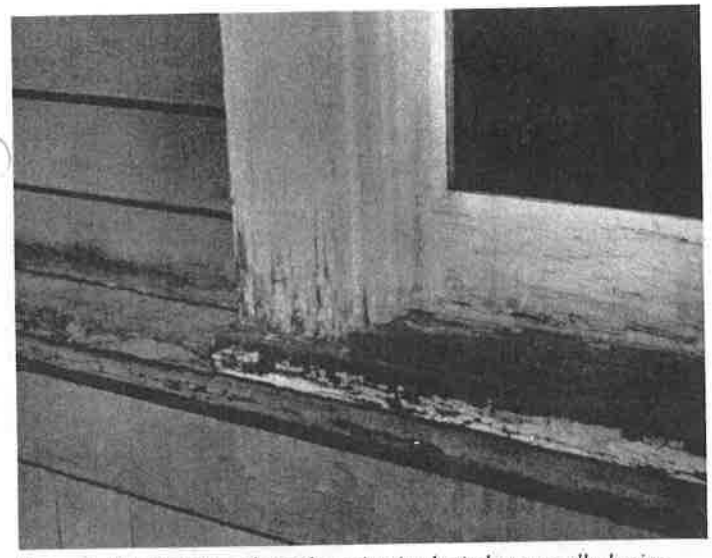

Figure 3. *Deterioration of poorly maintained windows usually begins on horizontal surfaces and at joints where water can collect and saturate the wood. The problem areas are clearly indicated by paint failure due to moisture. Photo: Baird M. Smith, AIA*

tion of the wood. Sound wood will separate in long fibrous splinters, but decayed wood will lift up in short irregular pieces due to the breakdown of fiber strength.

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

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

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

Repair Class I: Routine Maintenance

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

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

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

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

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

The sash can be stripped of paint using appropriate techniques, but if any heat treatment is used (see figure 4c), the glass should be removed or protected from the sudden temperature change which can cause breakage. An

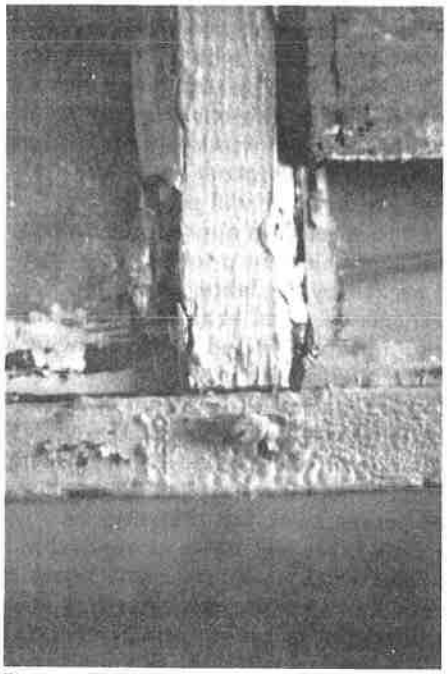

Figure 4a. *The following series of photographs of the repair of a historic double-hung window use a unit which is structurally sound but has many layers of paint, some cracked and missing putty, slight separation at the joints, broken sash cords, and one cracked pane. Photo: John H. Myers*

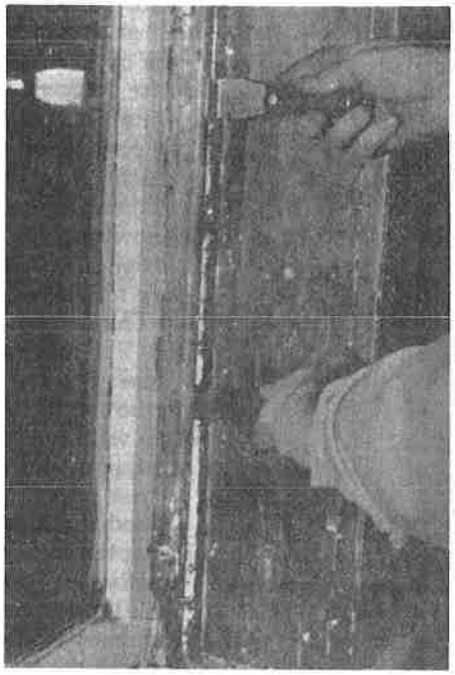

Figure 4b. *After removing paint from the seam between the interior stop and the jamb, the stop can be pried out and gradually worked loose using a pair of putty knives as shown. To avoid visible scarring of the wood, the sash can be raised and the stop pried loose initially from the outer side. Photo: John H. Myers*

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

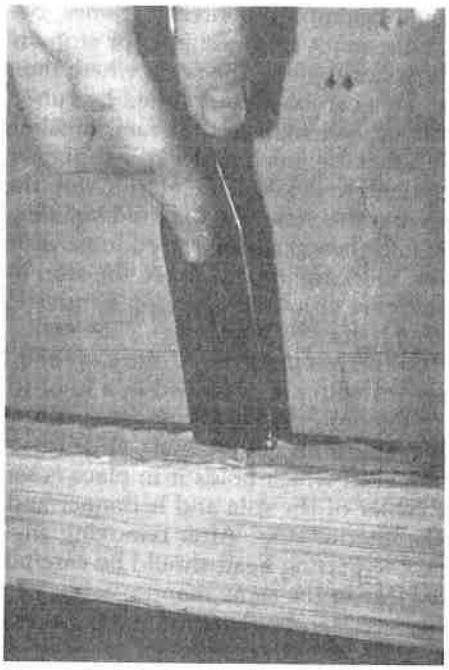

Figure 4d. *Reglazing or replacement of the putty requires that the existing putty be removed manually, the glazing points be extracted, the glass removed, and the back putty scraped out. To reglaze, a bed of putty is laid around the perimeter of the rabbet, the pane is pressed into place, glazing points are inserted to hold the pane (shown), and a final seal of putty is beveled around the edge of the glass. Photo: John H. Myers*

Figure 4e. *A common repair is the replacement of broken sash cords with new cords (shown) or with chains. The weight pocket is often accessible through a removable plate in the jamb, or by removing the interior trim. Photo: John H. Myers*

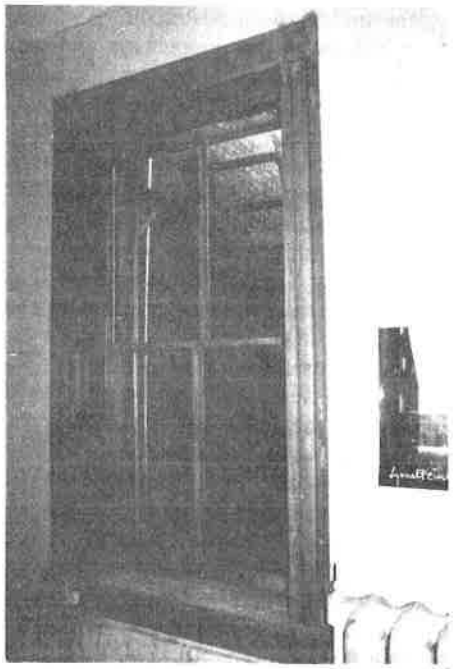

Figure 4f. *Following the relatively simple repairs, the window is weathertight, like new in appearance, and serviceable for many years to come. Both the historic material and the detailing and craftsmanship of this original window have been preserved. Photo: John H. Myers*

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

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

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

Repair Class II: Stabilization

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

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

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

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

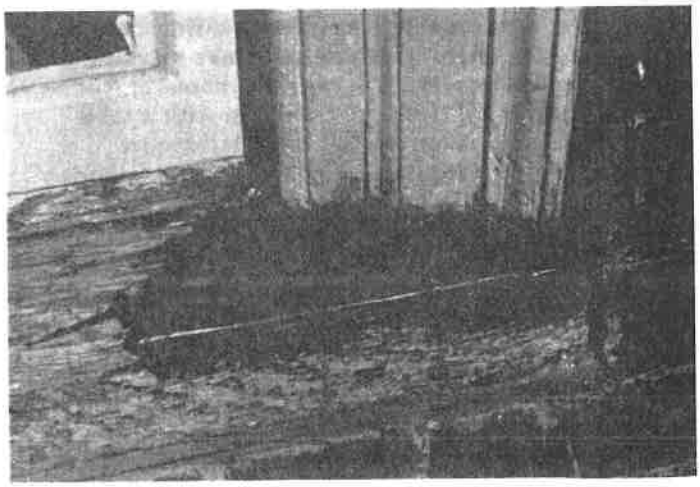

Figure 5. *This illustrates a two-part epoxy patching compound used to fill the surface of a weathered sill and rebuild the missing edge. When the epoxy cures, it can be sanded smooth and painted to achieve a durable and waterproof repair. Photo: John H. Myers*

missing sections or decayed ends of members. Profiles can be duplicated using hand molds, which are created by pressing a ball of patching compound over a sound section of the profile which has been rubbed with butcher's wax. This can be a very efficient technique where there are many typical repairs to be done. Technical Preservation Services has published *Epoxies for Wood Repairs in Historic Buildings* (see Additional Reading section at end), which discusses the theory and techniques of epoxy repairs. The process has been widely used and proven in marine applications; and proprietary products are available at hardware and marine supply stores. Although epoxy materials may be comparatively expensive, they hold the promise of being among the most durable and long lasting materials available for wood repair.

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

Repair Class III: Splices and Parts Replacement

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

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

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

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

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

Weatherization

A window which is repaired should be made as energy efficient as possible by the use of appropriate weatherstripping to reduce air infiltration. A wide variety of products are available to assist in this task. Felt may be fastened to the top, bottom, and meeting rails, but may have the disadvantage of absorbing and holding moisture, particularly at the bottom rail. Rolled vinyl strips may also be tacked into place in appropriate locations to reduce infiltration. Metal strips or new plastic spring strips may be used on the rails and, if space permits, in

the channels between the sash and jamb. Weatherstripping is a historic treatment, but old weatherstripping (felt) is not likely to perform very satisfactorily. Appropriate contemporary weatherstripping should be considered an integral part of the repair process for windows. The use of sash locks installed on the meeting rail will insure that the sash are kept tightly closed so that the weatherstripping will function more effectively to reduce infiltration. Although such locks will not always be historically accurate, they will usually be viewed as an acceptable contemporary modification in the interest of improved thermal performance.

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

Window Replacement

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

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

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

Conclusion

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

Additional Reading

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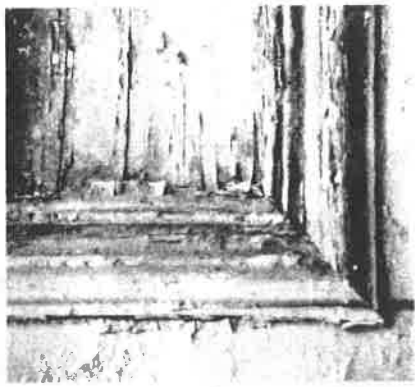
10 PRESERVATION BRIEFS



Exterior Paint Problems on Historic Woodwork

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National Park Service U.S. Department of the Interior

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

This Brief expands on that advice for the architect, building manager, contractor, or homeowner by identifying and describing common types of paint surface conditions and failures, then recommending appropriate treatments for preparing exterior wood surfaces for repainting[1] to assure the best adhesion and greatest durability of the new paint. Although the Brief focuses on responsible methods of "paint removal," several paint surface conditions will be described which do not require any paint removal, and still others which can be successfully handled by limited paint removal. In all cases, the information is intended to address the concerns related to *exterior wood*. It will also be generally assumed that, because houses built before 1950 involve one or more layers of lead-base paint,[2] the majority of conditions warranting paint removal will mean dealing with this toxic substance along with the dangers of the paint removal tools and chemical strippers themselves.

Purposes of Exterior Paint

Paint[3] applied to exterior wood must withstand yearly extremes of both temperature and humidity. While never expected to be more than a temporary physical shield—requiring re-application every 5-8 years—its importance should not be minimized. Because one of the main causes of wood deterioration is moisture penetration, a primary purpose for painting wood is to exclude such moisture, thereby slowing deterioration not only of a building's exterior siding and decorative features but, ultimately, its underlying structural members. Another important purpose for painting wood is, of course, to define and accent architectural features and to improve appearance.

Treating Paint Problems in Historic Buildings

Exterior paint is constantly deteriorating through the processes of weathering, but in a program of regular maintenance—assuming all other building systems are functioning properly—surfaces can be cleaned, lightly scraped, and hand sanded in preparation for a new finish coat. Unfortunately, these are ideal conditions. More often, complex maintenance problems are inherited by owners of historic buildings, including areas of paint that have failed[4] beyond the point of mere cleaning, scraping, and hand sanding (although much so-called "paint failure" is attributable to interior or exterior moisture problems or surface preparation and application mistakes with previous coats).

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

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

Justification for Paint Removal

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

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[1] General paint type recommendations will be made, but paint color recommendations are beyond the scope of this Brief.

[2] Douglas R. Shier and William Hall, *Analysis of Housing Data Collected in a Lead-Based Paint Survey in Pittsburgh, Pennsylvania, Part 1*, National Bureau of Standards, Inter-Report 77-1250, May 1977.

[3] Any pigmented liquid, liquefiable, or mastic composition designed for application to a substrate in a thin layer which is converted to an opaque solid film after application. *Paint and Coatings Dictionary*, 1978. Federation of Societies for Coatings and Technology.

[4] For purposes of the Brief, this includes any area of painted exterior woodwork displaying signs of peeling, cracking, or alligatoring to bare wood. See descriptions of these and other paint surface conditions as well as recommended treatments on pp. 5-10.

Fig. 1 *Excessive paint build-up on architectural details such as this ornamental bracket does not in itself justify total paint removal. If paint is cracked and peeling down to bare wood, however, it should be removed using the gentlest means possible. Photo: David W. Look, AIA.*

Fig. 2 *A traditionally painted bay window has been stripped to bare wood, then varnished. In addition to being historically inaccurate, the varnish will break down faster as a result of the sun's ultraviolet rays than would primer and finish coats of paint. Photo: David W. Look, AIA.*

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

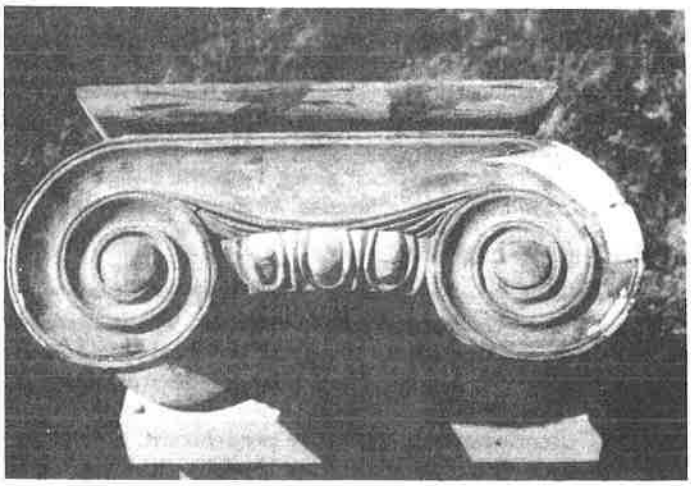

Fig. 3 *If damage to parts of a wooden element is severe, new sections of wood will need to be pieced-in. When such piecing is required, paint on the adjacent woodwork should be removed so that the old and new woods will make a smooth profile when joined. After repainting, the repair should be virtually impossible to detect. Photo: Morgan W. Phillips.*

Paint Removal Precautions

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

Owners of historic properties considering paint removal should also be aware of the amount of time and labor involved. While removing damaged layers of paint from a door or porch railing might be readily accomplished within a reasonable period of time by one or two people, removing paint from larger areas of a building can, with-

out professional assistance, easily become unmanageable and produce less than satisfactory results. The amount of work involved in any paint removal project must therefore be analyzed on a case-by-case basis. Hiring qualified professionals will often be a cost-effective decision due to the expense of materials, the special equipment required, and the amount of time involved. Further, paint removal companies experienced in dealing with the inherent health and safety dangers of paint removal should have purchased such protective devices as are needed to mitigate any dangers and should also be aware of State or local environmental and/or health regulations for hazardous waste disposal.

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

Repainting Historic Buildings for Cosmetic Reasons

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

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

If the decision to repaint is nonetheless made, the "new" color or colors should, at a minimum, be appropriate to the style and setting of the building. On the other hand, where the intent is to restore or accurately reproduce the colors originally used or those from a significant period in the building's evolution, they should be based on the results of a paint analysis.[5]

Identification of Exterior Paint Surface Conditions/Recommended Treatments

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

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

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

CLASS I Exterior Surface Conditions Generally Requiring No Paint Removal

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

Cause of Condition

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

Recommended Treatment

Most surface matter can be loosened by a strong, direct stream of water from the nozzle of a garden hose. Stubborn dirt and soot will need to be scrubbed off using ½ cup of household detergent in a gallon of water with a medium soft bristle brush. The cleaned surface should then be rinsed thoroughly, and permitted to dry before further inspection to determine if repainting is necessary. Quite often, cleaning provides a satisfactory enough result to postpone repainting.

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

- **Mildew**

Cause of Condition

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

Recommended Treatment

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

- **Excessive Chalking**

Cause of Condition

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

Recommended Treatment

The chalk should be cleaned off with a solution of ½ cup household detergent to one gallon water, using a medium soft bristle brush. After scrubbing to remove the chalk, the surface should be rinsed with a direct stream of water from the nozzle of a garden hose, allowed to dry thoroughly, (but not long enough for the chalking process to recur) and repainted, using a non-chalking paint.

- **Staining**

Cause of Condition

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

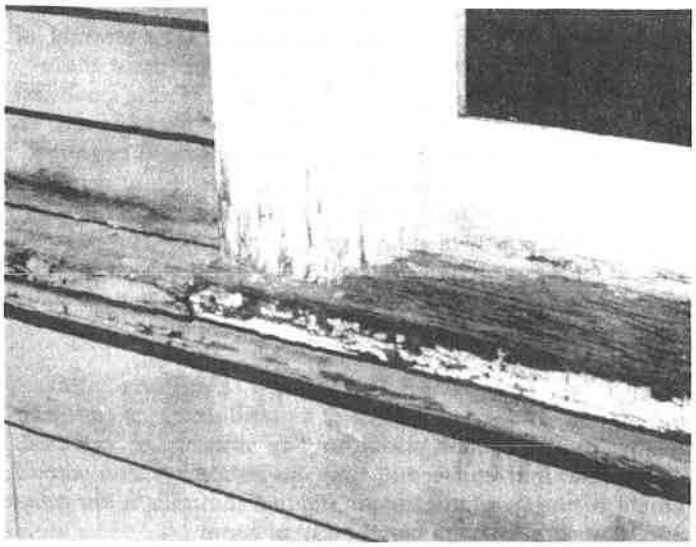

Fig. 4 *Paint films wear unevenly depending on exposure and location. Exterior locations which are susceptible to accelerated deterioration are horizontal surfaces such as window sills. These and similar areas will require repainting more often than less vulnerable surfaces. In the case of this window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

Recommended Treatment

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

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

Discoloration due to color extractives in replacement wood can usually be cleaned with a solution of equal parts denatured alcohol and water. After the affected area

has been rinsed and permitted to dry, a "stain-blocking primer" especially developed for preventing this type of stain should be applied (two primer coats are recommended for severe cases of bleeding prior to the finish coat). Each primer coat should be allowed to dry at least 48 hours.

CLASS II Exterior Surface Conditions Generally Requiring Limited Paint Removal

- **Crazing**

Cause of Condition

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

Recommended Treatment

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

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

- **Intercoat Peeling**

Cause of Condition

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

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

Recommended Treatment

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

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

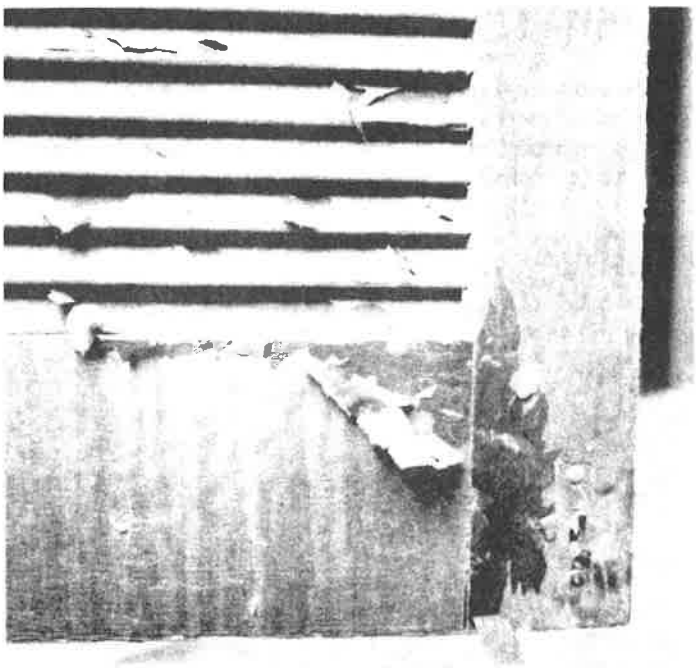

Fig. 6 *This is an example of intercoat peeling. A latex top coat was applied directly over old oil paint and, as a result, the latex paint was unable to adhere. If latex is being used over oil, an oil-base primer should be applied first. Although much of the peeling latex paint can be scraped off, in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

- **Solvent Blistering**

Cause of Condition

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

Recommended Treatment

Solvent-blistered areas can be scraped, hand or mechanically sanded to the next sound layer, then repainted. In order to prevent blistering of painted surfaces, paint should not be applied in direct sunlight.

- **Wrinkling**

Cause of Condition

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

Recommended Treatment

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

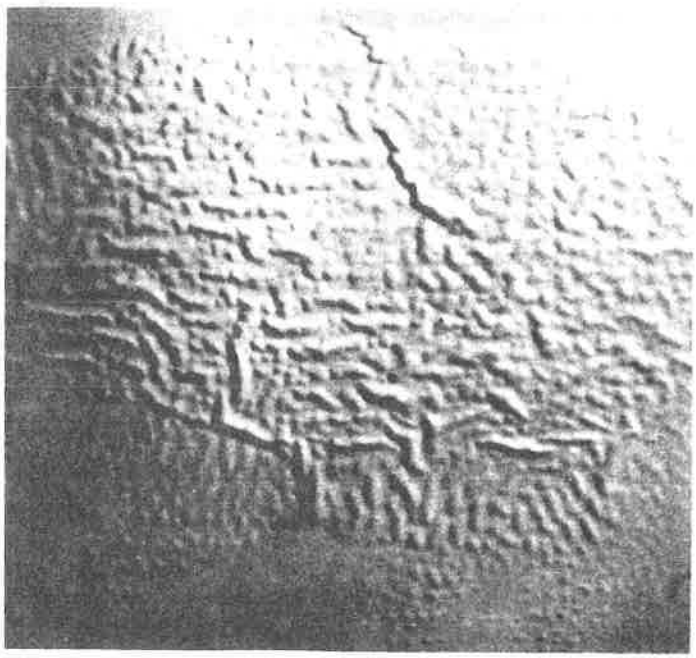

Fig. 7 *Wrinkled layers can generally be removed by scraping and sanding as opposed to total paint removal. Following manufacturers' application instructions is the best way to avoid this surface condition. Photo: Courtesy, National Decorating Products Association.*

CLASS III Exterior Surface Conditions Generally Requiring Total Paint Removal

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

- **Peeling**

Cause of Condition

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

Recommended Treatment

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

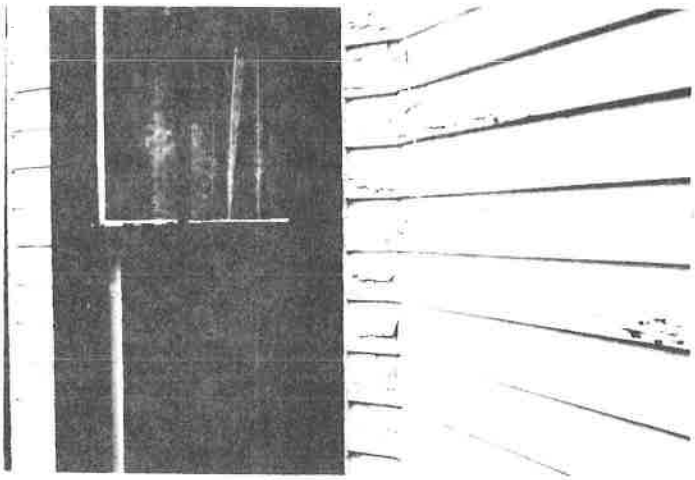

Fig. 8 *Peeling to bare wood—one of the most common types of paint failure—is usually caused by an interior or exterior moisture problem. Photo: Anne E. Grimmer.*

- **Cracking/Alligatoring**

Cause of Condition

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

Recommended Treatment

If cracking and alligatoring are present only in the top layers they can probably be scraped, hand or mechanically sanded to the next sound layer, then repainted. However, if cracking and/or alligatoring have progressed to

bare wood and the paint has begun to flake, it will need to be totally removed. Methods include scraping or paint removal with the electric heat plate, electric heat gun, or chemical strippers, depending on the particular area involved. Bare wood should be primed within 48 hours, then repainted.

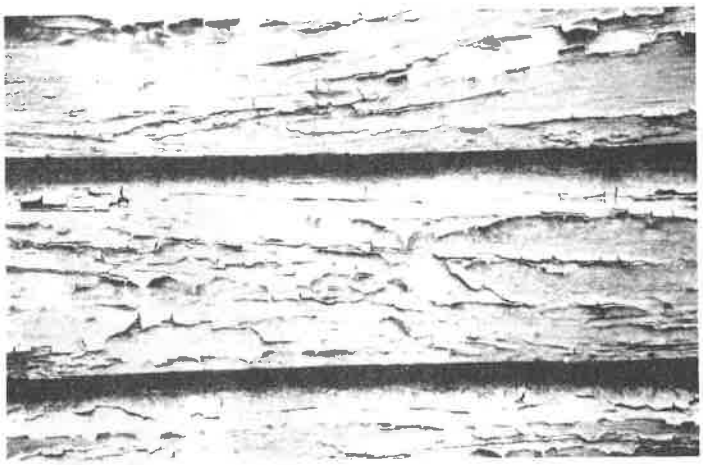

Fig. 9 *Cracking, alligatoring, and flaking are evidence of long-term neglect of painted surfaces. The remaining paint on the clapboard shown here can be removed with an electric heat plate and wide-bladed scraper. In addition, unsound wood should be replaced and moisture problems corrected before primer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

Selecting the Appropriate/Safest Method to Remove Paint

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

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

Methods for Removing Paint

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

The method or methods selected should be suitable for the specific paint problem as well as the particular wooden element of the building. Methods for paint removal can be divided into three categories (frequently, however, a combination of the three methods is used). Each method is defined below, then discussed further and specific recommendations made:

Abrasive—"Abrading" the painted surface by manual and/or mechanical means such as scraping and sanding. Generally used for surface preparation and limited paint removal.

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

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

- **Abrasive Methods (Manual)**

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

Recommended Abrasive Methods (Manual)

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

Paint scrapers are commonly available in 1 5/16, 2½, and 3½ inch widths and have replaceable blades. In addition, profiled scrapers can be made specifically for use on moldings. As opposed to the putty knife, the paint scraper is used in a pulling motion and works by raking the damaged areas of paint away.

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

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

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

Summary of Abrasive Methods (Manual)

Recommended: Putty knife, paint scraper, sandpaper, sanding block, sanding sponge.
Applicable areas of building: All areas.
For use on: Class I, Class II, and Class III conditions.
Health/Safety factors: Take precautions against lead dust, eye damage; dispose of lead paint residue properly.

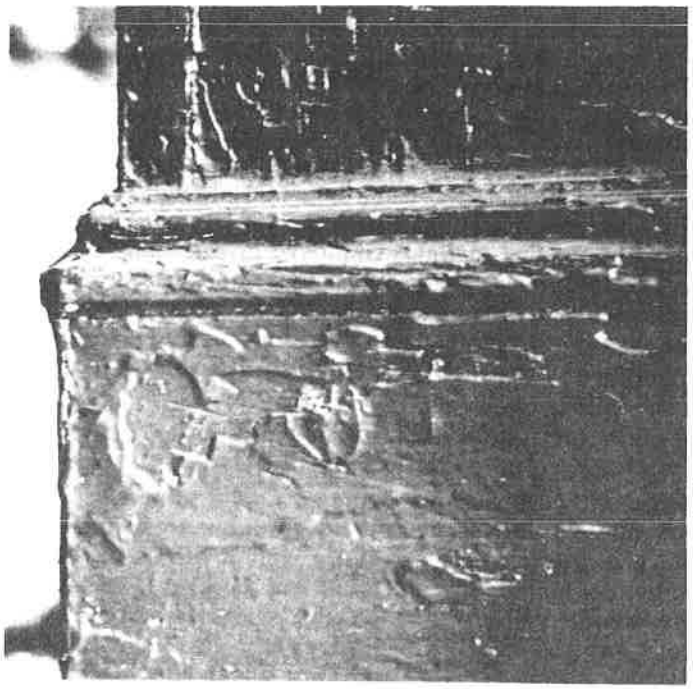

Fig. 10 *An excellent example of inadequate scraping before repainting, the problems here are far more than cosmetic. This improperly prepared surface will permit moisture to get behind the paint film which, in turn, will result in chipping and peeling. Photo: Baird M. Smith, AIA.*

- **Abrasive Methods (Mechanical)**

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

Recommended Abrasive Methods (Mechanical)

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

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

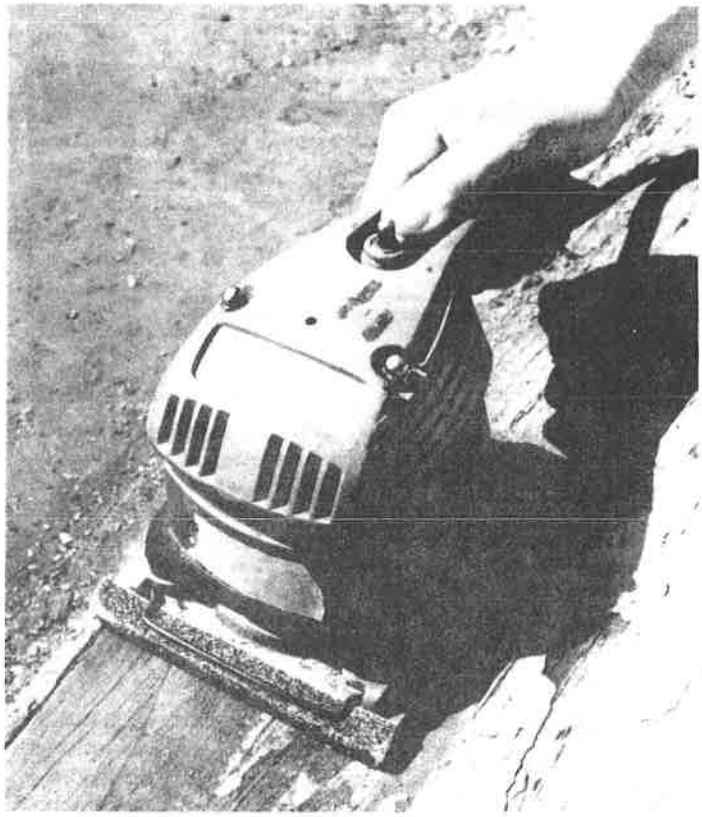

Fig. 11 *The orbital sander can be used for limited paint removal, i.e., for smoothing flat surfaces after the majority of deteriorated paint has already been scraped off. Photo: Charles E. Fisher, III.*

Not Recommended

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

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

Sandblasting: Finally—and undoubtedly most vehemently "not recommended"—sandblasting painted exterior woodwork will indeed remove paint, but at the same time can scar wooden elements beyond recognition. As with rotary wire strippers, sandblasting erodes the soft porous fibers (spring wood) faster than the hard, dense fibers (summer wood), leaving a pitted surface with ridges and valleys. Sandblasting will also erode projecting areas of carvings and moldings before it removes paint from concave areas (see figure 12). Hence, this abrasive method is potentially the most damaging of all possibilities, even if a contractor promises that blast pressure can be controlled so that the paint is removed without harming the historic exterior woodwork. (For Additional Information, See Presevation Briefs 6, "Dangers of Abrasive Cleaning to Historic Buildings".)

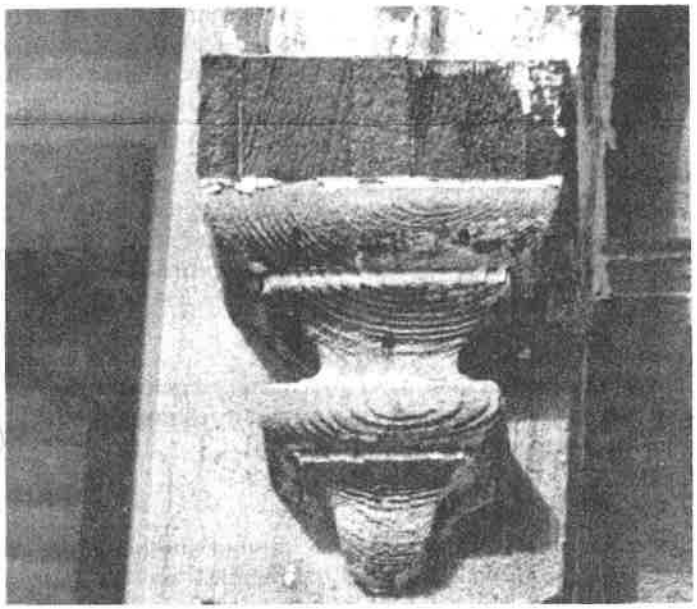

Fig. 12 *Sandblasting has permanently damaged this ornamental bracket. Even paint will not be able to hide the deep erosion of the wood. Photo: David W. Look, AIA.*

Summary of Abrasive Methods (Mechanical)

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

- **Thermal Methods**

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

Recommended Thermal Methods

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

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

Electric heat gun: The electric heat gun (electric hot-air gun) looks like a hand-held hairdryer with a heavy-duty metal case (see figure 14). It has an electrical resistance coil that typically heats between 500 and 750 degrees Fahrenheit and, again, uses about 15 amps of power which requires a heavy-duty extension cord. There are some heat guns that operate at higher temperatures but they should not be purchased for removing old paint

because of the danger of lead paint vapors. The temperature is controlled by a vent on the side of the heat gun. When the vent is closed, the heat increases. A fan forces a stream of hot air against the painted woodwork, causing a blister to form. At that point, the softened paint can be peeled back with a putty knife. It can be used to best advantage when a paneled door was originally varnished, then painted a number of times. In this case, the paint will come off quite easily, often leaving an almost pristine varnished surface behind. Like the heat plate, the heat gun works best on a heavy paint build-up. (It is, however, not very successful on only one or two layers of paint or on surfaces that have only been varnished. The varnish simply becomes sticky and the wood scorches.)

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

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

Not Recommended

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

Summary of Thermal Methods

Recommended: Electric heat plate, electric heat gun.
Applicable areas of building: Electric heat plate—flat surfaces such as siding, eaves, sash, sills, doors. Electric heat gun—solid decorative molding, balusters, fretwork, or "gingerbread."
For use on: Class III conditions.
Health/Safety factors: Take precautions against eye damage and fire. Dispose of lead paint residue properly.
Not Recommended: Blow torch.

- **Chemical Methods**

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

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

Recommended Chemical Methods
(Use With Extreme Caution)

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

paint layers—can be removed with a putty knife. Detachable wood elements such as exterior shutters can also be "dip-stripped."

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

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

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

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

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

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

If exterior shutters or other detachable elements are being sent out[6] for stripping in a caustic solution, it is wise to see samples of the company's finished work. While some companies do a first-rate job, others can leave a residue of paint in carvings and grooves. Wooden elements may also be soaked too long so that the wood grain is raised and roughened, requiring extensive hand sanding later. In addition, assurances should be given by these companies that caustic paint removers will be neutralized with a mild acid solution or at least thoroughly rinsed with water after dipping (a caustic residue makes the wood feel slippery). If this is not done, the lye residue will cause new paint to fail.

Summary of Chemical Methods

Recommended, with extreme caution: Solvent-base strippers, caustic strippers.
Applicable areas of buildings: decorative features, window muntins, doors, exterior shutters, columns, balusters, and railings.
For use on: Class III Conditions.
Health/Safety factors: Take precautions against inhaling toxic vapors; fire; eye damage; and chemical poisoning from skin contact. Dispose of lead residue properly

General Paint Type Recommendations

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

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

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

* If the top coat is latex paint (when viewed by the naked eye or, preferably, with a magnifying glass, it looks like a series of tiny craters) it may either be repainted with new latex paint or with oil paint. Normal surface preparation should precede any repainting.

If **CLASS III** conditions have necessitated total paint removal, there are two options, both of which assure protection of the exterior wood: (1) an oil primer may be applied followed by an oil-type top coat, preferably by the same manufacturer; or (2) an oil primer may be applied followed by a latex top coat, again using the same brand of paint. It should also be noted that primers were never intended to withstand the effects of weathering; therefore, the top coat should be applied as soon as possible after the primer has dried.

Conclusion

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

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

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

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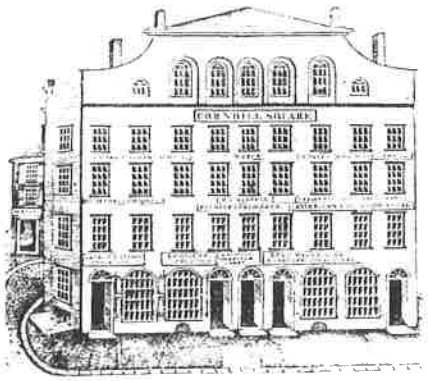

Rehabilitating Historic Storefronts

H. Ward Jandl

Technical Preservation Services Preservation Assistance Division
National Park Service U.S. Department of the Interior

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 (see figure 1).

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

Figure 1. *Inappropriate storefront alterations over the years—metal cladding, oversized signs and canopies—have detracted from the character of this historic district in Van Buren, Arkansas. A carefully considered rehabilitation plan for Main Street, including the removal of poorly designed signs, false fronts and the selection of an appropriate exterior paint color palette, serves to enhance the visual environment and preserves the district's sense of time and place. Photo above: Bob Dunn; Drawing, David Fitts*

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 1840's 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 1850's. Standardized sills, columns, and lintels could be arranged to create fronts of all sizes, styles and configurations. In the 1870's sheet metal storefronts became popular; they were also sold in standardized sizes and configurations through manufacturers' catalogs (see figure 2).

The typical 19th century storefront consisted of single or double doors flanked by display windows (see figure 3). 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

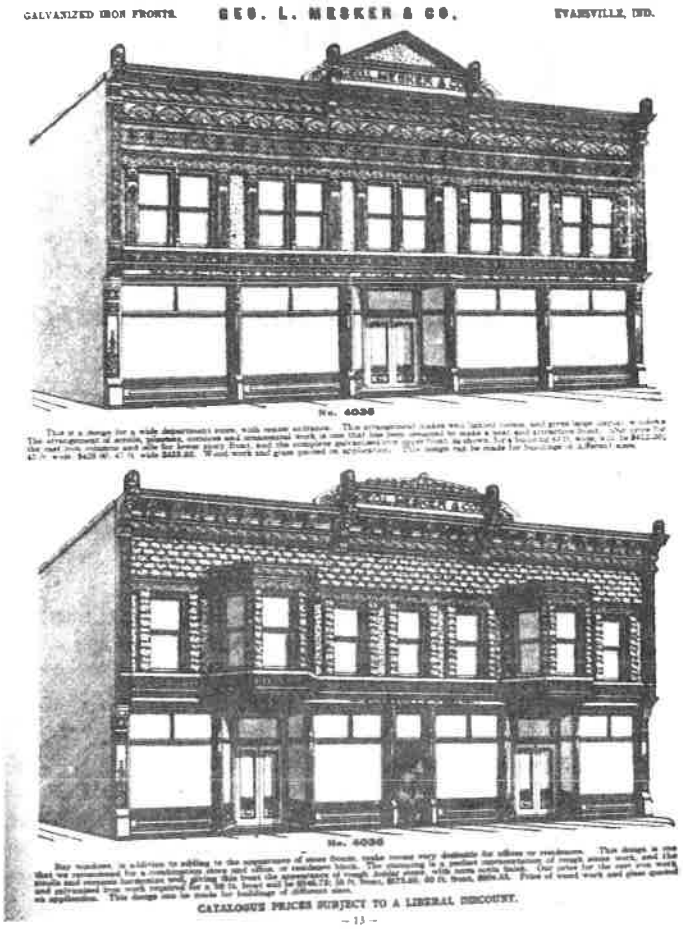

Figure 2. *These 19th century galvanized iron storefronts could be purchased from George L. Mesker & Co. in Evansville, Indiana.*

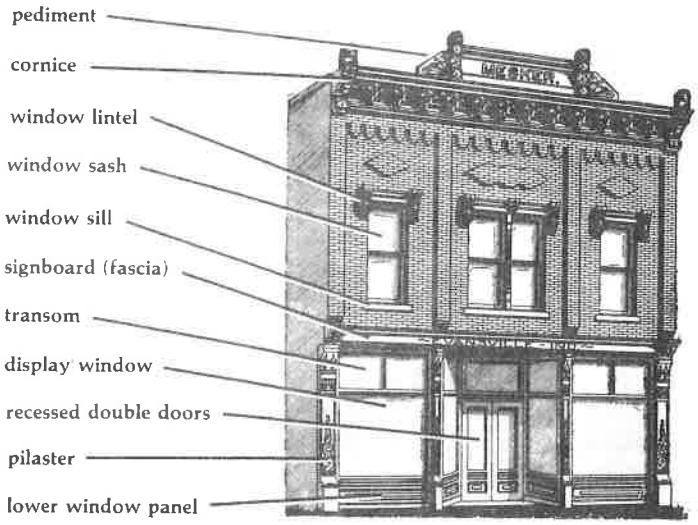

Figure 3. *Become familiar with the architectural features typical of historic commercial buildings. A close look at a storefront's construction materials, features and relationship to the upper stories will help in determining how much of the original facade remains.*

This particular storefront is No. 4016 in the George L. Mesker and Company catalog of 1905. One of Mesker's most popular designs, it featured cast-iron sills, columns and lintels, galvanized iron lintel and main cornice, window caps and pediment.

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 and the increasing use of canvas awnings, few major technical innovations in storefront design can be detected from the 1850's 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 1930's 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 (see figure 4).

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.

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 stores (see figure 5). 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 to determine the extent and nature of rehabilitation work needed (see figure 6). In most cases, this examination is best undertaken by a qualified professional.

Figure 4. *This storefront in New York City designed by Raymond Loewy typifies the streamlined look of the 1930's. Added to an earlier buiding, the front utilizes glass, stainless steel and neon to make a modern statement. This is a good example of a later storefront which has acquired significance and should be retained in any rehabilitation.*

Figure 5. *In some cases, as in the storefront on the extreme left, it is a simple matter to determine original appearance by looking at neighboring storefronts. Removal of the board and batten fasciaboard, pent roof, and "colonial" style door, all of which could be undertaken at minimal cost, would restore the original proportions and lines of the building. Photo: Day Johnston*

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 building's 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.

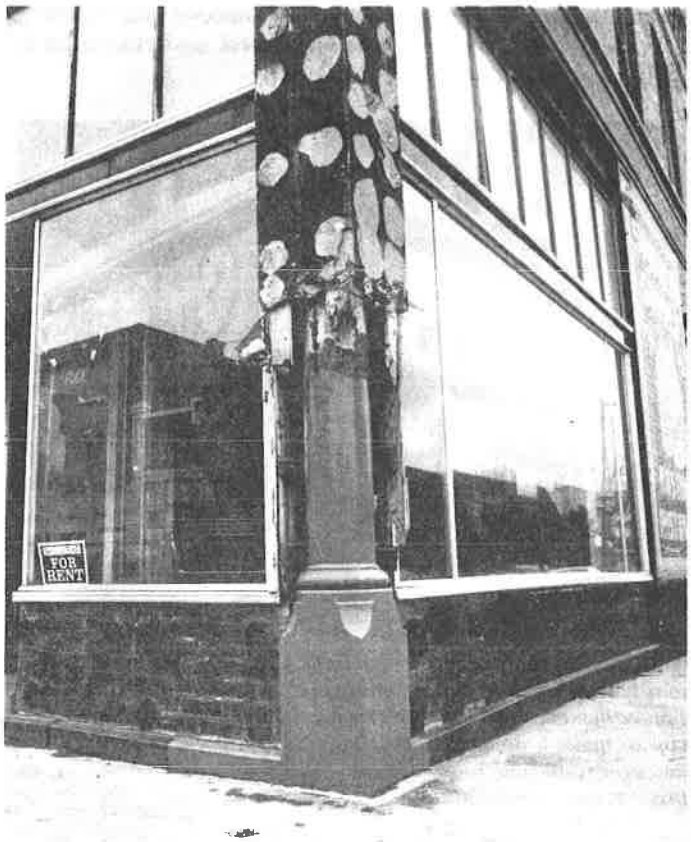

Figure 6. *Storefronts of the 1940's, 50's, and 60's were frequently installed by attaching studs or a metal grid over an early front and applying new covering materials. If the existing storefront is a relatively recent addition with little or no architectural merit, begin by removing the covering materials in several places as was done here. If this preliminary investigation reveals evidence of an earlier front, such as this cast-iron column, carefully remove the later materials to assess the overall condition of the historic storefront. The black mastic visible on the lower masonry panels was used for installing pigmented structural glass. Some attachment methods for modern facings, such as mastic or metal lath, may have seriously damaged the original fabric of the buiding, and this must be taken into account in the rehabilitation process. Photo: Bob Dunn*

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.

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 rehabilitaton.

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 (see figure 4). 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 1860's 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 found on page 3).

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 buiding 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 storefront 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 (see figure 7).

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

Figure 7. *Part of a large office building constructed in Washington, D.C. in 1928, this finely detailed bronze storefront is typical of many constructed during this period. It should be noted that the original grilles, spandrel panel and window above are all intact. Photo: David W. Look, AIA*

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 (see figure 8).

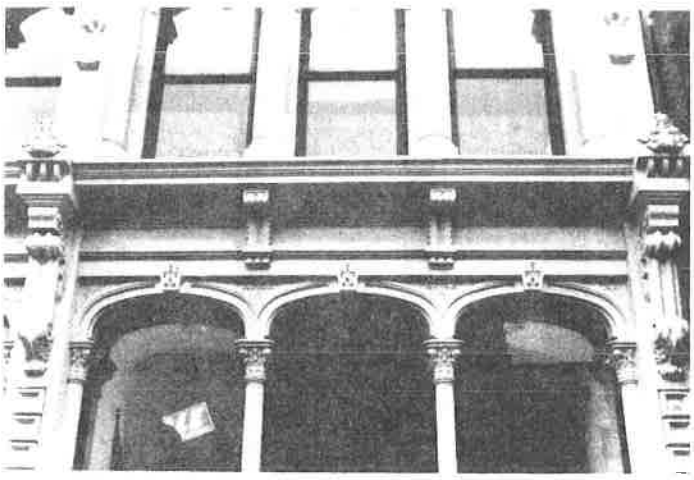

Figure 8. *When the Grand Opera House in Wilmington, Delaware, was rehabilitated, missing cast-iron columns were cast of aluminum to match the original; in this particular case, because these columns do not carry great loads, aluminum proved to be successful substitute. Photo: John G. Waite*

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 build-up 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 build-up 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 and terneplate) 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 rust-inhibiting primer coat should be applied. Finish coats 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. Paint failure should not be mistaken-

ly 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 semi-rigid epoxies which saturate porous decayed wood and then harden. The consolidated wood can then be filled with a semi-rigid 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 (see figure 9). 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.

Figure 9. *Rather than replace an entire wooden storefront when there is only localized deterioration, a new wooden component can be pieced-in, as seen here in this column base. The new wood will need to be given primer and top coats of a high quality exterior paint—either an oil-base or latex system. Also wood that is flaking and peeling should be scraped and hand-sanded prior to repainting. Photo: H. Ward Jandl*

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 non-historic 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 sofening 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, non-historic appearance inappropriate to the building style and period.

Designing Replacement Storefronts

Where an architecturally or historically significant storefront no longer exists or is too deterioriated 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 (see figure 10). 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.

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.

Figure 10. *(A) This existing storefront, added in the 1950's to a late 19th century brick building, extends beyond the plane of the facade; faced with anodized aluminum and permastone, it does not contribute to the architectural and historic character of the building. (B) This replacement design uses "lumberyard colonial" detailing, such as barn-type doors, shutters, small paned windows, and a wood shake pent roof. The design, detailing, and choice of materials are clearly inappropriate to this commercial building. (C) This replacement design retains the 1950's projecting canopy but symmetrical placement of the doors relates well to the second floor windows above; this contemporary design is compatible with the scale and character of the building. (D) This replacement design accurately restores the original appearance of the building; based on historical research and physical evidence, it too is an acceptable preservation approach. Drawings: Sharon C. Park, AIA*

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 (see figure 11). 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.

Figure 11. *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. They can be equally useful today.*

Signs

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

Glass 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

A key to the successful rehabilitation of historic commercial buildings is the sensitive treatment of the first floor itself (see figure 12). 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.

Figure 12. *This photograph of three late 19th century commercial buildings clearly shows the impact of preserving and rehabilitating storefronts. The one on the right has been totally obscured by a "modern" front added in the 1950's. Although inappropriate alterations have taken place on the left storefront, it is still possible to determine the original configuration of the doors and display windows. The storefront in the middle has remained intact. Although in need of some minor maintenance work, the appeal of the original design and materials is immediately apparent.*

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

Preservation Briefs 11 has been developed under the technical editorship of Lee H. Nelson, AIA, Chief, Preservation Assistance Division, National Park Service, U.S. Department of the Interior, Washington, D.C. 20240. Comments on the usefulness of this information are welcomed and can be sent to Mr. Nelson at the above address.

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Cover drawing: This woodcut of the Joy Building, built in 1808 in Boston, shows early storefronts with shutters; note the profusion of signs covering the facade, advertising the services of the tenants.

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