



## RESTORATION TECHNIQUES

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When a building is being restored, it is important not only to be sure that the original design is being reproduced accurately, but also that original building materials are treated with care to insure an extended life. This section suggests techniques for restoring original materials as well as offers solutions to problems often found in restoration work. Anyone attempting a restoration project should use this section only as a resource for more in-depth research. It is strongly urged that actual restoration work be done by a contractor who has an interest in and is sympathetic toward historic preservation, and who has had experience in this type of work.

### WOOD FRAME CONSTRUCTION

Buildings of wood frame construction are by far the most common in Vermont. Wood buildings are the easiest to maintain as most repair work involves nothing more than replacing defective material. The two most common problems in a wood frame building are deterioration of the structural frame and moisture penetration of the exterior weatherproof skin.

#### Foundation Moisture

The most common sources of moisture penetration are through the basement floor and foundation walls, through improperly flashed exterior joints, and through a leaking roof. Moisture in the ground naturally seeks the warmer, dryer conditions of most basements. Consequently, moisture penetration through the basement floor and the foundation walls is unavoidable. However, the degree of penetration and the level of humidity in the basement can be controlled.

Adequate ventilation in a basement will facilitate moisture evaporation, and holding wood construction twelve to eighteen inches above the surface of the ground will usually suffice to reduce and control excess condensation in a damp basement. Drainage around the exterior of the foundation walls and in the basement floor will also facilitate the removal of excessive amounts of ground water.

Almost any moisture condition, can be eliminated almost completely by building a vapor barrier over the basement floor and across the foundation walls. Most nineteenth century foundations were constructed out of masonry and, in spite of continued repointing, are poor barriers against penetrating ground moisture. Basement floors were usually left as bare ground and are as conducive to proper drainage as to seepage from below. An effective vapor barrier should include a layer of polyethylene sandwiched between coarse sand and the basement floor and covered by a thin poured concrete wall over the masonry foundation walls. The polyethylene on the walls should run down and underneath the polyethylene on the floor to guarantee a continuous vapor barrier.

#### Paint Problems

Blistering and peeling paint are the other common signs of an excessive moisture condition within the framework of the building. Solutions outlined above may not be absolutely necessary to correct this particular problem. Blistering and peeling are caused by inadequate ventilation which results in condensation on the interior of a wall. Moisture is trapped by an impervious membrane, usually a thick skin

of oil paint covering the exterior, which does not allow the wall to breathe and the moisture to evaporate through it. Instead, because the interior of the building, especially in the fall, winter and spring months, is warmer than the exterior, trapped moisture condenses between the frame of the building and the inside surface of the exterior wall covering. Dry and wet rot, and blistering and peeling paint are the typical results.

The simplest solutions to correct almost any paint problems are to adequately ventilate the exterior wall surface with small, round metal ventilators and to use an acrylic latex paint instead of oil. Unlike oil which forms an impervious membrane, acrylic paint is porous and will allow the wall to breathe. The surface should be properly prepared by scraping off all loose paint and removing as much of the old paint around the problem areas as is possible before priming and repainting. Acrylic may be painted over oil paint but not the reverse.

#### Structural Deterioration

Structural members infected with dry or wet rot should be removed and replaced with a new member of similar dimension. If only a section of a structural member is infected, the rotten section should be cut out to at least twelve inches beyond the rot and repaired by nailing or bolting in a new member.

Solid timber posts and beams where unexposed should be replaced with structurally superior built-up members of similar overall dimension.

Structural failures or repairs in the foundation

should be remedied or carried out before proceeding with restoration work on the wood construction of the building itself. Frequently, structural failures in the frame of the building are directly related to structural problems in the foundation wall and/or the footings. Such problems should be thoroughly investigated to accurately determine the real cause.

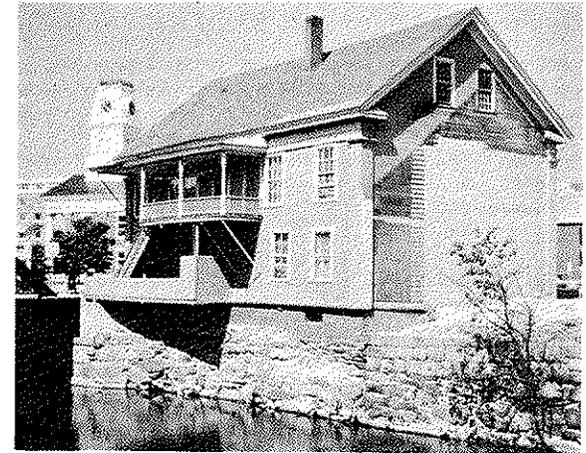
Leaking flashings or exterior joints and leaking roofs should be repaired and replaced if necessary. These are the most common sources for water penetration through an exterior surface and require constant inspection and maintenance. Many old buildings were built over a period of years, each new section merely abutting a previous section. Because each section was built on its own foundation, the various sections usually settled differently resulting in slight but sometimes significant gaps between the sections. Such gaps require special flashing details to properly weatherseal the involved sections together. Properly aligning the section of a building to eliminate such gaps usually requires major foundation work, an undertaking which can be prohibitively expensive. Sometimes the sections can be brought together with tie rods and turn buckles.

Once the foundation has been repaired or stabilized, most structural problems in a wood frame building can be solved by reinforcing the existing structure. Under-structured walls, floors and roofs can be built-up with additional studs, joists and rafters of similar dimension to the originals. Spreading walls and sagging floors usually can be straightened with tie rods and turn buckles.

### Siding and Details

The most important consideration to be made in the restoration of a wood frame building is the preservation of architectural details. Because wood is such an easy material to work with, many wood frame buildings, especially those in the Italianate, French Second Empire and Queen Anne styles, were encrusted with elaborate architectural details. While important to the architectural character of a building, they are more often than not removed in the process of minor or major repairs and not put back. Residing a building, usually with a synthetic material, is probably the single greatest cause for removing details essential to a building's character. Because wood is easy to work with, there should be no excuse for not duplicating almost any architectural detail even if the duplicate is nothing more than a basic outline of the original minus the minor decorative elements.

Wood shingles are the most durable siding material if properly weatherproofed and maintained but are extremely expensive. Commonly used on most wood frame Queen Anne style buildings, usually in combination with clapboards and sometimes board and batten siding, wood shingles should be replaced wherever originally used and should only be substituted for clapboards if they duplicate the horizontal spacing of the clapboards and are set in rigidly straight lines to mimic the appearance of the original clapboard siding as closely as possible. Board and batten siding, which is rare and was almost exclusively limited to Gothic Revival style buildings, should be replaced wherever used originally and should not be substituted for or replaced with any other siding material.



Clapboard siding is without question the most common nineteenth century siding material. However, the availability of synthetic substitutes for wood clapboards means that the relative merits of wood, aluminum and vinyl clapboard siding must be considered from the standpoint of expense as well as durability. It should be remembered that nothing will look better than the original siding material. No matter how carefully synthetic siding is put on, it is always going to look like a substitute for wood clapboards. Because the horizontal spacing is rigidly fixed, the spacing never lines up with existing window sills or lintels and the siding almost always never ends up with a full clapboard just below the cornice. The spacing on wood clapboards was always figured and adjusted so that it would line up around windows and end up with a full clapboard below the cornice.

Synthetic siding does have certain disadvantages which should be considered. Even though synthetic siding is supposed to elimi-

nate the need for continual repainting, the colors are sometimes not as permanent as the manufacturers claim. The choice of colors is also usually limited and, with the exception of white, may not be appropriate to the architectural style and character of the building. Synthetic siding is also generally more expensive than even several paint jobs. Aluminum siding can be easily and permanently dented and scratched. Both aluminum and vinyl cannot be painted over successfully. This means that although synthetic siding may be the end of a property owner's maintenance worries, once the color is selected it cannot be changed without replacing the siding. If a wrong color choice is made, the result will be essentially permanent.

Synthetic siding is often blamed for spoiling the character of an old building. However, it should be pointed out that it is not the material that is to blame but the way in which it is applied. Architectural details such as corner boards and the trim around windows and entrances are removed and either are not replaced or are replaced with thin synthetic equivalents. Other details such as cornices are removed and replaced with siding. Anyone who doubts the importance of details should try shaving off their eyebrows.

Aluminum and vinyl clapboards are imitation materials and should only be used as if they were wood clapboards. They should only be applied to surfaces originally covered with wood clapboards and be cut to fit around all architectural details, even corner boards. If the synthetic siding is applied in this fashion, there is no reason why the architectural character of the building should be spoiled.

The whole range of asphalt and asbestos shingles and siding and artificial stone and brick sidings should never be used. They are not historically correct to any architectural style and only destroy a building's architectural character. Artificial stone and brick sidings are an unsuccessful pretense to be something which they are not and devalue not only the building but the surrounding environment as well.

### **BRICK**

Large scale brick manufacturers using uniform clays to produce bricks of uniform size, color, hardness, and regularity did not come into existence until after the Civil War because of their dependence on the railroads. Before the Civil War, partly because of the bulk and weight of bricks and partly because clay and sand for making bricks were found everywhere, bricks were manufactured locally, very often right on the building site in temporary facilities. Differences in the basic properties of types of clays found in different localities produced bricks of different colors, and low and inconsistent firing temperatures produced variations in hardness. The low density of bricks made from molds packed by hand before the introduction of brick making machinery, together with low firing temperatures, were responsible for the soft, porous bricks, characteristic of the nineteenth century.

#### **Brick Deterioration**

Soft and porous by present standards, the bricks absorb twenty to twenty-five percent of their weight in water, whereas ten percent or less was considered the accepted maximum by

the end of the nineteenth century. Soft, under-burned bricks might even absorb as much as thirty-five percent of their weight in water. The absorbency factor is important to bear in mind when comparing modern bricks with old ones and when determining the causes of deterioration.

The deterioration of a brick wall can be caused in numerous ways. It was not uncommon for new brick walls to develop efflorescence. Soluble salts found in the brick and mortar, or formed by interaction between the two, reached the surface of the brick and dried. Eventually these salts were removed by natural action or by brushing and washing. Groundwater, rising by capillary action, also introduced harmful salts. As the salts became concentrated in the lower parts of the wall the dampness rose even higher. This action sometimes caused the face of the bricks to disintegrate. Leaking roofs, gutters and parapets also can constitute a major source of water on walls. Even small cracks where mortar has failed to adhere to the brick can allow water penetration.

The outer crust of each brick is harder and more dense than the material inside. Once this crust is removed by freezing and thawing, sand blasting or some other means, the disintegration of the brick is greatly increased.

Old bricks frequently develop cracks where shrinkage or laminating occurred in the clay or where unequal stresses were set up during firing. The corners of the brick commonly break or wear away more than the rest of the face, giving it a rounded exterior surface. Repointing of the joints is the most common operation in maintaining and repairing a brick

wall but if it is improperly done it can contribute to the deterioration of the bricks.

Once a brick begins to crumble, the crumbling invariably continues and the condition cannot be stopped except by replacing the brick. A few bricks can be removed and replaced at one time without damaging the structural stability of the wall. A dampproofing course can be introduced into a wall in short length by removing a few bricks at a time and inserting a waterproof membrane into the joint before the bricks are replaced.

Old bricks are difficult to match with modern brick because of basic differences in the manufacturing process. The most practical sources for old bricks are wrecking companies that specialize in old brick, demolition projects, or from the building itself. Usually the walls of a brick building are solid masonry constructed out of the same material on the interior of the wall as on the exterior. The brick can be easily removed from the interior of the wall and replaced with any modern brick of the correct size. The only problem is that sometimes the brick used on the interior was a softer grade of brick than the facing brick used on the exterior and may not be as impervious to water penetration. Besides attempting to match the size, texture and color of the brick, the bonding pattern of the wall should be matched exactly. Any special architectural details should also be matched exactly.



### TERRA COTTA

Terra cotta is related to brick but the clay and sand used are much finer in texture than those used in the manufacture of brick and consequently produce a much harder and smoother product. Terra cotta was commonly used in the Queen Anne period and in some twentieth century architectural styles for architectural detailing but is almost impossible to replace with new. Because of its finer quality and

greater density, terra cotta generally is structurally superior to brick and is not as susceptible to deterioration. If properly maintained along with the rest of the brick wall, terra cotta should never need to be replaced.

### STONE

Stone was generally used throughout Vermont for foundations and for architectural trim in brick buildings, and in certain areas, for entire buildings.

Besides structural failures, the other most common problem with stone is the deterioration of the stone itself. In areas where the atmosphere is polluted, this condition can be severe.

Every kind of stone is more or less porous and absorbs moisture from a damp atmosphere, from rain, from groundwater and from condensation on the interior of the building. If there are soluble salts within the stone, or if some are introduced by moisture carried upward from the ground through the wall by capillary action, they may be carried toward the face of the wall. If these salts crystallize within the pores of the stone, the action may cause the surface to break off, and if they are carried to the surface and then crystallize on it, unsightly efflorescence is formed.

All rainwater contains some dissolved carbon dioxide which becomes deposited on the exterior wall surface. Dirty surfaces, in turn, attract more moisture thus making them particularly vulnerable to disintegration. Water penetrates joints and cracks and can cause serious damage by freezing.

## Foundations

Foundations are usually of either coursed or uncoursed fieldstone with more regularly cut blocks above grade. The stone used above grade can usually be matched easily from a local quarry or by locating an old building that is scheduled for demolition and salvaging the



stone from it. Most repair work to foundations below grade can be done with reinforced concrete, either in the form of patchwork or buttresses. Replacement walls in reinforced concrete should be kept below grade, the original above grade stone work being saved and replaced or matched with new stone.

## Trim

Matching the stone of decorative architectural trim may prove to be difficult and every effort should be made to preserve and restore as much of the original sills, lintels, carved surfaces, moldings, door and window trim, and cornices as is feasible. While replacement stone for walls should be unnecessary, matching replacement stone for deteriorated pieces of trim can usually be purchased from an active local quarry or scrounged from a defunct one, very often the one from which the original stone was quarried.

## Repairs

Various cement-based materials or epoxy mixed with pulverized stone may often be used for repairs. It may be necessary to experiment with various mixtures before a suitable repair medium is developed. Such materials, particularly epoxy based, can be used to repair carved profiles and moldings. For patching stone, these materials can be mixed into a grout, which, when scrubbed into the face of the patched stone, often can match the repair to the surrounding original stone areas.

## REPAIR AND REPLACEMENT OF MASONRY

Stone and brick surfaces on old buildings have

been subjected to years of expansion and contraction caused by weather cycles and, in many cases, to excessive water penetration. Structural failures in masonry construction are manifested by cracking, uneven settlement, bulging, deterioration of the mortar, and other visible signs. Such failures usually are remedied by stabilizing the foundation of the building before proceeding with above grade restoration.

Frequently, it is impossible to obtain stone or brick of identical or similar color for repair work. Even if the color of the stone or brick cannot be duplicated exactly, if the type of stone or the texture and size of the brick, the width of the mortar joint, the color of the mortar, and the type of joint are matched exactly against the original, the repair work will be the most successful and visually as unobtrusive as is possible. Original masonry should, wherever feasible, be cleaned, repaired, and repointed rather than refaced.

Exterior masonry walls should never be covered, under any circumstances, with synthetic brick or stone, clapboards, asphalt shingles, or aluminum siding. This is not for esthetic reasons only. No matter what the salesman of artificial siding may say to the contrary, a masonry wall is generally one of the best bargains in terms of maintenance. It may cost as much to clean, repair and repoint as to cover it over, but the end result will last at least three times as long.

Molded bricks for special pattern work, recessed panels, belt courses, corbeled cornices, and other architectural details; tapered and wedge shaped bricks for arches; decoratively

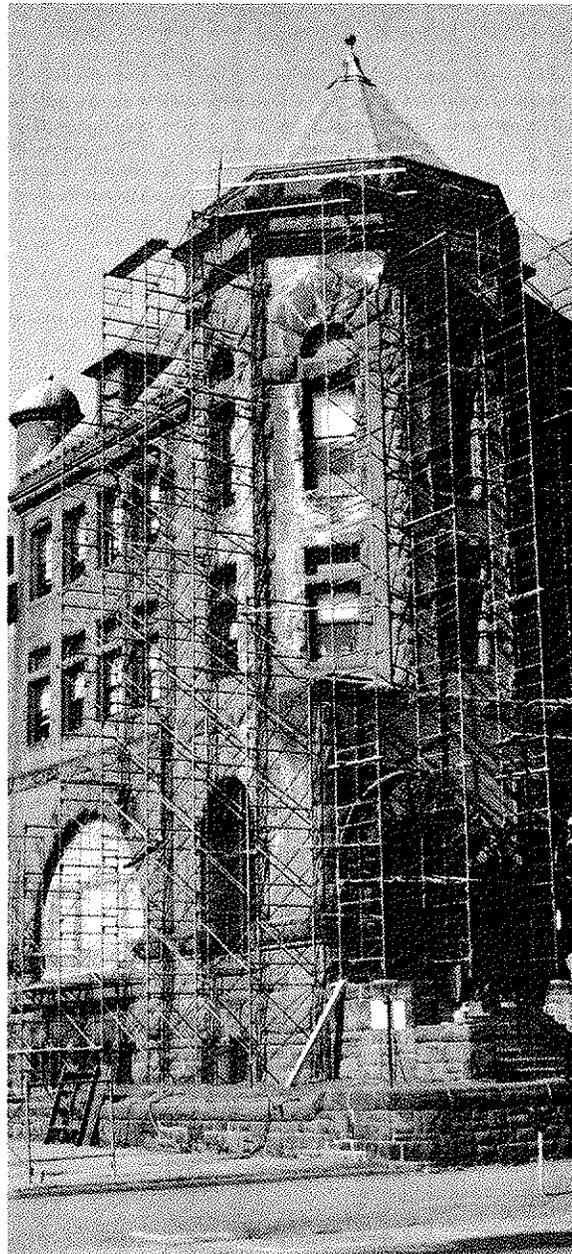
carved stones; and architectural terra cotta are almost impossible to replace with an exact or even close match. Consequently, every effort should be made to preserve these irreplaceable components.

The best technical source book on masonry is: Harley McKee; **Introduction to Early American Masonry, Stone, Brick, Mortar and Plaster**; the National Trust for Historic Preservation (740-748 Jackson Place, N.W., Washington, D.C. 20006); Washington, D.C.; 1973.

### CLEANING MASONRY SURFACES

Encrusted dirt and carbon deposits can be removed from brick walls by careful steam cleaning. This requires the cautious use of trisodium phosphate in a mild solution, which is thoroughly scrubbed onto the surface of the wall and then removed by steam jets. If the dirt and deposits on brick surfaces prove resistant to this technique, then mild solutions of hydrochloric acid may be used. A weak solution of hydrofluoric acid is equally effective, but window glass and painted areas must be adequately masked and metal components protected to prevent the acid from etching those surfaces. After the use of any acid solution, it is extremely important that it be removed completely by thoroughly washing the treated surfaces with a steam nozzle.

Stone may be properly cleaned with water pressure containing a friable aggregate of from 30 to 40 mesh that contains no free silica. If this material is not obtainable, silica sand of 50 to 60 mesh may be used. Water should be mixed with the sand or aggregate with a maximum air pressure of 60 pounds. The cushioning action



of the water and aggregate will allow the cleaning of the stone face without marring its finish.

An alternate method of cleaning stone is the use of a high pressure water hose without adding the aggregate. After the stone has been soaked with water for at least three to four hours, water is then applied at a pressure of 1,000 to 1,200 pounds through an aerating nozzle, which reduces the destructive force of the water. The cleanness obtained by this method is not as great as by steam or water and aggregate cleaning, but it will clean the surface of the stone to a reasonable degree.

Because of the technical equipment and knowledge required for these cleaning procedures, owners are encouraged to consult with reputable professionals before undertaking any work. In recent years great advancements in the use of chemical cleaners for stone have been made.

### REMOVING PAINT FROM MASONRY SURFACES

Removing paint from masonry surfaces poses a particularly difficult problem in that the majority of masonry structures erected before the Civil War were constructed out of soft brick. Those that have been painted usually have been painted over several times which has resulted in heavy paint encrustations that are thick and often difficult to remove except by sandblasting. Sandblasting, however, destroys the original texture and surface of these soft bricks, rendering them unattractive in appearance, and accelerates deterioration from moisture absorption. Sandblasting, therefore, is not recommended and should only be used as a last

resort.

Where masonry surfaces are coated with oil-based paints, an industrial paint remover may be used. This is generally applied by hand and allowed to partially dry, resulting in a curling action in the paint. The loosened paint is then abraded with a stiff brush and removed with a steam nozzle. It may be necessary to repeat this action several times depending upon the number of layers of paint. Again, at the end of this process it is necessary to steam the wall thoroughly and to rinse with water to rid the surface of all residue of paint remover.

A greater problem exists where casein paints have been used as a wall coating. These are relatively insoluble by standard paint removers. Soaking the wall with water over a period of several hours, followed by a thorough scrubbing of the wall surfaces with trypsin combined with trisodium phosphate, will help loosen the casein coating. A high-pressure water hose, using approximately 1,000 pounds of water pressure projected through an aerating nozzle may then be used to remove the softened coating. Very stubborn coatings may be removed by using a 1 percent sodium hydroxide solution, but this is a rather dangerous method.

Recent developments in industrial paint strippers offer possibilities for efficient methods of paint removal. Used primarily for removing large areas of paint, such as found on industrial tanks, these strippers can be sprayed on with proper equipment and the residue washed off with high-pressure water hoses. A particularly promising technique is the application of paint stripper with a special steam unit that increases the effectiveness of the remover. Technical

details on these products may be explored further by contacting industrial products chemical firms.

In many cases it is not necessary to completely remove all old paint. Instead only loosened and flaking paint need be removed. This can be done by hand scraping and is highly recommended.

### **WEATHERPROOFING MASONRY SURFACES**

Of great importance in a rehabilitation project in which the masonry wall is constructed out of soft brick is the final step of waterproofing the repaired wall. In recent years, the development of silicone solutions has proved invaluable for many waterproofing purposes. Silicone solutions form a chemical bond with the wall material and protects it from moisture absorption and carbon deposits. Colorless and usually undetectable to the eye, silicone application should only be undertaken after the building has been cleaned and repaired and only under the supervision of a waterproofing expert. The preservation effects of silicone will only last for several years after which time the process must be repeated.

Painting, on the other hand, is more permanent and provides some measure of waterproofing to masonry walls. Painting, however, introduces the problem of the color scheme and proper color selection. Because improper color selection can change the architectural character of a building and because paint usually does not bond effectively to a masonry surface and will eventually blister and peel, painting masonry surfaces is not recommended or encouraged

except for buildings which have been previously painted.

Effective treatment of previously painted groups of buildings designed as a block can be achieved through mutual agreements by property owners to paint their buildings at the same time with the same or compatible colors. Sharing contracting services will not only enhance the visual quality of the block but will result in reduced costs to the individual property owners.

All repair and repointing work should be completed before painting begins, and deposits of dirt or powdered masonry should be brushed off wall and ornamented surfaces. Acrylic latex house paints are the best for this use since they produce a matte finish and contain no oil base ingredients to react chemically with mortar elements.

Whenever it is determined to paint the decorative stone or brick trim of a brick building, all of the trim components, including front steps, porches, basements, cornices, and window framements, and other components, should be painted the same color. If, on commercial buildings, the cornice and storefront(s) are tin and/or cast iron, these should be painted the same as the stone trim. The elegant proportions of a building can be seriously altered if some parts are painted different colors. Because the original character of most masonry buildings depends upon the contrast of brick walls and stone trim, this technique should be reproduced whenever possible.

## REPOINTING

Nineteenth century mortar was composed of lime, sand, and water. Lime, the binding agent in mortar, may over many years leach out of mortar joints because of its chemical and physical nature and thereby leave the joints greatly weakened. Since this leaching effect is a result of contact with moisture and air at the surface of the joint, the eroding process works progressively from the outside inward. Except in severe cases this process can be halted and the building adequately stabilized by the process of repointing.

Repointing, or tuckpointing, consists of raking out the old mortar joint to a proper depth, thoroughly cleaning the joint sides, and refilling the joint with new mortar. After hardening, the new mortar assures the protection and stability of the brick wall for many years to come.

If the brick is to be painted after repointing, there is no need to duplicate the appearance of the old lime mortar. In this case a good commercially available masonry mortar that expands slightly on drying is recommended. If, however, the brick is to be left natural, it is desirable to simulate the old lime and sand mortars. A mixture consisting of one part of white masonry cement, two parts of lime, and seven to nine parts of the smallest available mesh sand is recommended.

Every attempt should be made to match the color of the original or existing mortar, a job which is sometimes difficult because of a basic difference between nineteenth century lime and the commercially produced lime presently

available. Commercially produced dyes in powder form are available for coloring mortar. Several test samples should be mixed and allowed to dry to insure the closest possible color match before proceeding with the general repointing job. Matching the color of the mortar is equally as important as matching the color, texture and size of the brick or stone if the repair job is to be as unobtrusive and inoffensive as possible.

In general, the mortar joint should be concave, as this gives the best appearance and the greatest bond of mortar to brick. If possible, the type of original joint should be ascertained and duplicated in the new work.

## SEALING JOINTS

Flashings, coping stones and capping bricks are very important to the integrity of a wall and to its longevity. If parapet walls exist and are topped by coping stones or capping bricks, the joints of the stones or bricks should be carefully repaired.

The use of a one-part sealant or a liquid synthetic rubber sealant in the joints is advisable. The condition of the flashing where the roof meets the parapet is important. Flashings and counter-flashings must be in perfect condition to prevent water entering at this critical junction.

Removing the parapets to prevent water leakage is not necessary if these procedures are carefully followed.

Removing the parapets is also not recommended as it destroys an essential feature of the

building's architectural character and style.

Windows and other openings should be caulked, preferably with polysulfide or silicone synthetic rubber sealants. These are obtainable in many colors and can be matched to the finished paint or trim. They offer as much as 15 years of flexible life, compared to the normal five-year maximum for regular, oil-based caulking materials.

Though caulking is often included in the painting specifications of a job, it is recommended that this be done as part of the masonry restoration, for it is actually a part of the waterproofing of the building.

