

Conservation and Restoration of Stained Glass – An Owner's Guide

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1. Why Conserve Stained Glass Windows?

Delighting the eye with ever-changing combinations of colored light, stained glass windows are functional, as well as decorative, and commemorate the religious, social, and economic history of their communities. While art is too often seen as a peculiar province of museums or wealthy private collectors, stained glass is found in homes, churches and public buildings that unite all levels of society. From standardized door panel to complex public commission, these windows have been part of America's experience, tracing an emerging nation's transition from recipient to innovator of great expressions of architectural adornment.

The simple stained glass set in our earliest churches, the richly worked windows in Victorian homes, or the elegantly modern panels of Frank Lloyd Wright, all are integral parts of the buildings they serve. To lose an original window is to lose the intent of the designer and to radically transform the function of the interior space.

The intent of this Guide is to emphasize the significance of the stained glass window to American artistic traditions, and to provide a means of preserving that tradition. The Census of Stained Glass Windows in America was founded to bring together art historians, museum professionals, craftspersons in stained glass, and preservation experts to research, catalogue, and disseminate information on 19th and 20th century glazing traditions. But we cannot study what no longer exists, or what has been so altered by changes that it has lost its historic integrity. Thus, the conservation and restoration of stained glass is of prime importance, and to achieve a better understanding of these practices, we offer this Guide.

2. What is a Stained Glass Window ?

(See Glossary for italicized words)

A stained glass window can appear in many forms. Essentially it is an arrangement of sections of glass set into an architectural framework. Traditional stained

glass is not stained at all, but composed of glass that has been colored with metallic *oxides* while still in the molten state thus called *pot metal*. The molten glass is then blown or rolled, and shaped into sheets that are later cut into segments conforming to a pattern laid out by the designer. These segments, for example, a face, or sections of a robe, receive detailing with *vitreous paint*, ground glass mixed with metallic oxides in a liquid medium. Such painting can be an extremely simple application of *traceline* to indicate features, or the creation of three-dimensional effects using *back-painting*, *matting*, *stippling*, *quill work*, or *scratching*. The painted glass is fired so that the ground glass in the paint fuses with the surface of the glass, producing an image of great permanence.

The many segments of glass are then joined together with narrow lead strips called *comes* that are fitted around the glass segments. The comes are then *soldered* at their joints and *puttied* to make them watertight. The sections of the leaded window must then be placed into a metal, stone, or wooden window frame. Additional strength is provided by *support bars* (T Bars) set in the frame of the window and thinner *saddle-bars* set on the interior to which the *panels* of glass are attached.

A number of additional techniques can be applied to the glass to produce a very wide variety of effects. *Silver stain* is silver nitrate painted on the glass that, when fired, turns the glass into various shades of transparent yellow. It is often used for hair and architectural and costume details. Color changes can also be achieved using *flushed glass*, consisting of a thin layer of colored glass fused onto a clear, or differently colored sheet. Using *abrasion* or *acid-etching*, sections are cut away in the colored layer to produce a two-tone result. *Enamel* colors, of all variety of hues, were introduced in the Renaissance and were often used in the 19th century and in today's modern panels. Many stained glass windows are actually sections of colorless glass painted with enamel

colors, fired and then set in an architectural frame. These windows often resemble paintings more closely than they resemble medieval stained glass, but they are still important manifestations of the glazing art. Even windows almost devoid of all color, such as *grisaille* windows, claim our respect. These windows depend for their effect on the strength of the leading patterns and the subtle use of trace-line or variations in surface texture.

Since the late 19th century many new glazing techniques have been introduced. *Opalescent glass*, glass with variegated colors produced by mixing the still molten glass from different pots, gave a whole new palette to the stained glass designer. An iridescent sheen was often added by exposing the hot opalescent glass to metallic fumes while in the *annealing* oven. Additional treatment to this glass brought new effects. *Confetti glass* received multi-colored chips, *drapery glass* was manipulated during the cooling process into ridges and furrows, and often textures, such as those in *ripple glass*, were added by variations in the rollers or the surface of the bed on which the glass rested while cooling. In windows of the "opalescent era," often only the hands or faces of the figures were painted, all other effects being achieved through variations in the glass itself.

Changes in the size and shape of the glass segments themselves have transformed the modern image of the stained glass window. *Plating*, or the use of two or more layers of glass set one behind the other, often adds considerable weight to a window, although it permits some spectacular effects. Non-figural windows or borders often display *beveled glass*, glass whose edges have been ground at an angle, or *jewels*, sometimes cast nuggets that refract light. The most dramatic change, however, is the *dalle-de-verre*, or *faceted glass window*, rejecting the traditional leaded system for a matrix of cement or *epoxy resin*. For these windows, slabs of colored glass are broken or cut with a saw, then chipped around the edges, and set in a pattern around which the matrix is poured. Once hardened, the matrix with its embedded faceted segments of glass is unmolded and set in a window.

For further discussion of glazing techniques, see: Elskus, Albinas. *The Art of Painting on Glass*. New York: Charles Scribner's Sons, 1980.

Reyntiens, Patrick. *The Techniques of Stained Glass*. New York: Watson-Guptill, 1967.

Duthie, Arthur Louis. *Decorative Glass Processes*. New York: Dover Publications, 1982.

Lee, Lawrence, and others. *Stained Glass*. New York: Crown Publishers, Inc., 1976.

3. Dangers of Poorly Advised and Over-Zealous Restoration

(See Glossary for italicized words)

Even the most well-intentioned program of restoration can have disastrous consequences. Every owner or person responsible for stained glass windows must be aware of potential dangers. We have seen, and quite recently, shockingly bad restorations commissioned by well-meaning individuals. Some deplorable examples deserve to be mentioned.

In a church in Connecticut, Tiffany windows were "restored" without removing them from the building. Their badly bulged panels were reattached to existing *saddle bars* with *wires* pierced through the lead *comes*. That some of the glass cracked in the process or that few additional and needed saddle bars were added to minimize stress did not seem to concern the restorer. Sheets of Plexiglas cut to fit the window frame and cemented in place with caulk were passed off as protective glazing. No attempt was made to fabricate frames for their glazing, so its effectiveness is probably of short duration. Unfortunately, this fast but certainly not cheap type of restoration is all too commonly foisted upon church congregations who have been pressured to trust the name of an old firm.

Other tragic incidents of unprincipled restoration can be cited in a landmark church in New York City, renowned for its 19th century glass. Here some delicately *enameled* windows were beginning to show deterioration of the colored enamel. The restorer who repaired these windows stripped them down to the bare glass and completely repainted the scenes in his own style of unbelievable crudeness. If he made a cartoon of the original, it was unrecognizable in the finished product. These windows have been destroyed as effectively as if the restorer had thrown a rock through them.

Repainting and refiring glass has not been unusual in restorations, again often destroying the window in the process. From another well-known and wealthy parish in New York comes a sad example. A fine window from the 1930s was beginning to show deterioration of its *trace lines* and *mat paint*. The glass was removed from its leads by the restorer, touched up with new paint, refired and releaded. Far from stopping the deterioration of the paint, the repainting has flaked off and with it has come most of the original paint. The window is now a ghost of its former beauty.

Temporary conservation attempts, if poorly advised, can also damage windows. To protect a window stored in an important New York museum, gummed paper tape was pasted across the painted surface of the glass. In removing the tape some years later, the delicately applied mat paint came off with the tape. Masking, "Scotch" and gummed paper tape are often carelessly used to support broken glass in transport for restoration. Tape should be used with the greatest care, never on painted surfaces and only for short duration. Skillful touch-up painting, using a full sized photo as a model, was able to repair the damage in the case of the museum's window, but proper handling would have made this expensive restoration unnecessary.

This Guide should help owners in the choice of con-servation/restoration procedures. Individuals can then more accurately weigh the urgency of immediate intervention against the caution in assessing long-term needs. Do not become a "deplorable example".

4. Philosophy of Conservation/Restoration

Stained glass windows are at once works of art and architectural elements. How does one begin to define a philosophy of conservation/restoration that is consistent with the windows' dual role as art and artifact? Fortunately, we can draw from precedents set by architectural conservators that are easily adaptable to our work in stained glass.

Throughout this Guide, three levels of intervention are discussed: conservation, restoration and adaptation.

CONSERVATION. The objective of conservation is to retain the existing design, material and aesthetic value of the stained glass window. This may require nothing more than regular maintenance, or it may require direct intervention to ensure the continued structural, historic and artistic integrity of the window.

RESTORATION. The objective of restoration is to return the stained glass window to its original form and design (or in rare cases to the form and design of a later period of significance). This may include the removal of later repairs, or the replication of missing or damaged portions of original work.

ADAPTATION. The objective of adaptation is to rework the stained glass window for a new installation. This may involve adding or removing glass to fit an opening of different size or configuration, or preparing a window for museum display. Professional conservators recognize that all materials de-

teriorate, and that the decay is irreversible. It is the job of the conservator to slow the rate of decay as much as is feasible, and certainly to not do anything that might accelerate the deterioration. To guide conservators in making decisions about appropriate intervention, national and international ethics of practice have been established. These ethics are best stated by Bernard M. Feilden in his book, *Conservation of Historic Buildings*.

The following standard of ethics must be rigorously observed in conservation work:

- (1) *The condition of the building before any intervention and all methods and materials used during treatment must be fully documented.*
- (2) *Historic evidence must not be destroyed, falsified or removed.*
- (3) *Any intervention must be the minimum necessary.*
- (4) *Any intervention must be governed by unswerving respect for the aesthetic, historical and physical integrity of cultural property.*

Any proposed interventions should (a) be reversible, if technically possible, or (b) at least not prejudice a future intervention whenever this may become necessary; (c) not hinder the possibility of later access to all evidence incorporated in the object; (d) allow the maximum amount of existing material to be retained; (e) be harmonious in colour, tone, texture, form and scale, if additions are necessary, but should be less noticeable than original material, while at the same time being identifiable; (f) not be undertaken by conservator/restorers who are insufficiently trained or experienced, unless they obtain competent advice.

Feilden is former Director of the International Centre for the Study of the Preservation and the Restoration of Cultural Property (ICCROM) in Rome, Italy. He was also conservation architect for such noted projects as St. Paul's Cathedral, London, and York Minster.

5. Planning Your Conservation/Restoration Campaign

I. Study and Evaluate the Windows

If at all possible, consult with someone trained in the study of the American Decorative Arts, an art or glass historian, local historian, theologian, or a specialist in stained glass to help with the study of the windows. They can help you evaluate your windows for their significance to your community and its history. Their objective opinion can aid you to edu-

cate the congregation, Board of Trustees, or public to the importance of the windows.

Gather all of the existing information about the windows, frames, and building. Develop the history of the windows from fabrication to the present day. If the windows are in a church or public building, investigate any possible records or photographs which may exist. Make public notices of the search, and request any relevant material from parishioners or members of organizations which made use of the facility. This information may be found in copies of old journals or public relations material produced for special events which occurred within the building. Old photographs may be immensely useful, whether they are professionally taken or are family snapshots from a wedding. Try to be creative when searching for this material. A case in point occurred at a large church which had been destroyed by fire, which also consumed the documentation covering their windows. However, the church had been used to photograph a wedding scene for a movie some years previous to the fire, and photographs of the windows existed in the film library of the movie studio. Draw from the above and collate the information gathered for the building and each of its stained glass windows. Know as much as possible about the following:

A. *The Building*

1. Date construction began and date completed.
2. Types of building materials used and their relative quality and the construction techniques employed.
3. Architect, designer and builder with any available information about them.
4. Original drawings, elevations or plans of the structure.
5. Major alterations or repairs to the building or interior furnishings. These are important because they may alter the way in which the windows were originally designed to be viewed, by exposing or covering parts of the window. This information may also be helpful in dating undocumented window restorations.

B. *The Stained Glass*

1. Artist/designer with information on other commissions in the area.
2. Fabricating studio.
3. Date fabricated and installed.
4. Donor or person who commissioned the windows.
5. The subject matter of the individual piece, and

how it may relate to the total ensemble. Make a record of all memorials or inscriptions, as these are difficult to reconstruct if damaged.

6. Collated records of previous repairs to the windows or frames. Identify the studio or craftsman who performed the work. Determine if it was an emergency repair, or a well-thought-out restoration. Was any of the original fabric or design intent altered by the repair/restoration?
7. Any catastrophes (i.e., fire, flood, etc.) or nearby demolition or construction which may have affected the windows.

Gather the above information, collate and make copies so that the originals may be stored in a safe place away from the building (i.e., safe deposit box, museum store room, etc.) You are now ready to proceed to the next phase.

II. *Survey the Existing Conditions of the Structural and Decorative Fabric of the Window*

A. *Purpose*

Regardless of whether a restoration program is possible in the near future, as soon as you realize the importance of the stained glass you may possess, a complete survey and update of documentation should be done. The purpose of this is threefold:

1. The survey allows you to begin monitoring the changes in the condition of the windows. Over time the serious problems will become self-evident, so that if and when restoration money becomes available, it will be well spent.
2. The completion of photo documentation may be invaluable if the window is seriously damaged by accidental or deliberate forces.
3. Historically, the documentation you develop will be of great interest in the future to art historians, conservators, owners/caretakers and concerned members of the public.

If a restoration program is feasible, then a survey is essential. It will serve the above purposes, as well as:

1. Help to create a set of specifications, so that the job may be put out to bid.
2. Help church members or public officials solicit grants or donations toward the restoration effort.

B. *The Survey*

1. A floor plan should be produced, or existing elevation drawings used, to locate and identify the windows. A logical numbering system should be devised so that the individual panels, parts of the window and the windows as a whole can be identified. All existing documentation should be

keyed into this system.

2. A Complete photographic documentation of the stained glass, frames, and associated architecture should be produced (See below for minimum photographs required).
3. A physical inspection of all aspects of the windows should be made. You should be prepared to provide ladders or scaffolding so this can be done correctly. If funds allow, the removal of a sample panel can be extremely helpful to delineate the problems which may exist and thereby to ascertain an accurate estimate of restoration costs. (See below for suggested physical inspection checkpoints.)
4. During the survey, be sensitive to proposed changes to the windows and what the structural, aesthetic and historical effects may be, such as:
 - a. Addition of, or removal of, protective glazing or screening.
 - b. Possible sealing of ventilators which are no longer used. (Due to the constant opening and closing of ventilators, the glass in these moving sections is more at risk than if they were stationary.)
 - c. Ways to better support the stained glass and surrounding frame, or to better seal them against the elements.
 - d. Possible addition of artificial lighting sources to illuminate at night, or replace daylight blocked by subsequent construction that altered original lighting conditions.
5. By inspection of the existing documentation and physical inspection of the setting, verify that the windows are in their original frames and location.

Although all of the above work can be accomplished by, or with the aid of, a stained glass consultant or competent restoration expert, you may also wish to consult an architect. An architect's services would be very useful in discerning the condition of the related fabric of the building (i.e., roof, stone or woodwork, major structural elements, etc.). Pains should be taken to secure the services of a competent preservation architect. The sensitivity and knowledge needed to preserve historic buildings are often different from that of new construction.

C. Suggested Photographic Documentation

The photographs should be 35mm color transparencies and black and white prints. If funds are available for a professional photographer, all the better, but a minimum requirement would be a person with

experience photographing stained glass windows. If the proposed photographer has no samples, shoot a test roll to guarantee a high degree of quality. A 28mm X 85mm macro zoom lense is ideal for most shots specified.

The photo set should include the following:

1. Interior overall views of window with:
 - a. Reflected light to illustrate surface texture and coloration and to differentiate leading pattern from possible painted details.
 - b. Transmitted light to indicate observed colors and painted details.
2. Interior detail shots of special situations such as:
 - a. Installation details (i.e., sill detail, typical meeting joint, jamb detail, head detail, support bar attachment to leaded panel and supporting frames).
 - b. Damaged areas (i.e., bulging sections, failing borders or support bars, areas of possible impact, etc.).
 - c. Areas of paint deterioration—this is particularly important if immediate restoration is not possible, for monitoring paint loss and to reconstruct the original linework when restoration is possible.
 - d. Studio signature plates to identify the maker for insurance or historical purposes.
3. Exterior detail shots of special areas
 - a. Pertinent installation details
 - b. Protective glass details
 - c. Special problems (i.e., condensation frame rot or rust, displacement of window elements).
 - d. Attendant architectural details which presently or in the future may affect the windows (i.e., repointing problems, movement of stonework, etc.).

Depending upon the artistic and historic value of the windows, budgetary concerns, and the needs of the owner, this list may be modified. But for accurate documentation and sensitive restoration purposes, this list represents the bare minimum requirement.

D. Problems to be Discussed with your Consultant/Restoration Studio

1. Stained Glass Panels
 - a. Lead Matrix
 1. Does the panel feel solid or does it bend easily?
 2. Inspect the vitality of the lead came. Are there visible cracks and signs of fatigue? How does the lead flange respond to a gentle

- bending? Does it flex or does it crack easily? Are sections of lead came missing?
3. Are there many broken solder joints?
 4. Has the putty fallen out or been washed out from under the lead flange?
- b. The Glass
1. Is there broken or cracked glass? Does the breakage seem to follow a pattern throughout the window, or is it the result of unrelated impacts?
 2. What is the condition of the glass paint? If it is deteriorating, does it appear as though it was originally well adhered? How effective would consolidation be? (Consolidation of paint is a process whereby loose or flaking paint is re-affixed to the glass.)
 3. Is the glass corroding? If so, does it appear to be due to a water condition or a special chemical condition? (Glass corrosion may be the result of attack by water, chemicals, or possibly biological agents. It is important to ascertain the type of attack so that the problem may be solved.)
- c. The Support System
1. Are the tie wires or support bars separating from the window? Are they missing entirely?
 2. Are there bulges in the window? If so, are they due to poor support design, poor leading pattern, or failure of the lead matrix due to metal fatigue?
 3. How are the support bars attached to the frames? For the support bars to function effectively, they must be attached to the frames in some way.
- d. Installation/Frames
1. What is the type and condition of the frames? Are they salvageable?
 2. What is the type and condition of the meeting joints? Are the individual panels adequately supported?
 3. What is the condition of the ventilators? Do they operate smoothly? Is the frame material in good shape? If replacement is necessary, will the new ventilators be of the same dimensions so that the historic glass will not be altered? This is always possible, albeit, more costly.
 4. Is there any type of protective glazing and how is it installed? Is it causing any condensation problems?
5. How are the windows held into the frames? What is the condition of the caulk or putty level?
 6. What is the condition of the sub-framing support of the frames?
 7. What is the possibility of breakage due to removal?
 8. How are attendant problems in the building (i.e., roof leaks, etc.) affecting the windows?
- When the above survey has been completed, the decision must be made as to whether the work can be performed in situ or if the windows must be removed. It should be remembered that windows are imperiled when ever they are removed from their frames. In general, the windows should be handled as few times as possible.
- E. *Documentary Summary*
- All of the information which you have gathered by following the guidelines of Sections I and II forms the record to date on documentation of the windows. It is extremely important that before any work (from the most minimal cleaning to complete restoration) is started, that your documentation papers be available to the conservator/ restorer. Make sure that any work done to the windows is accurately recorded so that the documentation is always current and complete. It cannot be stressed too often how important this record of the history of the windows is to future restorers, historians and concerned members of the general public.
- III. *Choice of Conservator and/or Restoration Studio*
- THIS IS THE MOST IMPORTANT DECISION** to be made for the preservation of the windows. Put time and effort into checking the references of proposed studios. Make inquiries of objective institutions, such as the conservation department of a large museum, or a not-for-profit conservation or preservation group, and the State Historical Preservation Office. Longevity of a studio does not insure quality; management changes may result in lowering of standards. Try to deal with a studio where the owners maintain knowledgeable responsibility for the quality of the work. Inspect previous work and speak with former clients. *Note well, the "best buy" may not be the lowest bid.* The owners/caretakers of the windows should visit the prospective studios to see work in progress. Be wary of a studio owner who refuses such a visit, no matter what his/her reasons may be.
- The owners of the studio must have a special

sensitivity for the preservation of historic windows, and a dedication to do what is best for them. They must be able to communicate clearly, respect the restoration philosophy of the owner/caretaker of the windows, and yet voice their opinions if they feel the owner's philosophy may negatively affect the ultimate quality of the restoration.

The studio must also know how the adjacent problems of the building may be affecting a window, as well as how to protect the window if work is done near them by other trades. The studio must have experience with setting scaffolding and methods of lowering and transporting the glass panels, once they are removed.

6. Conservation/ Restoration Procedures

I. *Cleaning of Stained and Leaded Glass*

Before any cleaning of painted glass is begun, the paint should be inspected to insure that it is firmly attached to the glass, that is, "stable" and will not be removed with the dirt. This process is highly technical and should be determined by a professional familiar with paint problems. Note well, that the most efficient method of removing the dirt from the glass may not ultimately be the best method to use due to the possible damage it may do to the glass or the paint layer. Where there is evidence of paint deterioration, it is better to half-clean the glass than risk the further loss of painted detail.

A. *Cleaning Methods to be Avoided*

1. Any application of, or immersion into a lye bath.
2. Steam or high pressure cleaning system, such as those used to clean masonry.
3. Any type of mechanical or air abrasive (sand blasting) equipment (except for the very controlled methods discussed below).
4. Any acid, caustic or abrasive cleansers, such as oven or bathroom cleaners, hydrofluoric or other acids, ammonia-based window cleaners, scouring powders or steel wool.
5. Note well that if any of the above are being used in the vicinity of the stained glass (to clean masonry, etc.), the windows must be protected.

B. On-site cleaning should be limited to dusting, or washing with a soft cloth and soft water (distilled water is preferred, hard water should be avoided).

C. In the restoration studio, the following procedures may be used to further clean the glass. Until the stability of the glass paint is verified, all cleaning should be done on a light table and closely monitored. Again, if cleaning will cause any further loss of paint,

do not clean at all.

1. If the paint is very *stable*, the section may be dipped in clear water or neutral pH solution
2. Use methylene chloride or a solution of dimethylformamide (DMF) thickened with cellulose to remove old putty. This mixture may also be used to remove house paint which has inadvertently been applied to the glass during building maintenance.
3. Under *very* controlled conditions mechanical removal of dirt may be done with the following: glass fibre brushes; wooden or metal scraping tools. *Extreme care* should be exercised, and sample pieces should be inspected by a qualified technician with a microscope to detect possible damage to the glass

All of the aforementioned techniques demand a high degree of sensitivity and supervision so that none of the applied decoration is removed. If the windows are not painted, the same guidelines should be followed. None of the "cleaning methods to be avoided" should be used.

II. *Removal and Transport to Studio*

Before any removal is started, review the documentation to insure that it is current. A minimum requirement would be in-place photography of any window to be removed. Review with the conservator/restorer the techniques which they intend to use. Know all you can about the following:

- A. Insurance—the owner should receive a certificate of insurance from the studio which lists all coverage in force. Compensation, general liability and any other type of insurance specified by local code should appear on this certificate. The owner (or studio) should further insure the windows against damage caused by transport, vandals, or other perils not covered by the general multi-peril policy of the studio.
- B. The removal of the glass is often a difficult and demanding job. Damage may occur to glass during the removal process. This may be caused by: the poor condition of the window; rock-hard putty; distortion of the framing members; or unanticipated setting details. Therefore, extreme caution should be exercised and specific setting details recorded in the documentation.
- C. If the leaded panels are in such a poor state of disrepair that they may fall apart upon removal and further damage the glass, special tape may be used to hold the panel together. This tape must not

be put on the painted surface of the glass. Masking tape, filament tape, duct tape etc., must not be used under any circumstances. The only tape that can safely be used is that in which the backing of the tape does not dissolve in the same solvent as the adhesive part of the tape. In general, tape should be used sparingly. Tape should be removed by skilled personnel as soon as possible. This should be done with solvents, not by simply pulling it off. *Tape will pull off paint.*

- D. The removed leaded panels should be transported and stored in a vertical position with sufficient packing material to prevent breakage. If the panels are so damaged that they cannot be kept vertical, they should be supported independently on trays of sufficient design to keep the panels as flat as possible. They should be stored away from moisture and damaging chemicals.
- E. After the panels have been removed, the frames should be inspected to see if they or other related setting details contributed to the deterioration of the stained glass panels. Some possible problems to look for are:
 - 1. Frame movement, which when transferred to the stained glass through rock-hard putty, causes breakage of glass.
 - 2. Architectural or protective glazing details that encourage condensation, or inhibit rainwater runoff.

III. *Stabilization Program*

- A. If the current survey indicates that a permanent loss of glass is imminent, but it is not financially feasible to complete the required restoration work, a stabilization program should be considered. This is composed of the following:
 - 1. Removal of panels in danger of falling out, and too far gone to stabilize on the site.
 - 2. Removal for storage of those individual pieces of glass in danger of falling out.
 - 3. Addition of storm panels to weakened areas to relieve the wind loads.
 - 4. Sandwiching areas of the windows between rigid sheets of Plexiglas to give them temporary support. (This must be done in such a manner so as not to trap condensation.)
 - 5. Possible erection of barriers so that the public cannot inadvertently damage the windows.
 - 6. Frequent visual inspections of the windows to

monitor endangered areas.

- 7. Cataloguing, and noting in existing documentation, the removal of panels or pieces of glass.
- B. Storage of stabilized glass. If possible, the glass should be stored in a vertical position with sufficient packing for support within wooden crates. Any tape used for removal purposes should be removed before packing. If the panels are too damaged to store vertically, they may be placed on trays within a horizontal rack arrangement similar to a pie-safe. The crates or racks should be clearly marked and placed out of harm's way in a cool, dry, ventilated safe place.
- C. Storm damage/emergency repairs/insurance estimates. If a local glazier is called upon to do emergency repairs, do not feel obligated to him or her for the actual restoration work. It may not be possible to follow the previously suggested selection process for a restorer when rain is actually pouring in through a broken window. Find a local glazier to temporarily weather-proof the window. Pay him or her, and feel no further obligation. This is true of people who may give you estimates for insurance purposes, also. Do not choose restorers because they are the first to see the job; choose them because they are the best qualified to do the job.
- D. Do not's of Stabilization
 - 1. *DO NOT* use tape of any kind to stabilize windows.
 - 2. *DO NOT* use silicone, roofing tar or other caulk materials to stabilize windows.
 - 3. *DO NOT* mislead yourself or others by thinking, "it's been that way for years, it won't fall apart." Once a window is gone, it's too late.
- IV. *Conservation and Restoration of the Windows in the Studio*
 - A. Verify if complete and current documentation exists, including photographic documentation. Plan for photography during restoration processes to illustrate techniques employed. Prepare rubbings of stained glass panels with notations indicating damaged areas.
 - B. Analyze the windows to discover why they failed (insufficient reinforcement system, weak lead, fatigue of structural elements). Begin to think of ways to improve the structure and restore the aesthetic appeal of the window.
 - C. 1. If the windows are to be releaded. Separate the glass pieces from the lead comes.

2. If the windows are not to be releaded, remove only those parts necessary to facilitate the flattening of any bulges (support bars, critical pieces of glass, plating, etc.) Remove individual pieces of glass which may be broken or damaged.

D. Clean glass as directed at the beginning of this chapter.

E. Repair individual pieces which are broken or damaged. This step requires a technical knowledge gained through experience as well as an aesthetic sensitivity. The restorer must also respect the history of the window and the owner's chosen preservation philosophy. This step of the restoration may involve one or more of the following procedures:

1. Copper foiling broken pieces of glass together and soldering on copper wire for additional support.
2. Edge gluing with silicone or epoxy glues.
3. Plating with a thin piece of new glass which has been slumped in the kiln to conform to the repaired piece of glass.

EXTRAORDINARY TECHNICAL AND ARTISTIC SKILL IS REQUIRED FOR THE FOLLOWING

- 4 Restoring lost or faded painting of figural elements by adding a painted plate behind the original piece. Thus the historic worth of the window is preserved.
- 5 When sections are missing (not just cracked) cut and paint new replacement pieces to closely match existing. These pieces should be identified and dated on their edge where the lead will cover the identifying marks.
- 6 Consolidation of the paint layer employing a silicone/epoxy system, or other proven method.
- 7 Infilling with colored epoxy or acrylic or polyester (may be unstable if exposed to the elements).
- 8 Touching-up with cold paint of decorative elements with acrylics (may be unstable if exposed to the elements).

Remember, every effort should be made to retain original glass and to employ reversable restoration processes.

F. Repair entire window.

- (1) Relead the panel with a lead of the proper alloy. This should contain antimony, tin, copper, silver, and lead. Pure lead is very weak and is not good for stained glass windows. Consider altering the profile of the existing lead came to a stronger one, but be conscious of the effect this may have on

the aesthetics of the window. The leading pattern chosen should augment the support system, with the continuous leads being perpendicular to support bars wherever possible.

2 If the panels are not to be related, the following pertinent steps should be executed:

- a. Flatten all bulges. This is accomplished with a combination of weights and moderate dry heat or soaking in warm water, depending on the circumstances. It is important to note that if the bulge is of medium to severe in its dimension, it is impossible to repair in place. Beware of workers on ladders with little rubber mallets.
- b. Reinsert the repaired individual pieces, which were removed or missing, into the leads.
- c. Remove the flanges of meading leads and apply copper wires to remaining lead hearts.

G. Re-putty the window. The window should be re-puttied with a linseed oil or equivalent putty. The putty should be forced under the leads, with all residue carefully cleaned away. Do not use Portland cement or silicone to re-putty.

H. Attach reinforcement system. This would include the original plus any modifications indicated by the cause of failure of the original system. This may include:

1. Copper tie-wires and round bars.
2. Brass, steel, or zinc bars or fins soldered directly to the panels.
3. Addition of clear glass plating. This may include additional glass plates to transfer the weight of original glass plates to a structural member such as a "T" bar or the frame.
4. The insertion of steel bars into the lead comes during re-leading, where it can be accommodated.

1. Prepare windows for reinstallation. Visually inspect all work performed for high quality and completeness. Amend documentation to reflect restoration.

J. Do not's of Restoration

1. **DO NOT** remove any panels without photography in place.
2. **DO NOT** use silicone to attach bars, seal up holes in windows, caulk over holes in the glass. Silicone has limited uses in the stained glass trade. It is often abused.
3. **DO NOT** throw away glass because it is cracked. Determine if it can be restored first.

4. *DO NOT* assume that a window must be reread because it has bulges or other defects. Many such windows can be repaired in the existing leads.
5. *DO NOT* attempt to flatten severe bulges in place. The window may be damaged more than it is helped.
6. *DO NOT* use Portland cement or silicone to reputty the window.
7. *DO NOT* use surface coatings, such as varnishes, polyurethanes, etc.

7. Adaption to Alternate Installations

Although it is always preferable to maintain windows in their original setting, there is sometimes no way to preserve a window but to remove it to an alternate installation. Buildings may be destroyed, or renovations compromise the safety of a window. In unusual cases, an extremely valuable window is transferred to a museum or private collection. Should an owner find that the original architectural setting of a window is no longer viable, several alternatives should be considered.

- A. If a building is slated for demolition, for example an older church facing destruction to make room for a hospital, windows can be reset in certain areas of the new building. In the case of the hospital, the meditation room, or the lobby seem viable areas. Thus a community can preserve its heritage by maintaining a link between the old use and new use of the site. See the following section *Security and Insurance*, for help in placing a value on old windows when arguing for their reuse.
- B. Windows taken from one portion of a building, for example a destroyed Sunday School room, can be converted to a screen separating offices, a hallway, or the entrance to a chapel.
- C. A false wall can be constructed against an interior wall and windows set into it. The windows would then be lit by artificial light. It is important to leave room between the false wall or panels and the original wall for periodic inspection and maintenance of the windows.
- D. Light boxes are more flexible than a wall installation and allow the owners to move the location of the windows, should this become imperative. It is preferable, in the case of artificial lighting, to place florescent tubes on the inside of the window wall, that is, next to the window, not behind it. Thus, the light does not shine directly through the window, or heat up only portions of the glass. The effect is more natural, since the light is diffused by striking the rear wall before it passes through the windows.
- E. Windows can also be reset within newer windows. Here great care must be taken to preserve the aesthetic integrity of the original. The resetting must be structurally sound and also take into account the color, range of value, and subject matter of the window. Patterns in decorative windows can often be copied, and thus continued in their new setting. It is far more difficult to approximate the painting style of an older window and, even if attempted, the costs are quite steep. Often it is better to set a colored, figural window in the midst of a neutral or geometric pattern. The colors and values selected for the setting should not overpower the window, but enhance it, much the way a mat and frame do for a painting.

8. Security and Insurance

As you begin to research your window, you may realize that it is indeed valuable. In this case, you should consider protecting it from theft, vandalism, or damage while it is in your building, and insuring it during restoration.

Replacement Value vs. Market Value.

In order to determine the monetary value of your window, it will have to be appraised. This appraisal is not the same as an appraisal of an antique or painting. Most smaller, more portable items are appraised at their market value by licensed appraisers, auction houses, antique dealers, or museum or gallery professionals. Stained glass windows, however, rarely have a market value, except in rare cases of very well known designers, such as Frank Lloyd Wright. This is due to a number of reasons. First, stained glass is an architectural element, and sometimes a window will lose much of its significance if it is removed from the building for which it was designed, or if a series is broken up. Often windows are difficult to sell because of their size or their imagery. But, more importantly, most often the market value has no relationship to the replacement value: often a window will be sold to make room for a replacement, which ends up costing many times more than the piece received for the original.

Stained glass should therefore always be appraised at *its replacement value* by a experienced stained glass craftsman, who has worked on projects of a

similar scope. The replacement value is a realistic estimate of what it would cost to replace the window with a theoretically identical copy, if the original were destroyed; in other words, what it would cost to build that window today. Do not look for the least expensive contractor to do this estimate, because this is the value on which your insurance will be based. Of course, if your window is a rare medieval piece, for example, it could never be replaced, which is why the replacement value is a theoretical figure. If this is the case, a fine arts appraiser should also place a value on the window, and the piece should be insured for the higher of these two figures.

Protection (cf., 10 Protective Glazing)

Regardless of the value of your window, it should be protected from theft, vandalism, or breakage, in areas where this is likely to occur. For instance, if your window is installed in a location where an attempt at theft would not be noticed immediately, such as a mausoleum or the rear chapels of a church, it is important to secure the window physically, instead of or in addition to installing an alarm system. A decorative iron or steel grille could be used, although its shadow might be visually disruptive from the interior. Lexan, an unbreakable polycarbonate sheet material, connected to an aluminum or steel frame from the interior, is very effective. Its exterior appearance is similar to that of plate glass, although it is not as highly reflective. If this is used, be sure the space between the Lexan and the stained glass is vented. (Other clear sheet material, such as Plexiglas or acrylics, are not unbreakable.)

If other restoration work is taking place near the stained glass, such as cleaning, repointing, or painting, care should be taken by the owner that the stained glass is protected from damage. Windows should be covered with plywood, whether the work is interior or exterior. Edges of the plywood should be caulked if any kind of liquid or air-abrasive methods are being used in the vicinity of the windows. A stained glass craftsman should do this, rather than the cleaning contractors, who may not know how to deal with a stained glass window.

Security.

In areas where vandalism and breakage are not likely and a more aesthetic solution to security is desired than those cited above, modern alarm systems can be adapted for use with a stained glass window. Only those types of alarms which do not interfere in

any way with the stained glass or the protective glazing should be considered; old-fashioned foil tape is not only out-moded, it should never be applied to stained glass. Infra-red sensors or sensitized mesh screens, currently available, should be investigated.

If the window is to be removed for restoration, the opening from which it came will obviously have to be closed to the weather and made secure. Plywood, Lexan or Plexiglas, or glass may be used to close the opening; the size, location, and type of frame will dictate the type of closure to be used. This should be installed in such a way that would be very difficult for unauthorized persons to remove. Access to all scaffolding or bridgework should be secured also. The restoration studio should be prepared and expected to deal with this issue adequately, and it should be discussed thoroughly with the owner.

Insurance.

If your windows are of significant historic or artistic value, you may wish to insure them for fire, theft, and vandalism, regardless of whether they will be restored. As discussed above, the insurance value in this instance is based on the replacement values of the window. Contact your local museum or historical society for the names of reputable art insurers in your area. If your windows are to be removed for restoration, they should be insured. Also, it is the responsibility of the owner to demand the studio to produce evidence of insurance coverage for theft, fire, and breakage from the moment of removal. This must include transportation.

9. Re-Installation of Restored Panels

A. Before installing the restored glass panels, determine that all pre-existing problems with the building that were detrimental to the glass have been repaired. Re-installation should be carefully coordinated with work of other trades so that any scaffolding erected is utilized efficiently, and so that the glass is not put at risk. The work of other trades should be complete before the glass goes onto the scaffold. This coordination is best handled by the project architect.

B. Have the conservator/restorer inspect the frame to insure that any deficiencies discovered during the survey or removal phases have been rectified. This may include the alteration of certain aspects of the original frame, if time has proved certain original design details to be faulty.

C. The following is a brief discussion of the types of frames into which stained glass may be set. This list

is not comprehensive, but the majority of windows are installed in the following ways:

1. *Stone.* There are two types of stone frames; one with a groove that is sight size on the interior and exterior of the building; or one with a rebate which is cut into the exterior of the stone. This second type may have a steel subframe, or the leaded glass frame may be glazed directly into the stone rebate and held with clips and a putty bevel. With minimal maintenance, stone frames may last for hundreds of years. Inspect the stone for possible deterioration due to chemical attack (i.e. pollution). Inspect the joints for possible repointing work. Always prime the stone groove or rebate with shellac or other suitable primer before applying putty. Apply a back bed of putty, set the glass with clips and apply an exterior putty bevel.
2. *Wood.* Many historic windows are set into wood frames. There are two basic types of wood frames: those with retaining moldings and the rebate type. Occasionally, one finds a groove similar to the stone setting. To prepare for installation, the wood must be primed. Apply a back bed of putty and set the glass. The glass is retained by moldings or is nailed to the wood with non-corrosive nails and a putty bevel is applied. Inspect the wood frames for signs of rot or severe weathering. Most wooden frames can be restored. If properly restored and maintained, wood frames can last for hundreds of years since they are more durable than most metal frames, especially in areas of high pollution or salt air.
3. *Metal frames.* These may be of steel or aluminium, and sometimes, brass or bronze. The two types of frames are ones with applied molding or putty bevel rebates. The installation procedure is similar to that for wood frames of similar type. Metal frames have to be carefully inspected for rust or corrosion. While metal frames can be restored, the process is more difficult than with wood frames. In installing new metal frames be particularly careful to avoid the contact of dissimilar metals. This may cause severe corrosion due to galvanic action. Make sure the architect's or the manufacture's specifications are followed very closely.

The above frames are found in many different shapes and configurations. There may be hundreds of dif-

ferent construction details. It is important to have a restorer/conservator who is familiar with many different types of frames. One should always investigate the possibility of restoring existing frames as opposed to installing new ones. Not only will the restoration be more historically correct, but the end product may very well be more durable.

D. Meeting joints. Most large stained glass windows are a series of panels which sit above one another. Where these panels touch is called the meeting joint. Whenever possible, it is preferable to have each panel supported independently by means of horizontal muntin (i.e. "T" bar). This muntin should be physically attached to the vertical mullion.

E. Sealants. A wide variety of sealants are available on the market today. It is extremely important to match the proper type of sealant or caulking to the special circumstances of each installation. The restorer/installer should submit product literature so that the owner/architect may judge on the appropriateness of the material proposed. After selecting the proper material, make sure that the manufacturer's recommended installation procedures are followed (e.g. temperature limitations, need for primer, type of substrate caulking will adhere to, etc.)

10. Protective Glazing

The installation of protective glazing is an aspect of many restoration projects which is often not given the thought and attention needed to insure a proper job. Protective glazing systems, when correctly installed, may greatly increase the longevity of historic glass, and may decrease the overall energy requirements of the building. When incorrectly installed, the protective glazing may greatly detract from the aesthetic beauty of the windows and the building, and set up conditions which may actually destroy the glass. (For example, it may cause condensation, additional stress to the existing frame, and other serious problems.) The best protective glazing system for any particular building is a sensitive compromise between the following factors: degree of protection; aesthetic effect; cost. The priorities for each of these factors should be clear to the owner/contractor before choosing a protective glazing system.

A. Types of glazing systems.

1. *Leaded panels.* Leaded glass panels that either duplicate the major leads of the design or are of a geometric pattern may be fabricated to protect the historic glass from the elements and enhance the

aesthetic beauty of the exterior of the building. This type should be chosen if aesthetic effect is of the highest priority. The main disadvantages of this system are increased cost and its vulnerability to determined attack by vandals.

2. **Laminated or tempered glass.** This system can be installed sensitively so that the negative effect on the exterior beauty is minimal. It is less attractive than leaded panels, but more attractive than plastic panels which tend to bow. This system offers increased protection from vandals.

3. **Acrylics or polycarbonates.** This system offers the greatest degree of protection from vandals or other attack on the glass. The main disadvantages of this system is the high coefficient of expansion for both materials. If this is not properly compensated for in the installation/framing system, it may impart great strain on the original frame system to which it is attached. Acrylics are subject to deterioration from ultra-violet radiation. This may result in a clouding of the plastic and decreased resistance to breakage. Both materials tend to bow and are not very resistant to scratching. Polycarbonates are theoretically crack-proof, however.

B. Installation.

Installation of the protective glazing system may be by one of two methods: either into a secondary rebate in the existing frame or into a separate frame that is attached to the exterior of the original frame. Either method works well; it is the execution of the actual installation that is more important than the method. The following factors should determine the method:

1. Possible loss of architectural details.

2. Proper weep-holes and venting. The airspace between the glass and the protective glazing can be vented to the outside or the inside depending on placement of the window and the climate conditions. It is essential to avoid condensation between either the exterior or the interior glazing panels. *Condensation will destroy the lead comes and attack the surface of the glass in the space of a very few years.*

3. Proper allowance for expansion and contraction.

4. Structural ability of exposing frame to support additional weight.

C. Do Not's of Protective Glazing

1. **DO NOT** install without proper weep-holes and venting.

2. **DO NOT** expect the installation of protective glazing to obviate the need for a proper restoration program.

3. **DO NOT** screw faste acrylics or polycarbonates to existing framework unless special installation details are specified to allow for the expansion and contraction of these materials.

4. **DO NOT** destroy the aesthetic beauty of the exterior in order to protect the stained glass.

11. Glossary

Abrade (Abrasion). To scrape away surface of glass or remove the colored layer of **Flashed Glass** with an iron point, wheel, or bit.

Acid-Etching. process of removing colored flashing. The area of flashing to be removed is first outlined. The rest is masked with bituminous paint, while hydrofluoric acid eats through the exposed portion to the paler-colored layers below.

Annealing. Final cooling process in glass manufacture which gives glass its temper.

Antique Glass. Hand-rolled mouth-blown clear or colored glass made by old glass blowing methods.

Armature. The iron, bronze or wood framework fixed in a window opening to support panels of stained glass.

Art Glass. Commercially designed and mass-produced windows, employing mainly **Opalescent Glass**.

Back-Painting. Painting on the back or outer surface of glass.

Badgering (Badger). A method of shading by dabbing a matted surface (see **Matting**) with a **Badger** a soft brush three to four inches long, in order to produce smooth or stippled effects on a **Wash of paint**. See **Blender, Stipple**

Bay. A single, whole unit of a wall or ceiling comprising a series of such units.

Beveled Glass. Plate glass with edges ground on an angle that extends beyond the flange of the **Came**. Often glazed with zinc instead of lead came.

Blender. Badger-hair brush used for blending **Vitreous** paints on the surface of glass. Also used for stippling. See **Stipple, Badgering**.

Border. Outer strip of a window, given to ornament. See **EdgingLine, Fillet**

Boss. Small circular panel of ornament, normally set in the background of a window. See **Medallion, Roundel**.

Bull's Eyes. The center of a piece of **Crown Glass** that includes the mark where the pontil was attached.

Came. Extruded lead strip, usually H-profile, used to hold together the individual pieces of glass in stained glass window.

- Canopy.** Architectural frame for a figure or scene.
- Cartoon.** Full-size drawing for a window or panel.
- Cathedral Glass.** Commercial, machine-rolled stained glass widely used in the United States.
- Confetti Glass.** Hand-rolled glass to which chips of multi-colored glass have been added in the blowing process.
- Core or Heart.** The cross bar of the 'H' section of the **Came**.
- Crackle Glass. Antique Glass** with crackeled texture which has been intentionally introduced in the cooling process.
- Crown Glass.** Made by blowing the molten glass into the shape of a globe and opening it up by spinning or twirling to form a flat disc. See **Muff Glass**.
- Cullet.** Scrap or waste glass remaining after cutting the pieces for a window.
- Cylinder Glass .** See **Muff Glass**.
- Dalle de Verre.** pieces of glass, usually about one inch thick and often chipped or **Faceted Glass** on the surface. which are set into concrete or **Epoxy Resin** or sometimes lead. A modern type of glass.
- Diaper, Diapered.** .Decoration of a surface with a regular pattern of geometric or vegetal forms, usually by **Stick Work**
- Drapery Glass..** **Opalescent** -type glass formed into ridges to resemble drapery folds.
- Edging Line.** Band of glass, sometimes with painted designs, placed as an edging around a **Panel**. See **Fillet, Border**.
- Enamel.** Opaque vitreous color applied to glass. changes to a transparent color during firing.
- Epoxy Resin.** Synthetic, colorless adhesive, used instead of leading to hold together pieces of stained glass. particularly **Dalle De Verre**. Used to mend broken glass.
- Etching.** See **Acid-Etching**.
- Faceted Glass.** See **Dalle De Verre**.
- Favrile Glass.** Iridescent glass, patented by Tiffany in the 1880s, produced by the exposure of hot glass to metallic fumes and oxides.
- Fillet.** Thin strip of glass. See **Border, Edging Line**.
- Firing.** Proces of heating painted glass so that the surface paint and the glass fuse smoothly and securely.
- Flange.** The vertical bar of the 'H' section of the **Lead** or **Came**. Width of the flange indicates the size of the lead.
- Flashed Glass.** A thin, concentrated layer of colored glass fused to the surface of another piece of colored or clear glass.
- Fused Glass.** Piece of colored glass bonded by heat to another sheet of glass.
- Glass.** A mixture of silica, potash, soda and lime fused by heating until molten and then formed by various processes.
- Glass Applique.** Collage of pieces of colored glass glued with **Epoxy Resin** to clear plate glass.
- Glazier.** A maker of glass windows.
- Grisaille.** (1) Blackish or brownish vitreous paint used for painting on glass (2) window or panel or ornamental designs composed almost entirely of clear glass.
- Hammered Glass.** Machine-rolled glass whose hammered textured side is produced by the pattern on the roller.
- Heart.** See **Core**.
- Insert.** To put one piece of glass into a hole previously opened in another piece of glass, and the second piece leaded into the first.
- Isothermal Glazing.** System of protective outer glazing.
- Jewel.** Cast, or chipped, polished nuggets of glass inserted in windows for a decorative effect.
- Lead.** See **Came**.
- LeadLine.** A term used in window design to indicate the placement of the lead **Came** in the actual **Panel**. Also used to describe the pattern of **Leads** in a window.
- Leading - up.** Assembly of glass with leads.
- Light.** Window opening bounded by frame. Usually in series with **Mullions** between.
- Mat Paint or Matting .** Applying a translucent coat of vitreous paint to the surface of a large area of glass.
- Medallion.** Large circular **Panel** with figures. See **Boss, Roundel**.
- Mending Lead.** Thin lead, also called a dutchman, used to support a crack.
- Mold-Blown Glass.** Glass blown into an open-topped mold.
- Muff Glass.** Made by blowing the molten glass into the shape of a cylinder and opening it up to form a flat rectangle. See **Crown Glass**.
- Mullion.** Vertical stone or wood shaft which divides window **Lights**.
- Oculus.** Circular window with no stone tracery.
- Opalescent Glass.** Glass developed in the late 19th century by La Farge and Tiffany, in which streaks of

color, when fused, give a milky, iridescent appearance.

Oxides. Metallic oxides used for coloring glass. Added during the fusing process. Color obtained are: blue from cobalt; red from copper, selenium or gold; yellow from lead or chromium; green from chromium or copper; violet from manganese or nickel; and brown or black from manganese or iron.

Paint (for glass). A mixture of finely ground glass, metallic oxides, and liquid mixing agent, such as water or gum arabic, used for painting on glass. It has to be fired for permanent adhesion. See also **Enamel, Grisaille and Silver Stain.**

Panel. Unit of stained glass leaded together and made to fit an opening in the **Armature.** May be of any shape. See **Boss, Medallion.**

Patina. A film produced by chemical action, oxidation or sulphurization, during the course of time.

Pits. Holes in the surface of the glass, generally circular and beginning as clusters of pinpoints, eventually enlarging so that they fuse as the glass corrodes.

Plating. The placing of one piece of glass of the same shape on another of different color or texture and leading them together for special effect. Also, a method of repairing broken pieces of glass by fitting new glass to the exterior face, or sometimes to both faces, and leading the pieces together.

Pot Metal. Glass colored in its molten state with various metallic oxides, so that the color is not confined to the surface. See **Flashed Glass and Silver Stain.**

Putty. Material forced between the leading and the glass to make the window watertight.

Quarry. Square or diamond shaped pane of glass used particularly in **Grisaille** windows.

Quill Work. Lines of variegated width that are scratched in glass paint using a quill. Quill work is often used to depict hair.

Reamy Glass. Glass with undulating surface showing the bubbles, striation and ridges formed in the process of the blowing.

Ripple Glass. Machine-rolled glass, the rippled texture of which is imprinted from the roller.

Rose Window. Circular window with tracery radiating in petal-like shapes.

Roundel. Circular pane of white glass with a complete composition painted on it. See **Medallion.**

Saddle - Bar. See **Support Bar.**

Sanguine. Reddish-brown paint made from hematite, iron sulphate or sienna.

Scratching. creating highlights with a needle (or similar instrument) by removing portions of paint on glass not yet fired. See **Stickwork.**

Seedy Glass./ Bubbly Antique Glass.

Semi-Antique Glass. Hand-blown glass mechanically finished.

Silver Stain. Silver nitrate mixed with gamboge gum. In the fire it stains the surface of the glass a transparent yellow color. It is nearly always on the outer surface of the glass. (Firing range about 1150F.)

Slab Glass. See **Dalle De Verre.**

Solder. A mixture of tin and lead that is sweated onto lead joints of a window.

Stenciling. A method of producing a repeated pattern on glass, frequently used in borders and backgrounds.

Stickwork. Scratching the paint with the handle of the brush, a stylus or needle before firing in the kiln. See **Scratching.**

Stipple. A method of shading, by dabbing a surface covered with **Matting** with a hard, blunt-ended brush before firing, See **Badgering.**

Stopgap. The use of old glass from another source to fill a missing piece in a window.

Support Bars. Iron bars set in the frame of the exterior of the window, to which the **Panels** of glass are attached on the inside by **Flanges** and metal keys. Also called irons and T bars. **Saddle Bars** are smaller bars on the interior of the window tied to the panels by wires.

Streaky Glass. Transparent glass in which the color appears as streaks, rather than being uniformly dispersed.

Tie Wires. Cooper wires soldered to the panel and twisted around a saddle bar.

Trace-Line Opaque painted line used for drawing facial features, outlines, etc.

Tracery. Ornamental stonework in the upper part of a GOTHIC window with openings for glass.

Vitreous Paint. See **Paint.**

Wash. A thin coat of paint.

Yellow Stain. See **Silver Stain.**

12 . Resources and Bibliography

Sources

State Historic Preservation Offices

to find out where your local office is, contact:

The National Park Service

U. S. Department of the Interior

Preservation Assistance Division

18th and C Sts., N.W.

Washington, D.C. 20240

(202) 343-9573

Local Historical Societies

to find out where your local office is, contact:

The American Association for State and Local History

708 Berry Road

Nashville, TN 37204

(615) 383-5991

Consultant Referral Services

The National Park Service Regional Offices

to locate your regional office, contact the address given above

The American Association for State and Local History

to locate those in your area, contact the address given above

The National Trust for Historic Preservation

to locate your regional office, write:

1785 Massachusetts Avenue, N.W.

Washington, D.C. 20036

(202) 673-4136

The American Association of Museums

1055 Thomas Jefferson Street, N.W.

Washington, D.C. 20007

(202) 338-5300

The Decorative Arts Trust

P. O. Box 1226

Camden, SC 29020

(803) 432-7864

The Association for Preservation Technology

P. O. Box 2487, Station D

Ottawa, Ontario K1P 5W6

Canada

(although this organization is located in Canada, it serves the United States also)

The American Institute of Architects

1735 New York Avenue, N.W.

Washington, D.C. 20006

The American Institute of Conservation

3545 Williamsburg Lane, N.W.

Washington, D.C. 20008

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*The Census of Stained Glass Windows in America is a not-for-profit organization dedicated to the study, recording and preservation of architectural stained glass in America. To this end it brings together experts from many different fields: craftspersons in the field of stained glass, art historians, museum professionals, and preservation experts.

Roster in 1986

Virginia C. Raguin, Director

Paul Norton, Assistant Director:

Committee on Conservation and Restoration

Art Femenella, Co-Owner, The Greenland Studio.

Jane Hayward, Curator, The Metropolitan Museum of Art, The Cloisters.

Michael Lynch, Historic Sites Restoration Officer, State of New York.

John Nussbaum, Stained Glass Artist.

Virginia C. Raguin, Associate Professor, College of the Holy Cross.

Julie Sloan, Preservation Consultant.

Robert Wysocki, Owner, Stained Glass Associates.

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Michael Lynch, Historic Sites Restoration Officer, State of New York.

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Julie Sloan, Preservation Consultant.

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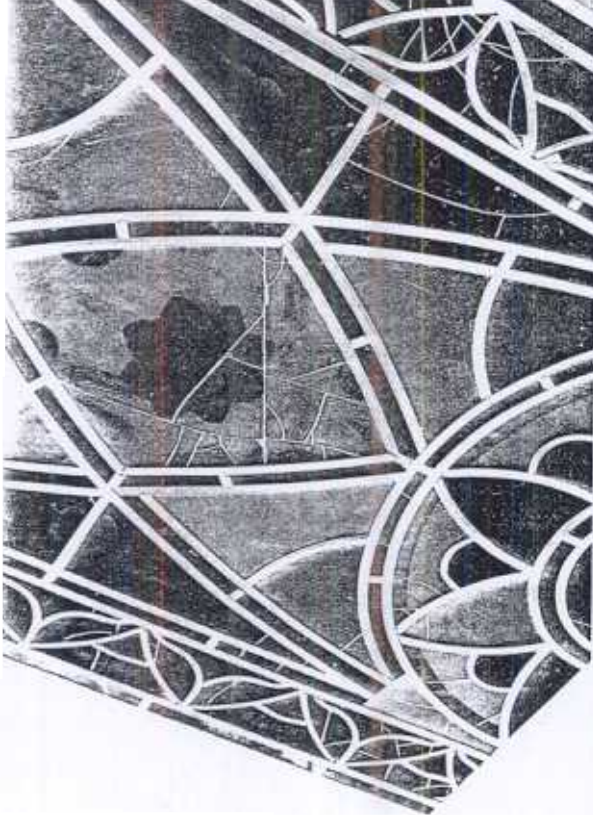
Margaret Floyd, Associate Professor, Tufts University.

Melville Greenland, Co-Owner, The Greenland Studio.

Dwight Lanmon, Director, The Corning Museum of Glass.

H. Barbara Weinberg, Professor, SUNY, Queens College.

Virginia Raguin



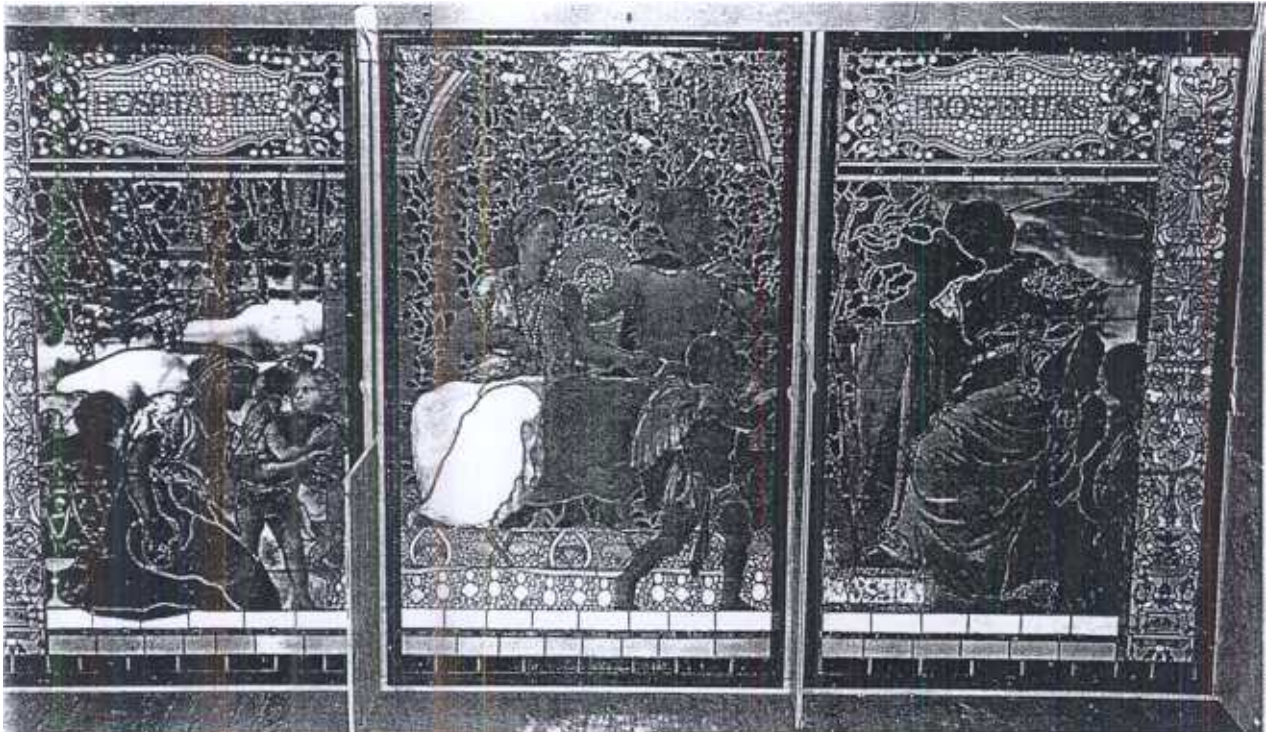
Windows by Morgan Studio, New York, Cathedral of the Holy Cross, Boston, c. 1876-80. Badly cracked original glass and 1940s replacements repaired with copper foil technique. Original glass shows back painting (Virginia Raguin)

Detail of enamel painting in heads. Probably Bavarian manufacture subcontracted to the Morgan Studio, New York. Cathedral of the Holy Cross, Boston, c. 1876-80. Copper foil repair made in arm. (Virginia Raguin)





3. *Raking light on a panel probably of Bavarian manufacture subcontracted to the Morgan Studio, New York. Cathedral of the Holy Cross, Boston, c. 1876-80. Cold paint applied to lower parts of head to left. (Virginia Raguin)*

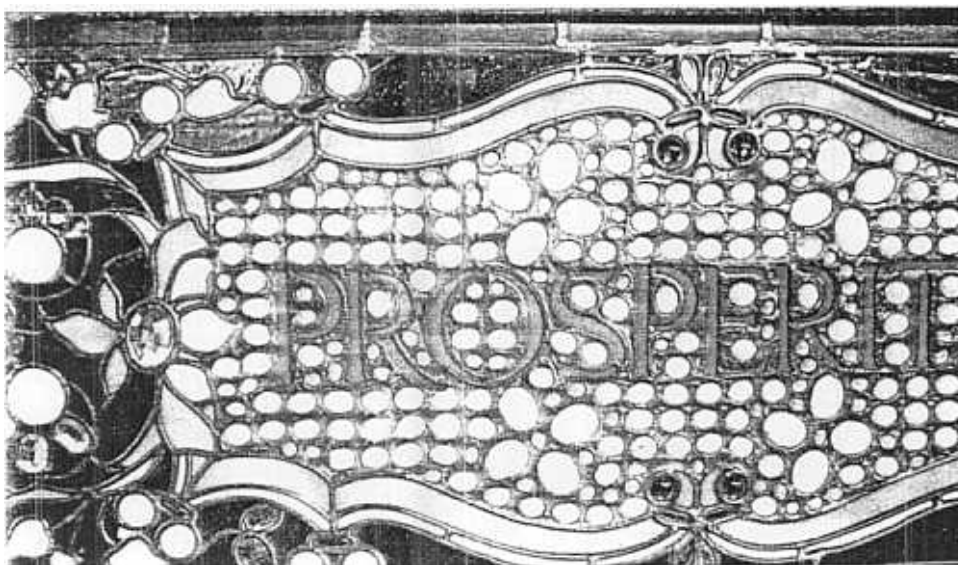


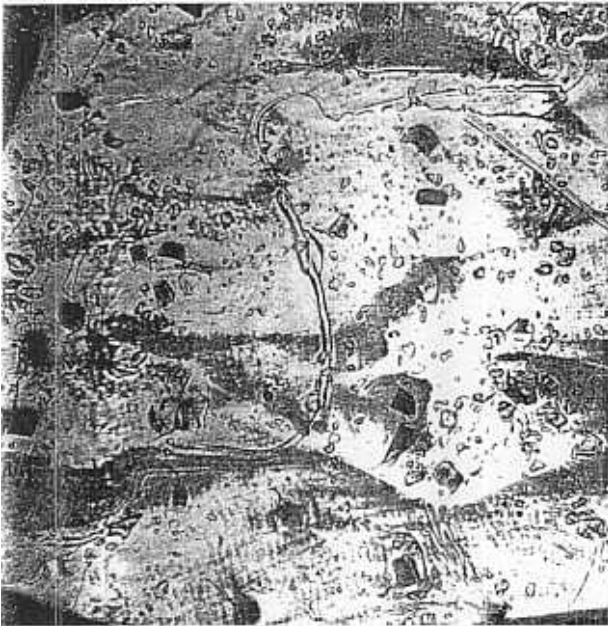
4. *This is an overall view of the Hospitalitas and prosperitas window designed by John Lafarge circa 1881 for the Vanderbilt Mansion on 5th Ave, New York. Window measures 1.6mx3m. Extensive use of opalescent glass and pressed glass jewels.*



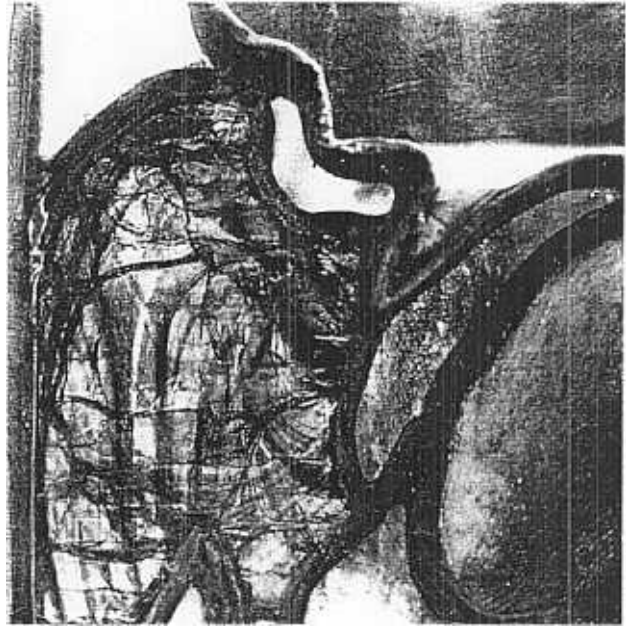
Detail of window in fig. 4 This illustrates the painting of La Farge. The vitreous paint is a reddish brown. The painted detail on the shield to the right of figure is blue enamel. La Farge regularly applied red oil paint onto the glass to modify the finished color.

Detail of window in fig. 4 illustrates the use of pressed glass jewels in the composition. Each jewel is wrapped in a U shaped lead came. The comes are soldered together, and all spaces between the jewels are filled with solder.



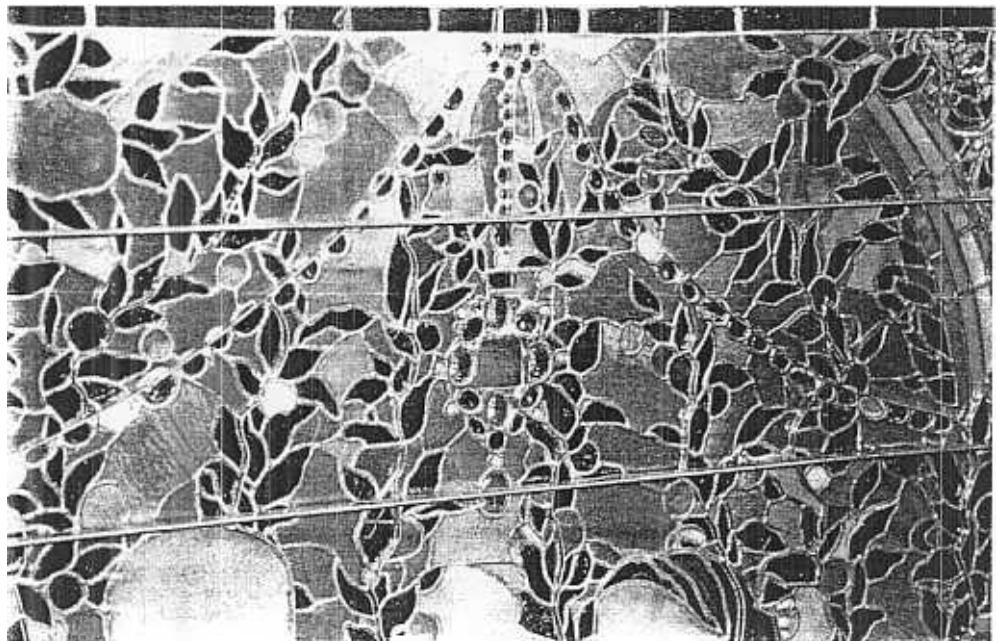


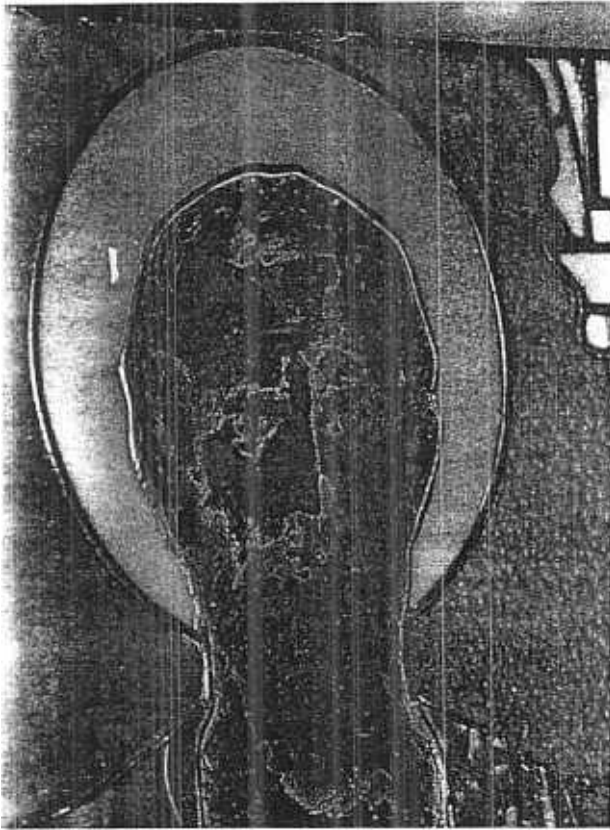
7. Detail of window in fig. 4. This glass is referred to as confetti or fractured glass. The small, darker bits are pieces of mouth-blown glass that are fused to the base glass during manufacture. This glass was used by Tiffany and La Farge, and tends to be unstable. The shadowing on the surface is applied glass paint.



8. Detail of window in fig 4. This illustrates a problem common to many windows of the American Opalescent Era. The glass is a heavily rippled translucent type with streaks of opalescence. Due to inexact chemistry during manufacture, the glass is inherently unstable. The internal fracturing will continue until the glass deteriorates to a fine powder.

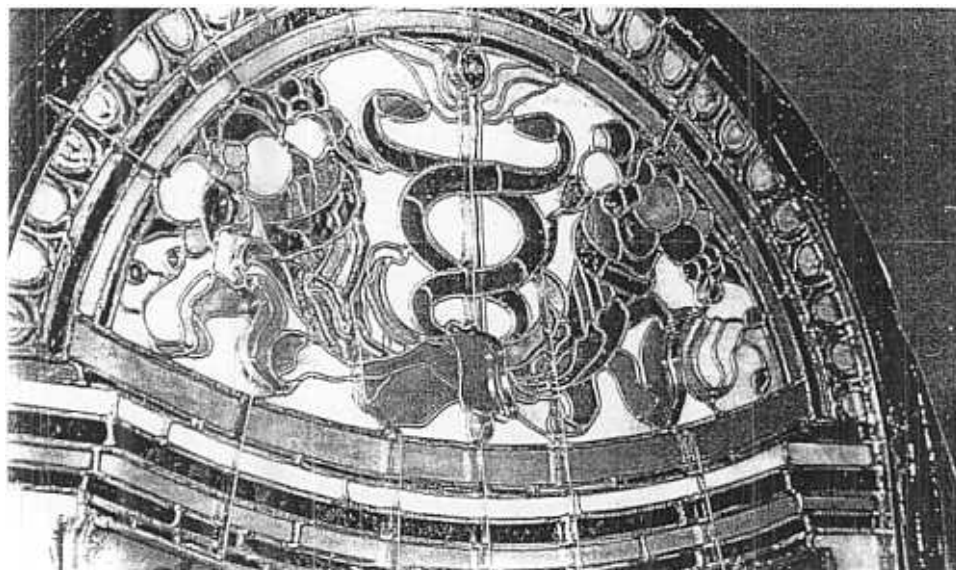
9. Detail of reverse side of window fig. 4. This window was severely deflected (bowing). After flattening, a support system thin brass fins and heavier steel bars was soldered directly onto the lead comes. This will prevent deflection in the future but is virtually invisible when viewing the window from the obverse side.

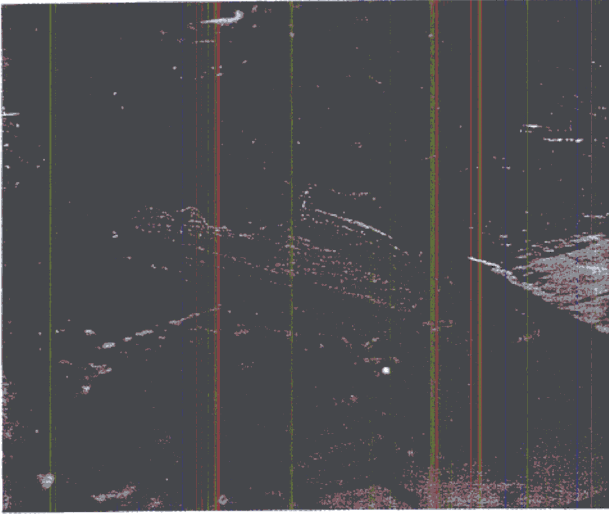




10. This is a photograph of the surface of a painted head. The whitish areas indicate deteriorating paint, a common problem with Tiffany, La Farge and other Opalescent Era windows.

11. Reverse side of a window designed by John La Farge circa 1881 for the Vanderbilt Mansion, 5th Ave. New York. The panel was deflected approx. 3 cm in the center. After flattening, the intricate fin system was added to prevent bowing in the future.





12. Window fabricated by the Tiffany studios circa 1905. The Tiffany studios were the originators of the fin support system as can be seen in this photo.