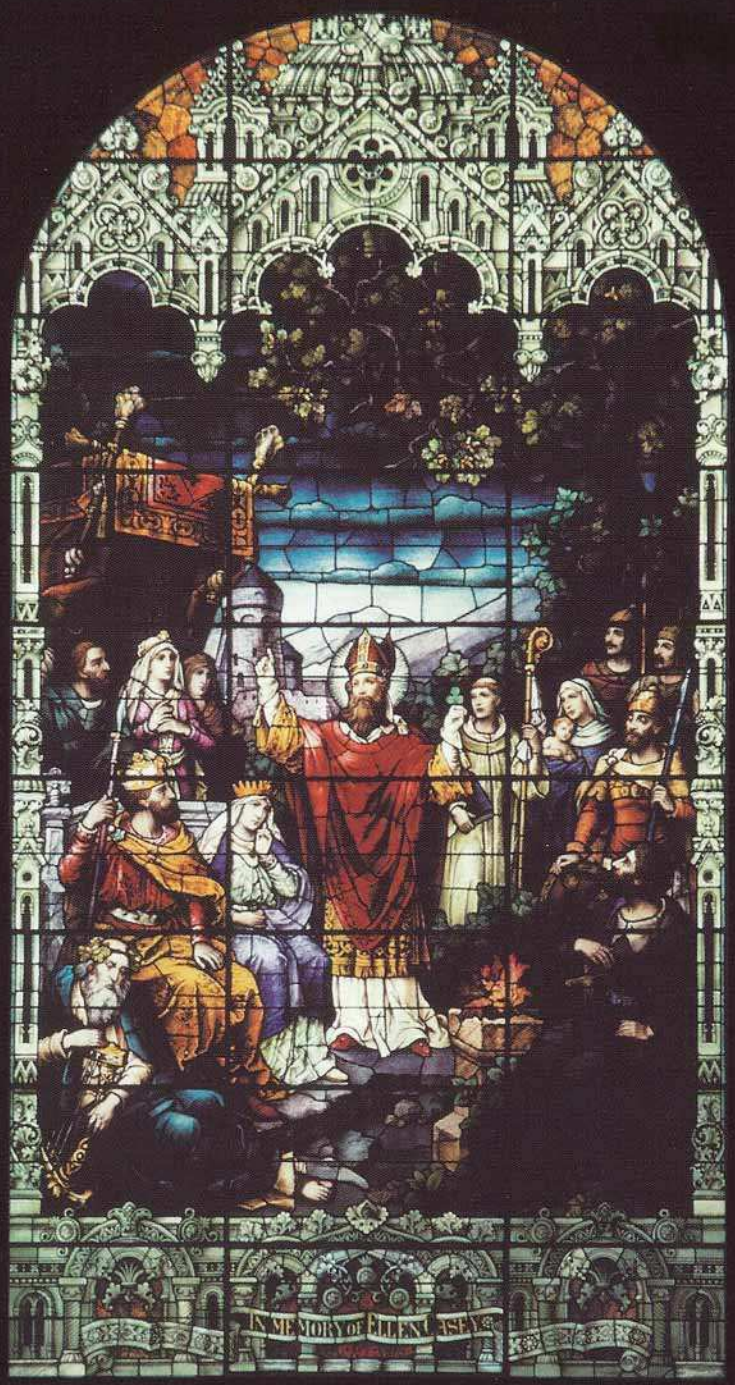

Stained Glass Resources, Inc.

DESIGN • FABRICATION • RESTORATION

Stained Glass Restoration:

The Necessary Facts

A Compilation of Answers to the
Most Frequently Asked Questions

Revised 2001

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St. Patrick Church, Erie, PA. Courtesy of Fr. William Sutherland
Back Cover:
Tiffany Window c. 1900, St. George Episcopal Church, Newburgh, NY

Preface

Chances are, the reason you are reading this booklet is that you have been charged with the duty of finding a studio to restore your stained glass windows. When choosing a studio, you are also required to choose a particular method of restoration. The greatest problem encountered by those involved in making these decisions is a lack of knowledge. Unfortunately, most people involved in this decision-making process know little, if anything, about stained glass windows, and as a result, end up making a decision based on "bottom line" prices rather than on the method, expertise and quality of the studio.

The decision-makers in this process are historically the custodians of architectural works of art and are responsible for the longevity and well being of these works of art long after the restoration process has been performed. They are also responsible for administering the thousands of dollars that will be spent on the restoration project.

This booklet will educate you in various methods of stained glass restoration, but its primary purpose is to familiarize you with the restoration method known as releading. This method of restoration has been performed in Europe for many centuries, but is relatively new in this country, due to the fact that most of the churches in the United States are just beginning to reach the age (80 to 125 years) where total lead replacement, rather than repair, is necessary.

We hope that the following information is educational, and demystifies an area of church restoration that is often clouded in superfluous and abstruse terminology to the advantage of the contractor providing the service.

As a window ages, the lead support structure will begin to deteriorate, allowing the window to bow and buckle.

Choosing a Qualified Restoration Studio

The first step in preparing for a stained glass window restoration project is to contact studios who do restoration work. Most people refer to the local yellow pages and look up the names of a few studios, or contact another church in the area that has had work done recently. Or, they have names of stained glass companies on file who have sent information and literature about their companies. This provides the church with a few contacts to follow up.

The next step, which is often ignored, should be that of establishing the credibility of the studios. In many cases, studios that are contacted will, after extensive questioning, show themselves to fall into the category of "and we also do restoration". There are many studios who are infamous "Jacks of all Trades and Masters of None". These include the retail shops that specialize in giving classes and selling supplies to students as well as doing residential commission work, and who "also do church work". Suffice to say, it is best to seek out someone who specializes in the field of restoration of stained glass in religious facilities and has extensive experience and references in that area.

To assure that you are choosing a qualified stained glass restoration studio, it is important that you visit the potential studios, and if possible, some of their current job sites, to observe work in progress. This will enable you to view the quality of the studio's work, employees, and facility, and with regard to sitework, the quality of their equipment. Also, visiting the studios will allow you to see first hand, the method of restoration that will be performed on your windows. The amount of education that this provides can be the determining factor in making the "right decision".

All too often, we have seen both large and small companies that have no studio facilities whatsoever, pass themselves off as fully qualified restorers of stained glass. These companies provide the client with on-site "out of the back of a truck" repairs, and an excessively priced protective overglaze job. This is what they consider to be restoration work. Unfortunately, and sad as it may seem, this is often the norm rather than the exception.

The following are some basic questions that you should ask in order to help you qualify the studios that are being considered.

- ✔ *How many years have you been in business?*
- ✔ *How many years have you specialized in restoration?*
- ✔ *How large is your studio?*
- ✔ *How many employees do you have?*
- ✔ *Will all the work be performed by you at your facility or will there be subcontracting?*
- ✔ *How many years experience do your employees have in performing this type of work?*
- ✔ *What is their background?*
- ✔ *What sort of equipment do you use on site to perform this work?*
- ✔ *Who is your insurance company? What are your insurance coverage limits? Does your insurance provide specifically for the property of others while in the contractor's care and custody (Bailee's Form)? (**Be sure to get a current certificate of insurance proving that the contractor is properly insured**).*
- ✔ *What is your method of restoration? **NOTE:** This means that you are requesting from them a step-by-step explanation of their restoration process from the moment of removal through reinstallation. This is necessary in order to make an "apples to apples" comparison of bids. Any company of note and worth will most certainly have a written description of their specifications for restoration of stained glass windows.*
- ✔ *Obtain a list of references. Two or three references are not sufficient. If a studio is to prove its level of experience and success in such a specific field of art restoration, they should provide extensive references spanning at least the last five years of business.*

***SUMMARY:** The best way to qualify stained glass restoration studios is to visit the studios, and their job sites to see work in progress.*

Choosing the Restoration Method

Careful choosing of the studio is not always a guarantee of a good job. You must also be quite specific in your choice of restoration methods. Once a method is chosen, it should be presented to all bidders in order to maintain the "apples to apples" attitude throughout the bidding process.

Only after this can the client make a clear decision as to the studio that they wish to use, based on detailed specifications of the restoration process and pricing.

SUMMARY: *It is important to determine the proper method of restoration for your windows and be sure each studio is bidding to do the same type, scope, and quality of restoration.*

Before disassembly, a detailed carbon rubbing is made of each window panel to record pattern of lead and placement of glass and support bars.

The window is disassembled by snipping the leads and removing the glass from the channel.

Old putty, dirt, soot and other foreign matter is gently removed from the glass.

What is Releading?

Releading is the process in which all of the original lead channel is removed from the stained glass window and is replaced with all new lead channel. This involves removing the stained glass window from the Church and transporting it to the workshop where proper restoration and glass conservation can be performed under ideal conditions. You should note that this process cannot be performed with the window in place.

The initial steps after the window has been removed and brought to the shop are: 1) view it in the light in order to make notes regarding previous repairs which resulted in improper glass replacement, badly faded painted glass, etc.; 2) photograph the window; 3) make an actual rubbing of the window that will be used later when the window is reassembled; 4) make notations as to overall window measurements, support bar placement, lead sizes and configurations, etc. The window is then disassembled, and all the old lead is sent to a scrap recycler.

Once the window has been disassembled, any broken pieces of glass are reviewed, and determinations are made as to the appropriate method of glass conservation to be employed. Once glass conservation has been completed, the window is ready to be rebuilt.

Using all new lead channel, the window is reassembled on the rubbing, fitting each piece of glass snugly into the lead channel. When the window has been reassembled, it is checked for sizing, and then prepared for soldering. The solder, usually a 60/40 mixture of tin and lead, is then soldered to each joint where the leads abut. After the first side of the window is soldered, it is thoroughly cleaned to remove any existing flux residue. The soldering and cleaning process is then repeated on the backside.

The next step, which contributes greatly to the overall structural integrity of the window, is the cementing process. This process also waterproofs the window; preventing rainwater from passing through the leads. A cementing compound is brushed under the edge of all the lead to fill in any space between the lead and the glass. The front side of the window is cemented first and allowed to cure; then the backside is cemented.

After the cement has been allowed to cure for a few days, the window is ready to undergo final inspection and cleaning. The window is once again viewed in the light so that it can be properly inspected and thoroughly cleaned.

The final step is to install the support bar wire ties to the appropriate lead joints. These wire ties are used to reattach the window to its support bars, which are affixed to the frame. The support bars are essential in "holding up" the weight of the window and preventing future sagging and bending from occurring.

At this point, for all intents and purposes, we have created a new window, except for the original glass and pattern. This newly remanufactured window should be maintenance-free for at least another 100 years.

SUMMARY: *Complete lead replacement gives a stained glass window a new "lease on life". It eliminates the main problem, which is the deteriorated lead, rather than ignoring the problem, as do so many other forms of restoration.*

Damaged pieces of glass are examined and separated for replacement or repair.

What are Some Other Methods of Restoration & Repair?

Many studios solicit and provide non-releading methods of restoration, which are actually "in-place" repairs. These companies do not remove the stained glass window from its frame to perform these repairs.

One of the common methods is to wash the windows, apply new cementing compound to the exterior of the stained glass window, and cover any broken or cracked glass with a bead or seam of silicone caulking. Frequently, this is done in conjunction with a very expensive exterior protective overglaze job.

Another very common method includes reduction of bowing and bulging and the addition of new or supplemental support bars over these areas. There are a variety of methods employed when flattening a window in place and adding support bars. Some of these involve drilling tiny holes in the lead came through which a thin piece of wire is threaded, then attached to a wooden dowel. This is usually done on both the inside and outside of the windows, after which workmen on either side tug or pull on the wire, and eventually reduce the size of the bow or bulge. An unfortunate by-product of this process is a great deal of cracked glass, since it is impossible to relieve the stress that brought about this condition by simply adding more outside force and stress to it. Once again, this is usually accompanied by an expensive overglaze job.

The third type of repair is a more complicated repair, which we find to be exceptionally deceptive. This is an extensive and expensive repair job, which often leads the customer to believe he is getting a complete restoration by releading. It sometimes costs as much if not more than actual releading. We have found that the key words to watch for in the specifications for this type of job is "repair of bad lead" or "replacement of all rotten or deteriorated lead" or "as required or necessary". This is a discretionary clause in the contract specification, which allows the repairer to replace as much or as little lead as he wishes. In most cases, there is as little as 10% lead replacement — usually in the outer borders and easily accessible areas of the window. In this method, the window is actually removed from its frame and taken back to the shop. Here, the bowed areas are flattened on the workbench through the application of weight and heat. After the bulges are flattened, a small amount of border lead is replaced to fulfill the legalities of the contract. Another step that is frequently taken is that the repairer reheats several of the old solder joints in the bowed areas, thus giving them a new silvery and shiny appearance in order to make it obvious that something has been done. This can often be the worst type of repair to involve yourself in, because the expense is usually very close to or exceeds that of complete lead replacement, and gives you little more than the previously mentioned, less expensive types of repair.

The above three processes will in fact result in some degree of short-term cosmetic improvement, but can create a situation where a short-term repair greatly increases the difficulty of an inevitable structural restoration. The reason for this is that one of the side effects of flattening and straightening a bowed stained glass window is glass breakage, and much of the original glass can be difficult if not impossible to duplicate.

The irony of all of this is that any of the above methods will, at best, give you a short period of cosmetic relief (10 to 15 years) after which you will have to restore the window anyway. Because the purpose of restoration is to give a stained glass window the opportunity to survive another century or more, this shortsighted approach is actually self-defeating. You shouldn't have to settle for ten, twenty, or even thirty years of survival. After proper restoration has been performed, your stained glass window will have a renewed service life of at least 100 years.

SUMMARY: *There are many so-called restoration methods, which are only temporary repairs. These repairs ignore the main problem, which is the deteriorated lead. Also, most of these repair methods are detrimental rather than beneficial to the overall condition of the window.*

Missing or shattered pieces are replaced and painted to match the original.

Why is Restoration by Releading the Method of Choice?

First of all, complete lead replacement is superior to any other method in attempting to return a stained glass window to its original pristine condition. No other method returns a window to its original or even greater structural strength and cosmetic appearance as well as releading. Only releading can provide the opportunity to properly conserve damaged pieces of glass, thereby guaranteeing a structurally sound and accurate restoration. Any other method of restoration or repair does not replace the structural backbone of the window, which is the lead channel. Also, releading allows for the total replacement of the second most important structural element of the window, the cementing compound. Any attempt to replace the cement without replacing the lead does not allow for the removal of the residual original cement, and therefore, does not allow any new cement to penetrate far enough under the edge of the old lead to do any good at all. Finally, only complete lead replacement allows for the fastening of new wire ties to new lead and solder joints. This is very important because in other methods, new wire ties are attached to the old lead and solder joints. This method is not appropriate because as lead and solder age and deteriorate, it becomes more and more difficult to bond new solder to it. After a period of time, the old lead and solder will reject the new solder and cause the newly affixed wire ties to break loose prematurely from the window.

SUMMARY: *Complete lead replacement is the only method by which you can successfully resolve all of the problems and conditions resulting from age, that occur in a stained glass window. Therefore, releading should be the only method to consider when doing anything other than repair of vandalism or spot damage from storms, etc.*

Why Reload Instead of Repeated Repairs?

Unfortunately, decisions regarding spending are usually based on thrift, rather than the long-term effects of the expenditure. As you will see, this is not always the wisest approach when making decisions on a stained glass window restoration project.

Although repair work appears to be less extensive than releading, it is not the least expensive over the long term. Most repair work will be somewhere in the area of one-third to one-half the cost of lead replacement, but even the most extensive repairs will last, at the very most, twenty years before needing to be repaired again. The lowest quality repair will last as little as five years and may actually hasten the window's deterioration.

When you consider that the absolute minimum lifespan of a window after lead replacement is 80 years, then a repair that lasts twenty years and costs one-half or even one-third as much as releading is a very poor investment.

Let's examine the following example. In this example, we will assume, very optimistically, that a repair will last as much as twenty years, and that releading will render a window maintenance-free for a minimum of 80 years.

	REPAIR	RELEAD
Present:	$ 15,000.00	$30,000.00
+ 20 years:	$ 22,000.00	
+ 20 years:	$ 32,500.00	
+ 20 years:	$ 48,000.00	
	$117,500.00	**$30,000.00**

NOTE: *These prices for repair are figured with an extremely modest inflation factor of 2% per year.*

In addition to the continuing glass damage that will result from repeated repair work, the issue of allocating money for the repairs will have to be faced at least every twenty years. And still, after all these repeated repairs, it is inevitable that the windows will have to be restored by complete releading, because the lead will eventually have to be replaced.

One must also realize that a repairer, even though he is one-third to one-half the price of releading, will want to perform the work all at once and collect total payment at that time. A restoration project can be funded and performed as an ongoing project over many years if necessary.

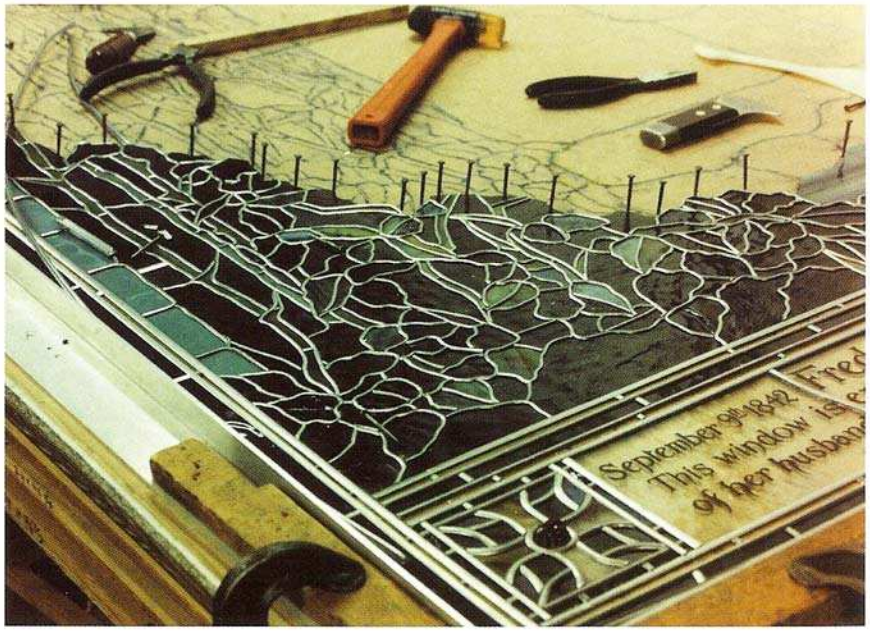
SUMMARY: *Restoration by releading is, by far, more cost effective than repeated repairs.*

Why Not Relead Just the Bad Areas?

There are studios that perform releading who will, in order to lower the price of a bid, recommend releading just the sections that are experiencing bulging.

Considering that the entire window was built at the same time, and the lead is all the same age, and has been exposed to the same weathering, one must understand that all of the lead is in the same condition. Releading of just the bulging areas will so strengthen them, that upon reinstallation, these new sections will put a tremendous amount of stress on the old unrestored sections, and thus greatly accelerate their rate of deterioration and buckling. The window will have to be removed again, and the newly bowed sections will have to be releaded. The cost of performing removal, transportation, and reinstallation again, not to mention the releading, will add up to even greater expense than if it had been done all at the same time.

SUMMARY: *A partial releading job is inefficient and impractical, and is usually recommended as a means of "cutting corners", to lower the price of a bid.*



Using the rubbing as a guide, the window panel is rebuilt using all new lead channel.

The lead intersections are joined with solder on both sides of the panel.

Can Releasing Prevent the Same Problems from Recurring?

No restoration process will ever stop a stained glass window from eventually deteriorating and needing to be restored again. This is because a stained glass window is designed primarily with two dissimilar materials (lead and glass). The rates of expansion and contraction vary greatly when these two most basic components are exposed to changes in temperatures. This condition wreaks havoc with the overall structure during the service life of the window. As long as lead remains lead, and glass remains glass, this bittersweet relationship will remain unchanged. However, the releading process will return the window to a state of structural equilibrium. This "good as new" condition guarantees a maintenance-free service life for the window that is at least as long as its "first" life.

What replacement of the lead can provide is the opportunity for subtle, yet very effective changes. Through the use of hindsight, we can look at a window in its deteriorated state and see where a support bar should have been placed. We can see where flaws in the original design created a weakness in the vertical strength of a panel, and add extra-heavy soldering to the lead joints in these areas. In addition, some of the configuration of lead used decades ago was inherently weak in design and structure. We now have the capability, through the use of modern machinery, to manufacture leads with a heavier heart and wall thickness without changing the outward appearance of the lead channel as it is viewed in the stained glass window.

We also have the ability now to alloy the lead with materials, previously not used for alloying, such as tin, nickel, tellurium and antimony. These elements contribute greatly to increasing the overall structural strength and longevity of the lead, and can increase the life expectancy of a newly releaded panel up to 200%. New soldering methods, with modern variable, heat-controlled soldering irons, allow for the application of solder to the lead joints in a manner far superior to those previously used. This new technology allows us to apply solder in a thicker, more even coat, to cover a larger area surrounding the lead joints. Most older windows have such small and tinsel thin solders, that when a window begins to bow, the solder on the lead joint cracks at the joint, thus allowing the bow to become even more distorted. This contributes to the acceleration of deterioration. Also, modern wire-tie material is 14 gauge, tin-plated copper, whereas the original material was simply a light gauge (18 or 20 gauge) bare copper wire. The old copper wire ties would quickly oxidize, turning greenish, then black, at which point, they would become extremely brittle, and could no longer hold up the weight of the window. At that point the wire tie would break and allow the weight of the window to press downward and create an even greater bow, and more glass breakage.

SUMMARY: *Lead replacement provides structural engineering adjustments through the use of hindsight as well as utilization of new materials and methods that are vastly superior to those that were available at the time of the original construction of the window.*

Waterproofing compound is applied to both sides of the panel, filling the space between the glass and the lead channel.

How Can I Be Assured that the Windows Have Been Completely Releaded?

First of all, to insure that your windows are completely releaded, be sure that the contract states "complete removal of all existing lead and replacement with new". Do not allow any wording such as "replacement or repair of all rotten lead", or "replacement or repair of all damaged or deteriorated lead". Any proposals which seem to suggest releading, but do not clearly and forthrightly state such, should be disregarded or rewritten. Also, we recommend that it should be made perfectly clear to the contractor that you plan to inspect these windows upon return prior to reinstallation to verify that they have been releaded.

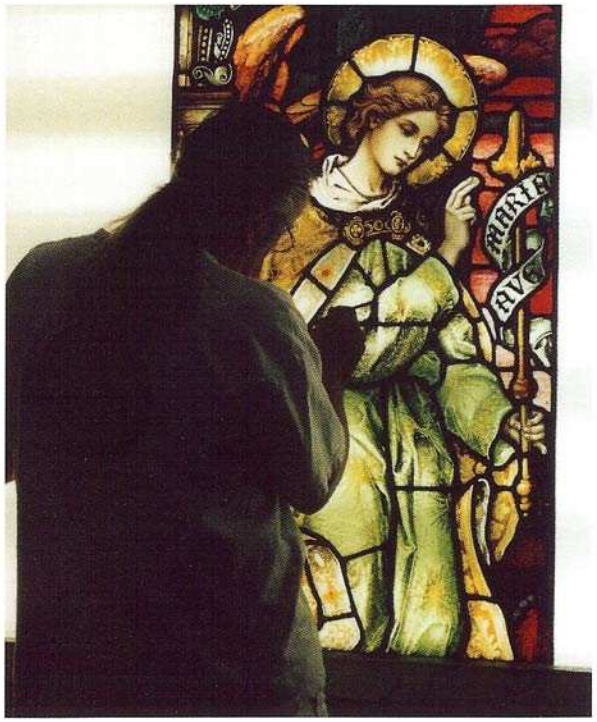
In addition, you should be granted the right of inspection during the restoration of your stained glass windows. This can be accomplished by appointing a member of your committee as a liaison between the church and studio. This person should have total access to the contractor's studio during normal business hours and be able to make spot inspections to verify compliance with the specifications of the contract. Also, as part of your contract, you may request a series of progress photographs, and/or verification of old materials prior to disposal.

These steps are going to make the company you are dealing with realize that you know what releading is, that you plan to verify the releading job, and that it would be in their best interest to provide you with exactly what you have requested.

SUMMARY: *Make sure the contract states clearly, the specifics of the work to be performed. Also, a visit to the studio while your work is in progress will assure you that you are getting what you paid for.*

What if We Choose to Do Nothing?

A window that is bulging and bowing will continue to do so and will start to bow in other parts of the window as well. The existing bulges will increase in size, and in the process, the lead will start to crack, revealing areas of daylight. When the window has reached this point, a great deal of glass will crack, and eventually, pieces of broken glass will begin to fall out of the lead came. At some point during this process, the wire ties will break, eliminating the window's vertical support. As these conditions are allowed to progress, irreparable harm will be done to the most important part of the window — the glass. We have been asked on occasion "but isn't it natural for a stained glass window to do this?". Although it is inevitable that the lead will deteriorate, it is unadvisable to allow the deterioration to continue, and in the process cause breakage of the original glass. We strongly suggest that you do not allow your windows to reach the above conditions, for if they do, it may be time to consider building new windows. Bear in mind that the cost of replacing your windows can range from four to five times the cost of releading. If your windows are finely painted / stained glass windows, or very finely detailed windows, the replacement cost can be much higher.



SUMMARY: *A decision not to restore your stained glass windows is not a final answer. It is just a postponement of an inevitable expenditure that will increase substantially as each year goes by.*

The window panel is inspected on a vertical light easel. Excess waterproofing compound is removed along with any other foreign matter that may have been missed in an earlier step.

How Can We Afford Restoration?

There are several creative ways to finance a stained glass window restoration project. The most common thing to do, if you cannot afford to fund the entire project at one time, is to break up the project into specific groups, in order of need, so that the windows in the worst condition are attended to first. Each year, a new group of windows is restored, and within a few years, the releading project is complete.

1. Some churches have funded their restoration projects by means of rededication of the windows. A person, family, or group of people decide to make a donation to restore a window in memory of a loved one. In certain cases this could be a descendant of the original donor. Through this rededication process, the restoration of the windows is funded, and over a period of time, all of the stained glass windows are restored. In some cases, a plaque with an inscription such as "Restored in memory of..." will be made up and placed on the window sill or somewhere near the window.

2. Frequently, the window restoration process is dealt with as a necessary maintenance process and is entered as a line in the budget with a certain amount of money allocated to it each year.

3. One novel method that we have seen is that of several families adopting a window. This process involves anywhere from two to ten families contributing small amounts of money which total the amount needed to restore one window. This process goes on and on over a period of several years, until all the windows have been restored.

4. Occasionally, we'll encounter a church that has stagnant Memorial Fund money that is not currently being used to fund a specific project. Sometimes these monies are used to pay for the restoration of a window.

5. Finally, there is always the approach of passing the hat. In some instances, it involves an additional collection (bi-weekly or monthly) to the benefit of the window restoration fund. Collecting loose change in large containers in the entryway of the church is another idea. The progress of these collections can be monitored on an easel with a thermometer or picture of a stained glass window that gradually gets colored in as the amount of money raised increases.

SUMMARY: *There always seems to be a way to raise the money to restore your windows properly, if the interest and concern is there. The most successful way of raising the level of people's concern and understanding is by having everyone hear, first hand, the reasons and the need for restoring the stained glass windows. This can be accomplished by conducting a general meeting of the whole congregation prior to or after a service, or at a special meeting. In cases where such meetings have been conducted, the level of enthusiasm and fund raising is greatly increased.*

Flat support bars (above) or tie wires for round bars (right) are soldered to the window panel.

Should I Have Protective Overglaze Installed With My Stained Glass Windows?

The use of protective overglazing (also known as secondary or storm glazing) is highly controversial. In many cases the potential drawbacks outweigh the potential benefits. Sadly, protective overglaze is often presented by some contractors and craftsmen as a "cheap" alternative to full-scale restoration. All too often protective overglaze is installed routinely when there is little risk from vandalism or other threats. The following is a list of potential benefits and drawbacks. The best advice we can offer is that you educate yourself about this subject, and make an informed decision that best suits your particular situation.

Potential Benefits

- Significantly decreases wind load exposure
- Can increase energy savings
- Provides vandalism and/or security protection
- May guard against environmental pollutants and some ultra-violet light exposure

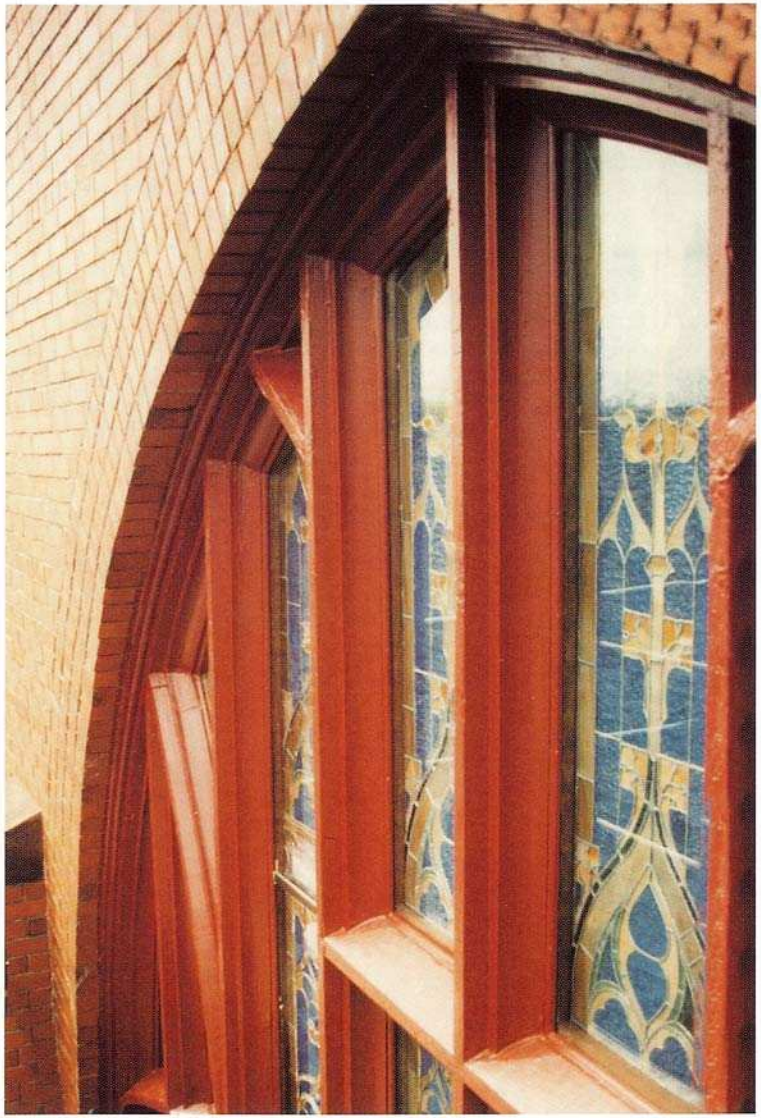
Potential Drawbacks

- Inhibits natural ventilation
- May cause retention of condensation
- Limits access for maintenance of windows and millwork
- Offers only minimal energy payback
- Can cause increased heat levels in the stained glass, leading to damage of the window
- May adversely affect the architectural aesthetics of the building

With all of these concerns in mind, we do believe that in certain instances, protective overglaze may be the right choice for a particular client. In areas where vandalism is destroying irreplaceable, historic windows, the installation of protective overglaze may be the only responsible solution. Also, for some multiple layer windows with irregular, exterior surfaces, or for windows with extremely thin glass, protective overglaze may be the best fortification against the elements. There are also some instances when protective overglaze is required as a condition of insurability.

If the necessity for overglaze is determined, it should be designed and engineered with the utmost regard for the life and appearance of the stained glass window. This is seldom a thrifty venture. Factors such as framing configuration, ventilation of the air space, and the use of a glass product versus a plastic product should be carefully considered. It is critical to remember that protective overglaze, especially when improperly installed, may actually hasten deterioration of the stained glass windows.

SUMMARY: *Protective overglaze is not necessary for a healthy, enduring stained glass window. If not properly installed it can create more problems than it cures. It is important to make a decision based on your own unique circumstances. When protective overglaze is installed, consideration of materials, framing and ventilation is critical.*

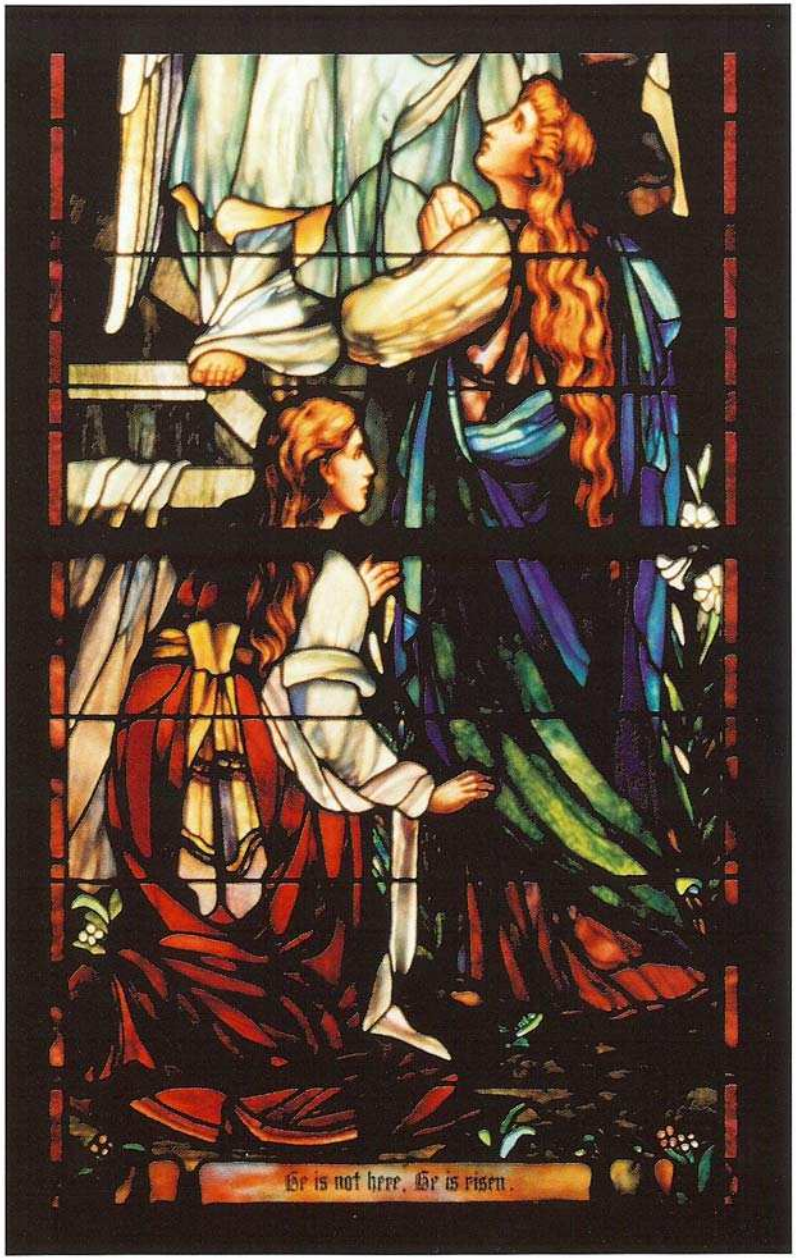


Consideration of the architectural elements of a building allows protective glazing to be unobtrusive as well as effective.

Conclusion

Stained glass windows are the art treasures of our churches. They should not be put in line behind other expenses that come along, nor should they be ignored. They appreciate in value each year; and therefore, they should not be allowed to depreciate in condition. All too often, I have seen the restoration of windows put off or disregarded in order to replace carpet, paint, heating systems, pews, etc. which are disposable goods and can be replaced at any time. Stained glass windows are not disposable, and should not be treated as such. Your windows should be inspected frequently, kept clean, and only where necessary, be covered by a properly vented and framed protective overglaze system.

Stained Glass Resources provides, at no charge, inspections, appraisals, educational seminars, demonstrations, and studio tours in an attempt to help you make educated decisions about your stained glass windows. We do this in order to establish a relationship in which we can work together from a point of mutual understanding, toward the common goal of preserving your stained glass windows. We hope this will result in a reputation of integrity and quality second to none.



Above is a window from Trinity Episcopal Church in Clarksville, TN that was completely restored after being heavily damaged by a tornado. To the left is a detail of this window during the restoration process.

Notes: