Conditions Assessment of Stained-Glass Windows

Brith Sholom Beth Israel Synagogue

Naomi Doddington, Graduate Fellow
Clemson University/College of Charleston
Graduate Program in Historic Preservation
Conservation Science Lab HP 8100/HSPV 810

Spring 2015
# Table of Contents

List of Illustrations  
3  

Introduction  
4  

History  
5  

Methodology  
7  

 Literary Review  
8  

General Findings and Recommendations  
10  

Window Key  
13  

 Individual Window Assessments  
14  

Conclusion  
99  

Published Sources  
100  

Acknowledgements  
101
List of Illustrations


Image 2: Beth Israel Synagogue, 145 St. Phillip Street, ca. 1948, *Orthodoxy in Charleston*, 16.


Image 5: Beth Israel Synagogue (interior), 182 Rutledge Avenue, 1948, *The Charleston Evening Post*.


All other images, drawings, renderings, and photographs by the author.
Introduction

As part of the Clemson University/College of Charleston MSHP course HP 8100/HSPV 810 (Conservation Science Lab), students are tasked with producing a conservation report. This work is expected to involve the student in documenting the existing conditions of a particular historic building material at a site of the student's choosing. After assessing conservation issues related to this material and researching industry-accepted best-practices, the student generates a report which offers recommendations for the owner of the historic material in conserving, repairing, and maintaining the material.

This report addresses the conditions of the stained-glass windows at Brith Sholom Beth Israel Synagogue, 182 Rutledge Avenue. The goal of this report is to create a document with accurate drawings of each window, along with both graphic and photographic representation of the conditions affecting each window. This assessment began with an intense measure-drawings period to produce accurate renderings of the windows in the space. After these drawings were created, more time was spent documenting the condition of each window. A review of current (within the last ten years) literature in the field of stained glass conservation, along with reference to industry manuals, allowed the evaluation of existing conditions and the generation of a series of recommendations. It is the intent of this report to synthesize all of this information as a manual for the congregation as they take the next steps in the process, namely, getting an estimate of the cost of such repairs as are recommended, raising these sums, and executing the repairs.

Anatomy of a Window

- Cames
- Saddle Bars
Brith Sholom Beth Israel has an extensive collection of late 19th century stained glass. 85 windows, were assessed for this project, some with upwards of 200 individual panes of glass. Knowing the history of these windows is important to understanding their present condition and some of the idiosyncrasies in their present-day installation.

The Orthodox synagogue of Brith Sholom was founded in 1855. First occupying rented space at 68 St. Phillip Street, by the 1870’s, the congregation grew and prospered in such a way as to necessitate the construction of a new building. In 1874, having acquired the property on St. Phillip Street, Brith Sholom laid the cornerstone for their wood and brick Greek Revival-style building. A surviving early photograph, circa 1900, appears to show stained-glass windows in place at that time. 1 An undated interior photograph shows what appear to be windows 1-5 and 77-81 installed flanking the ark, with other windows running along the sides of the main sanctuary. 2 The congregation's records were destroyed sometime in the early 1930's, which means the likelihood of discovering the designer or manufacturer of the windows is, unlikely.

A great influx of European Orthodox Jews in the latter part of the 19th century caused a challenging situation within Brith Sholom. These newer members, not as assimilated as their brethren, were not content with the status quo of keeping to Orthodox traditions in a lackadaisical manner. In the end, this group separated from Brith Sholom and created the Beth Israel congregation in 1886, moving to a wooden building at 145 St. Phillip Street. 3 This building was never retrofitted to appear as a synagogue from the exterior, retaining its original façade through the 1940’s. The Charleston area suffered a very large earthquake that same year. Brith Sholom’s building suffered $600 worth of damage, the equivalent of $14,800 in 2015. 4 It is unclear what, if any, damage was sustained by the stained-glass windows.

By 1929, Brith Sholom had grown too large for its synagogue. The Greek Temple-front was enclosed and the entirety of the structure was enlarged and re-clad in brick. A photograph first published in the paper in 1934 shows the end results of this renovation. 5 The pediment roofline is still discernible, although it has been broken up by what can best be described as crenellations at the apex and on both sides. Two small round stained-glass windows with a Star of David motif, which had been placed at the base of the original structure (flanking the central staircase) were replaced with doors, though one appears to have been re-installed very near the top of the façade. A very large round stained-glass window, also with a Star of David motif, acts as a transom window over the central doorway. In the 1934 image it is shown tilted down to allow air to enter the building (a later 1949 photograph shows the motif of this same window). 6 The windows on either side of this central entrance appear to be windows 30-36 and 46-52. The 1900 photograph is too overexposed to reveal the detail of the windows which makes it impossible to assess if these windows were moved from what was the front façade then to this new, expanded, front façade, though that seems to be the most likely case considering the comparable windows were installed at the rear of the sanctuary.

In 1941, Beth Israel congregation announced plans to construct a new, 500-seat synagogue at their location on St. Phillip Street. The brick building was intended to be centrally heated with modern amenities. Interestingly, the plans also called for “…ten large stained-glass windows.” 7 The intentions for a new building at that site were abandoned and in 1948, the congregation sold their old building to a group of Masons. 8 The congregation chose a new site, 182 Rutledge Avenue, and constructed their new synagogue. The plans originally described for the St. Phillip Street location seem to have been carried over to the new site. A 1946 photograph shows the new building just after it opened for services.

---

1 Gurock, Jeffrey S., Orthodoxy in Charleston: Brith Sholom Beth Israel & American Jewish History (Charleston, South Carolina: College of Charleston Library, 2004), 9.
2 Ibid, 9.
3 Ibid, 16.
5 “Do You Know Your Charleston?” The News & Courier, October 15, 1934.
6 Gurock, 36.
7 “New Synagogue To Be Erected,” The Evening Post (Charleston), August 15, 1941.
8 Gurock, 16.
History

[although the paper notes it would not be fully completed until January of the following year]. The windows on the front façade appear to have some sort of decorative pattern outlined in white. These could be some of the ten stained-glass windows announced in 1941, although, if they were, they do not correspond with the windows currently in these locations. A different image from 1948 shows the interior of the new synagogue.

The 650 seat auditorium looks quite different from what is seen today. There are large clear glass windows, each made up of 2 sashes with 20 panes apiece and topped by a semi-circular window, running down the sides of the sanctuary. There are also no balconies running down the sides. It is not evident if a rear balcony, which was mentioned in the plans in 1941, was in place, although it seems highly likely as indicated by the stairwell design. With central heat and air conditioning, it was “…one of the most modern Jewish religious centers in the South…”

Over the course of the late 1940’s and early 1950’s, conciliatory efforts were made between Brith Sholom and Beth Israel, culminating in their merger in 1955. The new congregation, known as Brith Sholom Beth Israel in honor of both congregations, came together under the same roof. The synagogue on Rutledge Avenue, less than a decade old, was remodeled by retrofitting the stained-glass windows from the original Brith Sholom synagogue into the existing fenestration. The discrepancies between old and new resulted in the interesting arrangement of windows in the sanctuary as seen today. The extra space of the fenestration was filled in with wood trim-work, creating frames of the appropriate size for the extant stained-glass windows, if creating an unusual mix of void to glass within the frame. Other modifications also resulted in idiosyncratic elements.

The windows that were originally installed in the front and rear elevations of Brith Sholom were installed in the side aisles at the merged synagogue. The differences are apparent in that both the motif and number of windows vary in these arrangements, both from the other windows and from each other. There is also an unusual situation with windows 24-29 and 53-58 in that the trim is significantly reduced, from the built-up 8” of all the other windows, to a flat surface of merely 2 ½”. Why this was done is unclear at this time. It is less noticeable in the North Elevation, but causes the South Elevation to have one window frame which appears to be shorter than the others. In fact, the tricks with trim couldn't completely compensate for the size of the available stained-glass panels and the very tops of the window frames have had copper tiles installed in them to fill what would otherwise be awkward blank space. In the front elevation, the windows with the diamond pattern that had been installed were removed and replaced with more stained-glass panels from Brith Sholom's old synagogue. The panels available were, once again, smaller than the available space, and the extra area was filled in with wood. This is evident on the exterior of the windows as the wooden parts are painted white, which accentuates that the windows sit strangely high in the openings. From the interior, the stairwell windows show these wood filler pieces but the interior wall with the three west windows has been framed out so that the windows appear to take up the entire frame of the window.

The large round window with the Star of David motif was installed in the small Concrete Masonry Unit building at the rear of the property. As the building was designed around the window, it is perfectly fitted in its frame. With the merger of the two congregations, Brith Sholom's iron columns (which hold up the side balconies as they did in the old synagogue) were installed at the same time as the stained-glass windows. These additional balconies do not meet the rear balcony evenly because the columns were shorter than the bottom of the rear balcony. They also hide quite a large portion of the windows. These little details, which are immediately noticeable though not instantly comprehended, make a great deal more sense once the history of the windows of Brith Sholom Beth Israel is known.

---

3 Ibid.
Methodology

Following industry standards, the first phase of this project required the production of accurate measured drawings of the sanctuary and all windows. There is no existing accurate floor plan for the space from which to create elevations. There are some plans in the archives of the Addelstone Library at the College of Charleston, but it appears they are copies that were not rendered to scale. General elevations were made by careful measuring utilizing both a standard metal measuring tape and a measuring pole. These elevations were done to the Historic American Buildings Survey (HABS) standards and should be accurate to within 1/8". Any errors or discrepancies are entirely my own fault. From these field drawings, AutoCAD, a computer aided drafting software, was utilized to create the final elevations.

Once the general elevations were made, the windows were carefully photographed. These photographs were then rectified using Photoshop in order to create straight and level images. An overall measurement of each window was taken, allowing the rectified photographs to be scaled in AutoCAD and the cames were traced. Each window is slightly different and this is duplicated faithfully in the final drawings. Each individual pane of glass was not measured and, as such, one hundred percent accuracy cannot be guaranteed, though the inconsistencies will be very minor. Some windows, hidden by the balconies, could not be adequately photographed as a whole. These may be slightly more inaccurate as the renderings were created from two separate images, one of which was taken at a very oblique angle unsuitable for rectifying. Once again, any errors in the rendering of the tracery on these windows is entirely my own.

After these drawings were created, print-outs were taken to the site where they were carefully examined from as close a position as was possible. Colors representing different conditions were pre-assigned and were used on-site to represent the different conditions present in each window. Cracked glass, probably the most noticeable problem for any layperson, was one of the conditions noted. Similarly, biological growth, broken solder joints, holes, inappropriate prior repairs, and other areas of concern were noted. Once again, the information gathered in the field was brought back to the studio in order to render a diagrammatic representation of the condition of each window. It is hoped that, through the use of these diagrams, overall and detailed photographs, and a narrative description, the present condition of each window will be clear. In this manner, the necessary repairs can be placed in order of priority, work that requires a professional conservator can be sent out for bids, and the proper funding can be raised to ensure that these works of art last for another 141 years.
In order to provide the most accurate and up-to-date advice for the preservation of the stained glass windows at Brith Sholom Beth Israel synagogue a review of current literature in the field was necessary. The literature review for this project can be broken into two sections: information regarding protection, conservation, and documentation of stained glass, and a scientific approach to sources of decay and possible solutions. Two articles have been reviewed in each of the sections.

In “Shadow Removal from Image of Stained Glass Windows”, the authors explore varying techniques for producing documentation photographs of stained glass windows that minimize or remove shadows caused by structural support bars (ferramenta), lead tracery (cames), exterior support grilles, or the masonry surrounding the window opening. Due to the nature of stained glass, the authors point out; shadows from any or all of the sources are almost inevitable in photographic or other digital imaging. The first challenge that they address are shadows caused by the ferramenta and cames. They utilize three digital techniques to isolate these structures from the glass they support: thresholding, template matching, and a Gabor filter. Visual images are presented showing a part of a stained glass window as originally imaged, the same segment of window is then shown after a threshold filter is run over the image. Likewise examples are shown after a template matching and Gabor filter were applied to the image. The original photograph and three post-filter images are presented so that the reader may assess the accuracy of the results. The original sample has flat, textured, and painted glass. The threshold technique seems to be the least effective as the texture of some of the glass panels and the painting on the surface is interpreted as components of the cames or ferramenta. The template matching, which uses the standard width of the actual tracery lead or bars, is not as accurate as might be hoped. Filtering the image in this manner provides very soft edges which would hinder the function the filter from isolating the structure from the shadow. The final filter is the combined Gabor filter which is the most effective of the three. After the Gabor filter is used, the structure of the window is clearly evident as a crisp outline, which would make the shadows easy to isolate from the structure and the remaining glass. Once the shadows are located, an algorithm can be written which removes the shadow from the glass yet retains details that have been painted on, all the while minimizing unwanted noise from the shadow removal.

After the initial results are presented, the authors go on to show that a similar process is used in the removal of vertical and horizontal grille marks (which are used to support the glass from the exterior); the vertical grille and the horizontal grille are isolated separately, the grille is then removed from the consideration of the algorithm which can then be used to remove the shadows caused by the grille from the final image. The examples in this work are very clear and helpful in explaining the process, although the promise of showing the removal of shadows cast by masonry around the window is not brought to fruition. Likewise, the technique requires advanced coding skills, which make its application in all but the most specialized labs moot.

Under the edict of “first, do no harm” authors Adriana Bernardi, et al, utilized multiple specialized observation processes to study protective glazing’s affect on stained glass windows at three project sites. Their results were presented in, “Conservation of stained glass windows with protective glazing: Mean results from the European VIDRIO research programme”. The coalition of scientists studied sample windows at cathedral’s located in Paris, Cologne, and Troyes. One cathedral was chosen in each city and two windows were chosen from each cathedral. The windows were chosen for their use of stained glass decorated by grisaille, a type of vitrified paint. At the Sainte Chapelle in Paris, the 13th century windows chosen had both been restored within the past 25 years. The detachment of the glass paint was a subject of considerable interest in these particular windows. One of the windows, restored in 1987, is not protected by special exterior glazing. The other, restored in 1999-2002 had modern thermoformed glass placed several centimeters away from the original surface with the interspace ventilated through several slots left in the modern glazing. The Saint Urbain Basilica (Troyes) dating from the late 13th century, or most recently restored from 1993-1997. At that time, modern glass was assembled in leadwork reproducing the original framework of the stained glass windows. This was mounted, leaving a 1 cm slot along the sides of the modern glass panels. The interspace between the modern and ancient glass varied from 3 cm to as little as 8 mm. Cologne Cathedral’s earliest windows date to 1260, though the windows used for this study date to 1300. In 2003, a non reflected security glass was installed on these windows. The interspace (5.5 cm) was ventilated from the inside by tilting the original window panels in their frames. Utilizing a variety of sensors, the VIDIRIO team measured the temperature in the interspace and discovered


that in all three the temperature was much closer to that of the interior of the church than the exterior, that any condensation which occurred was happening on the surface of the modern glass and not the ancient; and that the relative number of particulates in the interspace is at the same level as the interior of the church rather than the exterior. The team was able to conclude that the protective glazing did not elevate the temperature of the exterior of the ancient windows, in fact it mitigated the effects of exterior temperature fluctuations reducing the danger of micro cracks. While the team has formulated recommendations for the most effective exterior glazing system, they conclude that even a sub-optimal system has its benefits. The recommendations of the VIDIRIO team will be forwarded to the BSBI leaders as part of the conditions assessment.

While physical and chemical agents which cause decay in stained glass are readily apparent and easily understood, Alexandra Rodrigues and her fellow writers point out that biological corrosion has not been greatly studied and is poorly understood. This fascinating study, “Fungal biodeterioration of stained-glass windows” seeks to explore the types of biological agents that can cause deterioration as well as the conditions which exacerbate this process. The team sampled two windows one from the 15th century and one from the 17th century in the collection of the Ajuda National Palace in Lisbon, Portugal. The tumble agents found on these two samples were cultured, identified, and it exposed to various glass reproduction samples. The team utilized traditional glass blowing techniques to create samples of both the 15th and 17th century based on their chemical composition as determined by micro energy dispersive x-ray fluorescence analysis of the originals. In addition three permutations of color and corrosion. The samples were examined after physically removing the biofilm on the surface using a scraping blade. The purple glass experienced the most overall pitting. Perhaps the most important finding as relates to BSBI is that the standard cleaning solution of water: ethanol is ineffective in removing fungal agents. They were then reexamine and after cleaning repeatedly with water and ethanol in a 1:1 solution. Each time the samples were examined using optical, scanning electron, FTIR spectroscopy. The examination after just 2.5 months showed biodeterioration in all the samples with significant deterioration at six months. No significant difference was seen between corroded and non-corroded examples, it was the composition of the glass that made a big difference. The potash glass showed more changes in optical properties while the clear glass experienced more initial fungal growth. The purple glass experienced the most overall pitting. Perhaps the most important finding as relates to BSBI is that the standard cleaning solution of water: ethanol is ineffective in removing fungal agents.

Most studies of the weathering in deterioration of glass reveal both leaching and corrosion. The authors of the study similarly expected to find both of these processes but, they were interested in seeing if the kinetic forces involved in humidity and rain would show any differences from results achieved utilizing the standard water-based-solution tests. Tiziana Lombardo, et al. released their results in “Long term assessment of atmospheric decay of stained glass windows”. Using a combination of fragments of uncolored stained-glass from two locations in France along with modern weathered analogs the team analyzed the samples with SEM-EDX to determine the composition of the original glass and the exterior surface which displays the greatest amount of decay. What the team discovered is that there’s a great deal of heterogeneity in the un-decayed portion of the glass within each sample, along with similar heterogeneity within the decayed layer. Even as each sample of glass was quite different from the others. The result that seemed most interesting to the team was the extreme level of variability in the thickness of the layer of decay, with some areas of buried the decay bordering areas would significantly less decay. In the end, these results are unsurprising yet slightly inconsistent with the theory current within the field.

An exploration of current literature in the field of stained-glass conservation has revealed that there are physical, chemical, and biological dangers to the integrity of these works of art. Furthermore, it appears that one of the best things that can be done for the glass is to install an exterior secondary glazing system with adequate ventilation. There’s also hope that imaging software will continue to be developed that will allow the average conservator to document photographically the actual condition of a window without the interference of shadows.

References:

The care and maintenance of the stained-glass windows is vital to their future. There are some issues that are relatively easy to take care of and will not require a specialist, while others will require a professional to perform. A major and immediately ameliorable condition issue is one of general cleanliness. Inside the sanctuary many of the windows have a coating of biological growth (in this case, mold), which can lead to deterioration of the glass and is unsightly. In order to keep the graphics legible, this biological growth has not been rendered but will be pointed out in photographs where it is most extensive. Utilizing a soft cloth and soft water, each pane should be gently cleaned, avoiding the ones with paint on them. Windows should never be cleaned with ammonia-based products (Windex, etc.) as they can abrade the glass or cause deterioration of the cames. If pure water is not effective enough, a non-ionic liquid such as acetone or isopropyl alcohol may be used to clean the glass. Once again, this should not be used on the painted glass panes and must be followed by a gentle rinsing with pure water, making sure to remove any residue. Some of the painted glass panels are already showing signs of paint loss. Wiping these panels down may cause further damage to the paint. With careful attention to detail, the non-painted parts may be cleaned with a cotton-tipped swab and plain water, progressing to alcohol if absolutely necessary. Regular maintenance of the glass surfaces is important and should be worked into the standard routine maintenance of the building.

The wooden frames around the windows need to be properly maintained. The unusual nature of the windows downstairs has created some maintenance issues. While some of the windows are still functional, pivoting about 45˚ to allow the ingress of fresh air, the vast majority are not. This might not be so problematic were they stuck in the closed position, but most are unable to open or to close fully. Without the capacity to close and latch, there is essentially a constant admittance of precipitation through these windows. This is causing damage to the wood of the sills and mullions as is evidenced by the cracking paint. The issue is further exacerbated on the north side of the building where there is naturally less direct sunlight. Here there are the unmistakable signs of biological growth on the sills and mullions. The windows need a good, solid frame to support them and the excess moisture in this area is compromising the integrity of this frame. The mechanism for opening and closing the windows on most of the frames is quite rusty, which inhibits their smooth functioning. It also seems that the wooden frames have shifted over the years, which causes the problems closing and latching so many of the windows. A professional should assess the woodwork and metal mechanism to see if there is a possibility of repairing and returning functionality to these windows. If this is not possible, it may be necessary to alter the windows so that they are placed in a permanently closed state. For the immediate term, a mild bleach solution could be used to kill the mold growing on the woodwork followed by scraping the old flaking paint, properly prepping the surfaces, and repainting. Some sills below non-operable windows show evidence of water as well. This is likely caused by condensation gathering on these windows in the winter, when the exterior temperature is much colder than that inside, or in the summer, when the reverse is true. The sills in these areas should also receive preparation and fresh paint. The condensation will continue to be a problem, therefore frequent inspections will be required to keep them in good repair.

Another issue with many of the windows could easily have been avoided. Many windows have drips or splatters of paint, ranging from pin-point drops to long drips. In addition, there are few windows that don’t have paint along the edges. Oftentimes, this overpaint covers the entire edge pane of glass and several of the cames on the periphery. It is imperative that a professional determine the best way to remove this paint from the windows and that no attempts to scrape off or use solvents be made without first consulting a professional. The synagogue should also oversee future paint campaigns very carefully to ensure that the windows are properly masked (some of the tiniest droplets are the apparent result of cast-off from rolling paint on the nearby walls) and that the frames are cut in with utmost care. These aspects of preparation for a proper paint job should be written into any contract with a painting company or, if congregation members take the task on themselves, should be ensured by the person in charge.

A stained-glass window is only as strong as its weakest joint. The windows at BSBI are facing quite a few challenges in this department. Over the years, many of the cames have begun to give way. Given the time period of the initial production of these windows, the cames are most likely 100% lead. At the time, this was thought to be an advantage over previous lead which had impurities such as tin, copper, or silver. Over the course of time, though, this has proven to be untrue and many conservators consider this lead came to have a life expectancy of about 100 years. At over 140 years, the windows in BSBI are certainly well over this expected life. The deficient came is the main source of the most obvious damage, cracks in the glass. The sagging of the cames has led to significant distortion of the forces on the glass. Nearly all of the windows have some form of lead creep, though there are some that are far worse than others. These windows are reaching a critical point where the distortion of the cames is so great that the windows will need to be re-made. Ironically, some of the worst problems have arisen in areas where the saddle bars have been attached. These bars, which run horizontally across the windows and are inserted into the wooden frame, are tied and soldered to the cames. This, though, seems to have caused some of the worst problems. As the rest of the lead cames have shifted over time, these strong bars (likely iron) have held the cames they are attached to very rigidly. The pressure...
General Findings & Recommendations

this has put on the surrounding glass is evidenced by the many cracks located very near the saddle bar. There are a few
broken solder joints and even a few broken cames as well. There is also a significant amount of deterioration on most
of the cames. The mastic that was worked between the windows and the cames (which is used to keep the glass from
rattling) is cracked and falling out of its position in many places. There are corrosion products also gathering on many
of the cames. The corrosion (rust) and deterioration of this mastic is so extensive, it is not shown on the diagram of
each window to allow the diagram to be legible. Photographs will be used to show examples of some of this
deterioration, but it is safe to assume that no window is unaffected. The main issues with the corrosion and
deterioration is that they distort the delicate details of the design and allow movement which can lead to breakage.

Although a professional would have to make the final determination, it appears that a substantial number of windows
will have to be remade. This is not something that can be done in-situ, the windows must be carefully removed, taken
apart, and re-assembled. Oftentimes the same cames can be re-used, which helps maintain the historic integrity of the
windows, although it is likely not advisable in this case. Not all of the windows will need such a radical repair campaign,
and it is most likely that this is a campaign that can be undertaken in successive steps, with the most at-risk windows
repaired first, and followed later by the others. As previously stated, the exact number of windows that will need to be
re-made is entirely the purview of a professional, although this report will point to certain windows which appear to be in
most immediate need.

Inadequate repairs are another problem encountered when studying the condition of these windows. Several
windows have cracked and have been mended with some form of silicone. While well-intentioned, this is not a rec-
commended repair. The silicone releases certain chemicals as it cures and ages that can actually be harmful to the glass.

Edge-gluing with silicone is sometimes utilized by restorers, but that is not how it was applied in this case. Indeed a vast
swath of the glass is coated in a rather thick (approaching 1/8") layer of silicone. This exposes more of the glass to the
chemicals released by the silicone, is unsightly, and acts as an excellent substrate for biological growth and dust
collection. Meanwhile, being more flexible than the glass, the silicone allows the glass to continue to move and rattle.
This means that many of the windows with these silicone repairs have developed new cracks. While the silicone has
stopped the most immediate problem, that of a crack or hole that allowed the ingress of water, it has not addressed
the deeper structural problems that led to the cracking in the first place. Other repairs to the windows have not been
well-executed. A few of the windows have had areas re-soldered with too much lead. The excessive amounts of solder
on these joints is actually counter-productive as it creates a weaker joint. In addition, a previous repair campaign which
utilized the then-industry standard “Dutchman” or “false lead” system in which strips of lead were attached on both
sides of a break is failing in multiple areas. While this form of treatment hides the crack from view, it does not actually
fix the crack. The two edges of the break continually rub against each other, causing further damage to the glass. The
fact that several of these repairs are failing is clear evidence that this once-adequate solution is no longer effective. On
several of the windows, there are replacement panes of glass. They are very obvious in that, where the rest of the
border of the window is amber-colored, these replacement pieces are purple. What is more disturbing is that they
appear to match some of the panes in a few of the windows, which may indicate that a window was sacrificed in order
to scavenge this glass for the repair. It is always best to fix and re-use the original glass. Only in the most hopeless of
cases should the glass be completely replaced. When this is done, every resource should be tried to locate a surviving
piece of the same glass, or barring that, a custom pane could be produced.

A final area of concern are the painted panels. The dedication panels, which bear the names those members in
whose memory the windows were sponsored, are an area of concern. The first is the aesthetic consideration that a few
of the panes have lost some of their paint, with two, windows 33-34, rendered nearly illegible. Similarly, the
dedication panels to be precise, is the serious accumulation of biological growth and dirt behind these panels. The way these areas were assembled is part of the cause of this deterioration. The colored glass
was set into place with the rest of the design, then a second frame was welded to the front of the came. Once the
dedication were made, the names were painted onto clear glass and this was placed in this second frame and sealed
shut. Unfortunately, the failing seal around the colored glass has allowed the agents of decay to enter behind the clear
glass and they have colonized this area.

While some of the necessary work for the restoration of the windows at BSBI is inexpensive and relatively easy
to perform, there is a great deal of work that must be executed by professionals. This work, which requires the utmost
of care, planning, and dedication, will not be inexpensive and may require several years of active labor. Once this work
is completed, it will be in the best interest of the synagogue to protect their investment. There is one final
recommendation that needs to be made, based on the latest studies in the field of stained-glass preservation. This
recommendation is that a professional be hired to design and install a protective glazing system. These systems involve
the installation of a second, clear layer of glass on the exterior of each window. This clear glass protective layer must
be designed with portals for air circulation as well as a proper amount of interspace (space between the stained-glass
and the clear glass). Once in place, this system will perform several functions. First, it will protect the glass from break-
age due to impacts from exterior debris. The holes in several windows appear to be the result of soft body impacts to
the glass, which would be reduced by the installation of protective glazing. In other areas, such as thermal conduction
and environmental pollution, protective glazing has been shown to have marked advantages. The installation of pro-
tective glazing has been shown to reduce the level of thermal conductivity significantly. The insulative effect of the air
in the interspace region helps to maintain the stained-glass at a temperature more similar to that of the interior of the
building. This moderation of the difference between the temperatures on each side of the historic glass would signifi-
cantly reduce the problems of condensation that currently face the windows. In fact, any condensation that does occur
takes place on the surface of the clear glass, keeping the humidity level low, rather than trapping it as once feared. As a
further boon, the systems have been shown to reduce levels of pollution on the exterior of the glass to match those of
the interior of the glass. These environmental pollutants are a source of deterioration, including corrosion and loss of
chemical integrity of the glass. Another note, which might seem trite but does deserve consideration, is that a protec-
tive glazing system does not have to be unattractive. While older technologies have marred the appearance of windows,
with yellowed panes and support bars that were visible in an unpleasing manner on the inside, these systems have come
a long way in recent years. For this reason, the professional who is charged with designing BSBI’s system needs to be
carefully selected to ensure they are up-to-date on the latest developments in this technology.

General Findings & Recommendations
### Conditions Color Key

<table>
<thead>
<tr>
<th>Condition</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broken Glass</td>
<td>Gray</td>
</tr>
<tr>
<td>Prior Repair</td>
<td>Red</td>
</tr>
<tr>
<td>Water Damaged Wood</td>
<td>Orange</td>
</tr>
<tr>
<td>Glass Paint Failure</td>
<td>Green</td>
</tr>
<tr>
<td>Glass under high-stress</td>
<td>Blue</td>
</tr>
<tr>
<td>Lead Creep (buckling)</td>
<td>Magenta</td>
</tr>
<tr>
<td>Broken Solder Joint</td>
<td>Yellow</td>
</tr>
<tr>
<td>Paint Splatter</td>
<td>Black</td>
</tr>
<tr>
<td>Rust Stain</td>
<td>Brown</td>
</tr>
<tr>
<td>Broken Came</td>
<td>Red</td>
</tr>
</tbody>
</table>

### Notes:

- Weak came allows center to bulge out
- Danger of further glass breakage
- Paint on glass and came
- Silicone covers several panes of glass
- Corrosion/Mastic deterioration

### Areas of Concern

- Broken glass
- Center of window bulges out
- Paint on glass and came
- Broken glass

### Overall Window:

- Brith Sholom Beth Israel Synagogue
- Window #1

- Broken Glass
- Glass under high-stress
- Silicone
- Paint Splatter
- Lead Creep (buckling)
- Broken Solder Joint
- Rust Stain
- Broken Came
Window #2

Notes:
- Broken glass coated in silicone
- Paint drips
- Broken glass
- Weak came allow center to bulge out
- Paint loss
- Corrosion/Mastic deterioration
- Broken came
- Biological growth

Conditions Color Key

<table>
<thead>
<tr>
<th>Broken Glass</th>
<th>Silicone</th>
<th>Glass under high-stress</th>
<th>Paint Splatter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior Repair</td>
<td>Glass Paint Failure</td>
<td>Lead Creep (buckling)</td>
<td>Broken Solder Joint</td>
</tr>
<tr>
<td>Water Damaged Wood</td>
<td>Replacement Glass</td>
<td>Raint Stain</td>
<td>Broken Came</td>
</tr>
</tbody>
</table>

Area of Concern: Broken glass coated with silicone

Area of Concern: Corrosion of saddle bars

Area of Concern: Center bulges out

Area of Concern: Broken glass
Window #3

Conditions Color Key

<table>
<thead>
<tr>
<th>Condition</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broken Glass</td>
<td>Gray</td>
</tr>
<tr>
<td>Silicone</td>
<td>Blue</td>
</tr>
<tr>
<td>Glass under high-stress</td>
<td>Cyan</td>
</tr>
<tr>
<td>Paint Splatter</td>
<td>Orange</td>
</tr>
<tr>
<td>Broken Solder Joint</td>
<td>Yellow</td>
</tr>
<tr>
<td>Broken Came</td>
<td>Red</td>
</tr>
<tr>
<td>Replacement Glass</td>
<td>Blue</td>
</tr>
<tr>
<td>Rain Stain</td>
<td>Purple</td>
</tr>
<tr>
<td>Water Damaged Wood</td>
<td>Brown</td>
</tr>
<tr>
<td>Prior Repair</td>
<td>Black</td>
</tr>
</tbody>
</table>

Notes:

- Broken glass coated in silicone
- Broken glass
- Paint splatters
- Paint loss
- Broken solder joints
- Repaired solder joints use excessive amounts of solder
- Biological growth
- Corrosion/Mastic deterioration

Overall Window

Area of Concern - Paint loss

Area of Concern - Broken glass

Area of Concern - Excess solder

Area of Concern - Biological growth
Window #4

Overall Window

Notes:
- Broken glass coated in silicone
- Broken glass
- Paint splatters
- Broken metal frame
- Biological growth behind clear glass name plaque
- Corrosion/Mastic deterioration
- Replacement glass in non-matching color
- Prior repair with surface lead
- Water damage to wood sill

Conditions Color Key
Window #5

Conditions Color Key

<table>
<thead>
<tr>
<th>Broken Glass</th>
<th>Silicone</th>
<th>Glass under high-stress</th>
<th>Paint Splatter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior Repair</td>
<td>Glass Paint Failure</td>
<td>Lead Creep (buckling)</td>
<td>Broken Solder Joint</td>
</tr>
<tr>
<td>Water Damaged Wood</td>
<td>Replacement Glass</td>
<td>Rust Stain</td>
<td>Broken Came</td>
</tr>
</tbody>
</table>

Notes:
- Broken glass coated in silicone
- Broken glass
- Biological growth behind clear glass name plaque
- Prior repair with surface lead
- Replacement glass in non-matching color
- Water damage to wood sill
- Corrosion/Mastic deterioration
Window #6

BSBI
Brith Sholom Beth Israel
SYNAGOGUE

Notes:
- Weak came allows center to bulge out
- Broken glass
- Corrosion/Mastic deterioration
- Paint on glass and came
- Prior repair with surface lead
- Biological growth

Conditions Color Key

Overall Window

Area of Concern: Mastic packed in behind twisted came

Area of Concern: Broken glass

Area of Concern: Corrosion of saddle bar

Area of Concern: Broken glass, Paint on glass
Window #7

**Conditions Color Key**

- Broken Glass
- Silicone
- Glass Paint Failure
- Glass under high stress
- Paint Splatter
- Lead Creep (buckling)
- Broken Solder Joint
- Rain Stain
- Broken Came
- Prior Repair
- Water Damaged Wood
- Replacement Glass

**Notes:**

- Broken glass
- Buckling came
- Twisting came
- Corrosion/Mastic deterioration
- Biological growth

Area of Concern - Bulging away from wood frame

Area of Concern - Damaged came

Area of Concern - Came buckling

Area of Concern - Mastic deterioration
Window #8

Notes:
- Broken glass
- Corrosion/Mastic deterioration
- Paint splatters
- Biological growth
- Prior repairs with surface lead
- Surface cracks indicating stress

Conditions Color Key

- Broken Glass
- Silicone
- Glass under high stress
- Paint Splatter
- Corrosion/Mastic deterioration
- Glass Paint Failure
- Lead Creep (buckling)
- Broken Solder Joint
- Water Damaged Wood
- Replacement Glass
- Rain Stain
- Broken Came

Overall Window

Area of Concern - Surface cracks

Area of Concern - Paint splatter

Area of Concern - Broken glass

Area of Concern - Mastic deterioration
Window #9

Conditions Color Key

- Broken Glass
- Silicone
- Glass under high-stress
- Paint Splatter
- Prior Repair
- Glass Paint Failure
- Lead Creep (buckling)
- Broken Solder Joint
- Water Damaged Wood
- Replacement Glass
- Rust Stain
- Broken Came

Notes:

- Broken glass with what looks like a wad of solder
- Parallel cracks, indicative of stress
- Broken glass coated in silicone
- Corrosion/Mastic deterioration
- Paint splatters
- Prior repairs with surface lead
- Biological growth

Area of Concern: Paint splatters and paint on glass

Area of Concern: Broken glass with what looks like a wad of solder

Area of Concern: Broken glass coated with silicone

Area of Concern: Parallel breaks

Overall Window
Window #10

Conditions Color Key

- Broken Glass
- Silicone
- Glass under high-stress
- Paint Splitter
- Prior Repair
- Glass Paint Failure
- Lead Creep (buckling)
- Broken Solder Joint
- Water Damaged Wood
- Replacement Glass
- Rust Stain
- Broken Came

Notes:
- Came shifts causing three panes to come out of their cames
- Corrosion/Mastic deterioration
- Water damage to window sill
- Paint loss
- Broken glass
- Prior repairs with surface lead

Overall Window

Area of Concern: Biological growth behind clear glass name plaque

Area of Concern: Came shift leaving gap

Area of Concern: Significant came shift, mastic packed behind

Area of Concern: Rigid saddle bars pulling on cames

*Windows #11-#85 were not included in this online version of the assessment. If you are interested in reading the report in its entirety, please contact the MSHP program directly at 843-937-9596 or mschley@clemson.edu.
Conclusion

Documentation of the stained-glass windows at Brith Sholom Beth Israel Synagogue has revealed the condition of these pieces of art. Some of the issues present, such as cleanliness and paint splatters, are fairly easy to remedy. Others will require the re-making of certain windows. The next step for the conservation of these windows is to coordinate with a professional conservation company to organize the repair campaign in tiers according to immediacy of need. Once this is done, the congregation can put the work out for competitive bids, or ask for a quote with the consulting company. This will allow the congregation to begin raising the funds to make the necessary repairs and allow it to implement tier-one repairs as soon as possible. The congregation has been unhappy with the companies available locally and have asked for guidance in locating the appropriate conservator. This is beyond the scope of this project, but it is recommended that they seek out conservators in major American and Canadian cities.

The following is a list of resources which might prove helpful:

Organizations

Corning Museum of Glass- www.cmog.org/
International Council of Museums- www.icom-cc.org/15/about-icom-cc/
Stained Glass Association of America- stainedglass.org/

It is also worth noting that the current renovation of the Gibbes Museum of Art in Charleston will include the restoration of its original Tiffany stained-glass dome. Inquiries with individuals familiar with the project may be useful in establishing which company is performing this work for the museum.
Published Sources


Pallot-Frossard, Isabelle, et al. “Main conclusions from VIDRIO EU research programme on the determination of conditions to prevent weathering of ancient stained glass windows and recommendations for end-users and practitioners.” Rivista della Stazione sperimentale del vetro 35, no. 3 (June 2005): 75-83.


Acknowledgements

A special thank you to the people who helped make this project a success...

Mary Campbell
Frances Ford
Jessica Fortney
Walter Fox
Richard Marks
Dr. Barry Stiefel

The Congregation of Brith Sholom Beth Israel
The Staff of the Addlestone Library, College of Charleston
The Staff of Brith Sholom Beth Israel
The Staff of the South Carolina Room, Charleston County Public Library