

PRESERVATION MATTERS: HISTORIC PLACES OF WORSHIP

STAINED GLASS

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National Center for Preservation
Technology and Training
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The use of stained glass in places of worship has a long history, stretching back to the Middle Ages. This is especially true of church windows, where images in glass illustrate biblical narratives for the faithful, who had little access to the scriptures themselves. Today, stained glass is appreciated for its artistic, historic, and inspirational value.

Many issues affect the preservation of stained glass. Religious activities, such as the burning of incense and candles, pollution from urban environments, and weather may adversely affect these treasures. In order to prolong the lifespan of stained glass, special attention should be given to its maintenance, and proper repair and restoration should be undertaken when necessary. This document serves as an introduction to the basic care of stained glass in historic places of worship.

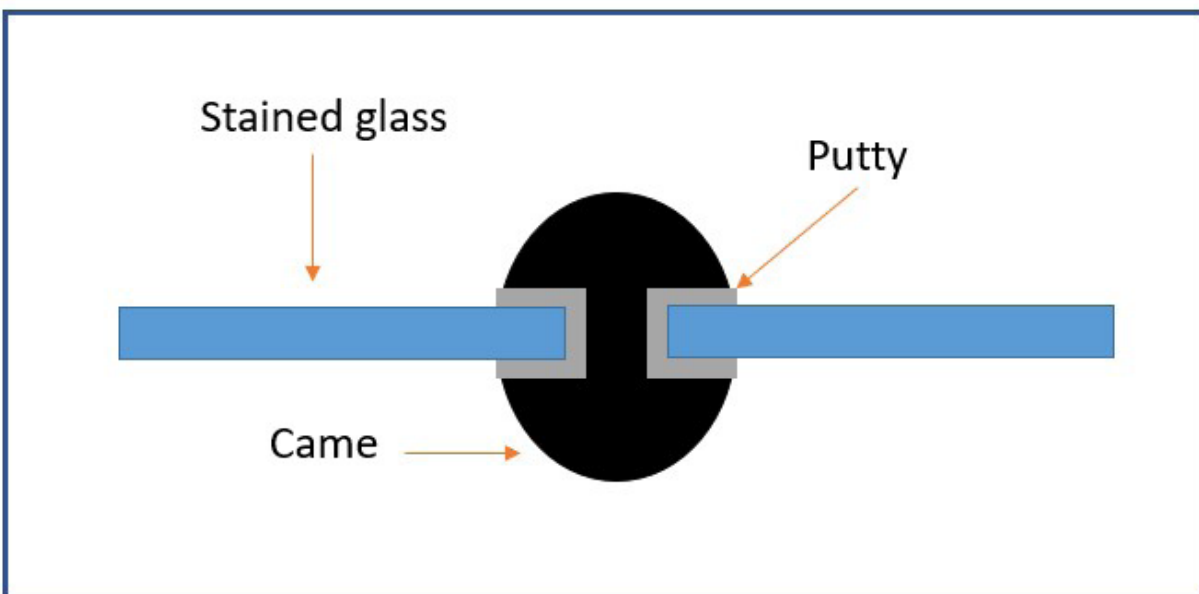
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COMPONENTS

Stained glass is made up of five major components.

- *Glass: May be antique glass (handblown, uneven texture), machine-rolled or cathedral glass (evenly textured), or opalescent glass (milky appearance). Glass may be colored or painted.*
- *Cames: Metal strips typically made of lead, zinc, copper, and brass, used to join individual pieces of glass together to form a larger window pane.*
- *Putty: A cement compound typically made of an organic oil medium, such as linseed or soya, used to secure glass into cames, making the joints watertight.*
- *Window frame: May be made of wood, steel, iron, stone, and aluminum, the frame surrounds the whole window, holding the stained glass composition together.*
- *Environment: The setting in which the stained glass is housed. Several factors may impact the preservation of the stained glass: the use of heating and air conditioning in the building; a hot, cold, humid, or dry outdoor climate; severe weather conditions; etc.*



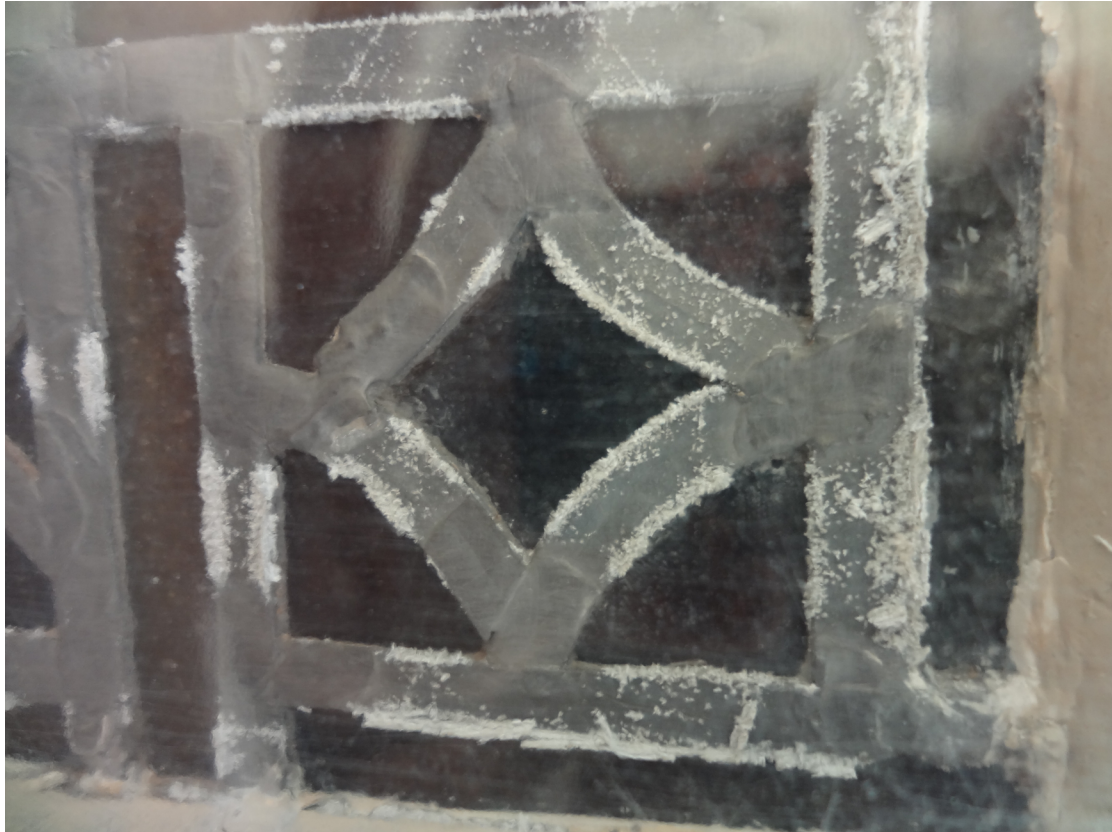
*Cross section of a stained glass window.
Source: Stéphanie Machabée.*



COMMON ISSUES

Several issues can impact the preservation of stained glass. Some of the most common ones include:

- *Came deterioration: Most American-produced came tends to last between 75 to 200 years, though 100 years is a good rule of thumb. Inspect for oxidation (white powdery appearance) and soldering issues (tearing of metal next to soldered areas).*



Corrosion of metal came.

Source: Jason Church.

- *Protective glazing: Though intended to protect stained glass against environmental pollutants, vandalism, and the elements, protective glazing (a glass or plastic pane added to stained glass) has often caused more preservation issues because of improper ventilation. Examine for condensation on the inside of the window, a sign it may not be properly ventilated. Dirt and debris between the protective glazing and stained glass window may be a sign that the protective glazing is not properly sealed. For more information, see “Historic Places of Worship: Protective Glazing of Stained Glass.”*

- *Frame deterioration: Deterioration of the window frame can pose additional threats to the stained glass. For wood frames, check for rot or severe weathering. For metal frames, inspect for corrosion or rust. For stone frames, examine for loose stone fragments and missing mortar.*



*Examine stone frames for loose fragments and missing mortar.
Source: Jason Church.*

- *Broken or cracked glass: Stained glass can crack, break, or scratch from improper installation, poor maintenance, severe weather conditions, or vandalism. Cracks typically radiate straight from the source, which can help identify what is causing stress to the glass.*
- *Paint deterioration: Paint can deteriorate or detach due to environmental factors, such as severe weathering, or issues in the production of stained glass, where incorrect firing times and temperatures produce a weak bond between the paint and the glass. Look out for flaking and discoloration.*
- *Putty deterioration: Over time, putty will harden and crack, losing its adhesion to the glass and the came. The window may leak air and water as a result, thus causing moisture issues as well as heat loss. Look out for glass that rattles or moves easily in its came.*
- *Moisture issues: Water can etch and pit glass, cause erosion of metals in comes or window frames, or cause wooden frames to rot, etc. Look out for fogging, water beading, and water droplets.*
- *Sagging and bulging: Leaded glass expands and contracts due to temperature changes that cause the solder joints to loosen or fail. Without the right support, windows slowly start to buckle under their own weight. Minor forms of sagging and bulging are to be expected, but a bulge exceeding 1.5 inches (38mm) out of plane is cause for concern. Look out for cracked glass and bulged areas that move when gently pressed.*



MAINTENANCE

Proper, regular maintenance of stained glass can help prevent or delay the need for expensive repairs or restoration in the future. A good maintenance plan includes documentation, inspection, and cleaning.

- *Documentation: Include historical research, descriptions and measurements, and photographs. Keep paper copies off site, in case of fire or other damage, and back up digital copies on an external drive.*
- *Historical research: Make better-informed decisions by learning when and where the glass was produced (USA or imported), when the window was installed (original to the building or added later), as well as major alterations made. Resources can include the local library, municipal or county building department records, local newspapers, church directories, and vestry or council meeting minutes.*
- *Descriptions and measurements: Include observations from the interior and exterior of the building, word-by-word inscriptions, and preservation issues or concerns. Any conjectural information should be labelled as such. Include measurements of the glass panels, the frame, the window, and anything else that may be relevant.*
- *Photographs: Crucial preservation documents, photographs should include overall shots of the stained glass and of each panel. With restoration work, include photographs of ongoing restoration, of panels after restoration work is complete, and of overall shots after the window is reinstalled.*
- *Inspections: Inspections by the property custodian should be conducted yearly, and a professional assessment conducted by a specialist every 3 to 5 years. These inspections can help detect issues at an earlier stage, which could lead to significant savings in the longer term. Keep records of all inspections. It is recommended to mark conditions with dates on photographs.*
- *Cleaning: All cleaning should be done with the utmost care, in a controlled and focused manner. For fairly clean glass, cleaning can be undertaken twice a year. Windows should be gently dry-wiped with a soft cloth on a monthly basis. Any heavy-duty cleaning should always be done by a professional.*



Use a soft cloth or cotton swap to carefully clean a window from top to bottom.

Source: Stéphanie Machabée.

- *Be especially careful with painted glass. Always test a sample area first. If cleaning poses further risk of deterioration, do not clean and note it in the stained glass documentation.*
- *Products: The first step is to use only water to clean the glass. Soft water is preferable, as well as deionized water for especially significant glass. If ineffective, the next step is to use a non-ionic detergent, such as Ivory or Dawn. Alcohol or solvents can be used for especially stubborn grime. Cleaning products should have a neutral pH. If unsure, consult a stained glass specialist.*
- *Techniques: Do not spray the surface directly. Instead, spray a soft cloth or cotton swab with water or cleaning product and clean the window from top to bottom. Using a damp cloth, ensure all chemical products are rinsed off with clean water, taking care to not reuse water as it can redeposit chemicals on the glass surface. Wipe the glass dry with a soft cloth. Be mindful of tears in the came or sharp edges on solder joints that could snag on cloth and cause more damage. Do not scrub metal surfaces with abrasives or wire brushes.*



REPAIR

Repair typically refers to on-site work that addresses minor preservation issues. Examples of repair include: securing loose braces, addressing minor glass cracks or breaks, and replacing old, dried-up putty.

There are three primary techniques for repairing glass:

- *Epoxy edge-gluing: It produces a nearly invisible line and resins can be tinted with pigments to match glass color. However, this should only be done by a professional, as it is the least reversible option. It is also the most time-consuming and expensive of the techniques, and it deteriorates in sunlight.*
- *Silicone edge-gluing: It is an easily reversible and typically less expensive technique, and resins can be tinted with pigments to match glass color. However, it has the lowest strength of the three techniques and is sometimes visible.*
- *Copper foiling: This technique involves applying a thin adhesive copper tape along the side of each glass piece, which is trimmed to minimal width on the faces and then soldered. It produces a strong, reversible repair with negligible aesthetic impact. However, this technique should not be used on unstable glass, for it requires heat which can further damage the glass.*

It is always preferable to repair windows in their original settings. However, many issues cannot or should not be addressed on site, such as when the window is bulging or sagging far out of plane, when over 5% of glass is broken, or when solder joints are failing. Such issues will require the removal and treatment of the stained glass by a professional, to be restored in a studio



RESTORATION

Restoration typically refers to off-site work that addresses larger preservation issues or that requires the use of special equipment.

Examples of restoration include: releading (replacing the cames) and more significant repair or replacement of broken glass.

- *Restoration work involves removing, crating and transporting the window to the studio; documenting the work with photography, rubbings, and measurements; taking the window apart piece-by-piece; conserving; and reassembling. The work may take weeks or months to complete.*
- *Vacant openings will need to be weathertight for the duration of the restoration work. Plywood, acrylics, or polymer film can be used to cover the opening.*
- *When selecting a professional for restoration work, approach at least three different firms. Look for accredited members of the Stained Glass Association. Ask the studio about their history of working with stained glass and observe their conservation work in studio. Ask for references and follow up, inquiring about timely completion, cleanliness, communication, and satisfaction level.*
- *Ensure bids are as detailed as possible. The professional should provide itemized costs and services, specification sheets, detailed plans for removal and re-installation, and schedule.*
- *The studio should provide a certificate of insurance listing compensation, general liability, and any other type of insurance specified by local code. Purchase further insurance against damage caused in the transportation process.*



Releading of stained glass in a professional studio.

Source: Conrad Schmitt Studios.



Professional restores a stained glass window in studio.

Source: Conrad Schmitt Studios.

Remember: The less one intervenes with stained glass, the better! Windows are imperiled when removed from their frames. A good maintenance plan can help minimize future repairs and restoration work.



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ABOUT NCPTT

The **National Center for Preservation Technology and Training (NCPTT)** is the leading research, technology and training center within the National Park Service.

NCPTT helps preservationists find better tools, better materials, and better approaches to conserving historic buildings and landscapes, archaeological sites, and museum collections. It conducts research and testing in its laboratories, provides cutting edge training around the U.S., and supports research and training projects at universities and nonprofits. NCPTT pushes the envelope of current preservation practice by exploring advances in science and technology in other fields and applying them to issues in cultural resource management.

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