



# BOVARD STUDIO INC. INTRODUCTION

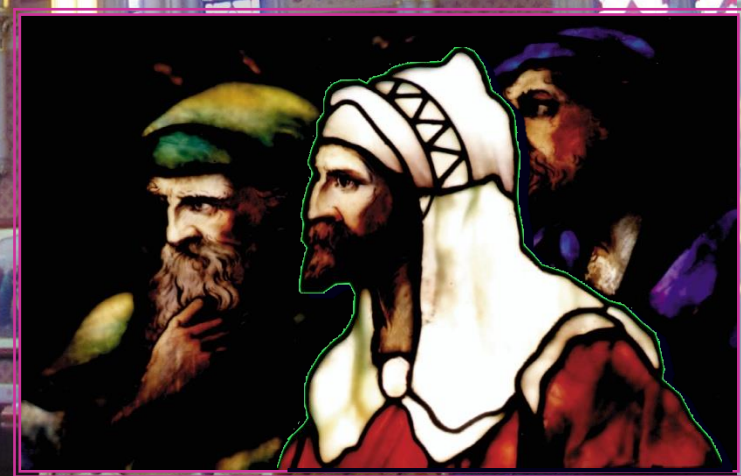


St. Peter's Church  
San Francisco  
California



Thirty eight of 46 of St. Peter's stained glass windows  
 Boushrock windows were leaded and restored by Bovard  
 Studio Inc. Bovard Studio Inc. is a family owned and operated  
 company with over 30 years of experience in the stained glass  
 industry. We have a large inventory of leaded glass and  
 windows and are able to fabricate and install leaded glass  
 windows in a variety of styles and colors. We also have a  
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Courthouse in Evansville, Indiana.  
 and fabricated and installed laminated tempered glass  
 Reid Memorial Presbyterian Church, Richmond, IN  
 Complete Set of Tiffany Stained Glass Windows  
 Restored by Bovard Studio Inc.





Course Title:

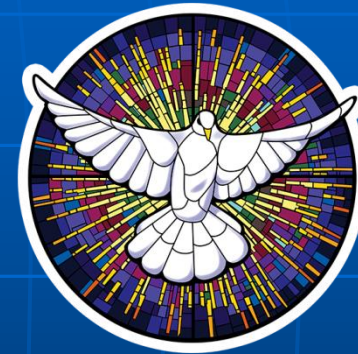
# **“RESTORING, MAINTAINING, AND REPAIRING STAINED GLASS WINDOWS”**

Course Number: MSP1909

Company Name: **BOVARD STUDIO, INC.**

Speaker Name: **RON BOVARD**

Presentation Date: MAY 16, 2019



Provider:

**CONFERENCE FOR CATHOLIC FACILITY MANAGEMENT**

Provider Number: G460

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BOVARD



STUDIO



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# COURSE DESCRIPTION

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This course will define the restoration of stained glass versus the repair and maintenance of stained glass. Participants will also learn why stained glass windows fail; what comprises stained glass restoration and the techniques used; how to properly design protective covering systems; how to document the restoration process; and the safety and environmental exposures and practices for leaded stained glass restoration.

# LEARNING OBJECTIVES

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At the end of the program, participants will be able to do the following using illustrations and explanations:

1. Differentiate between the repair and restoration of stained glass windows
2. Identify main causes of stained glass window failure
3. Understand the correct design for exterior glazing and window frames for stained glass windows that will preserve the client's stained glass heritage
4. Complete a cursory report on the condition of stained glass windows, and execute the safety and environmental exposures and practices for leaded stained glass restoration

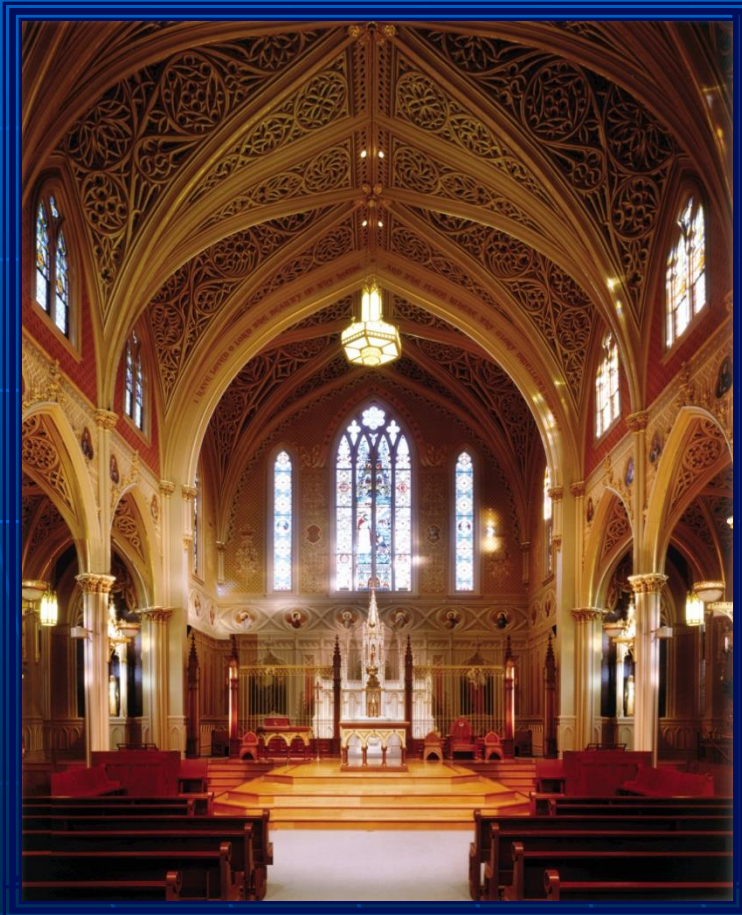




# HISTORIC STAINED GLASS WINDOWS

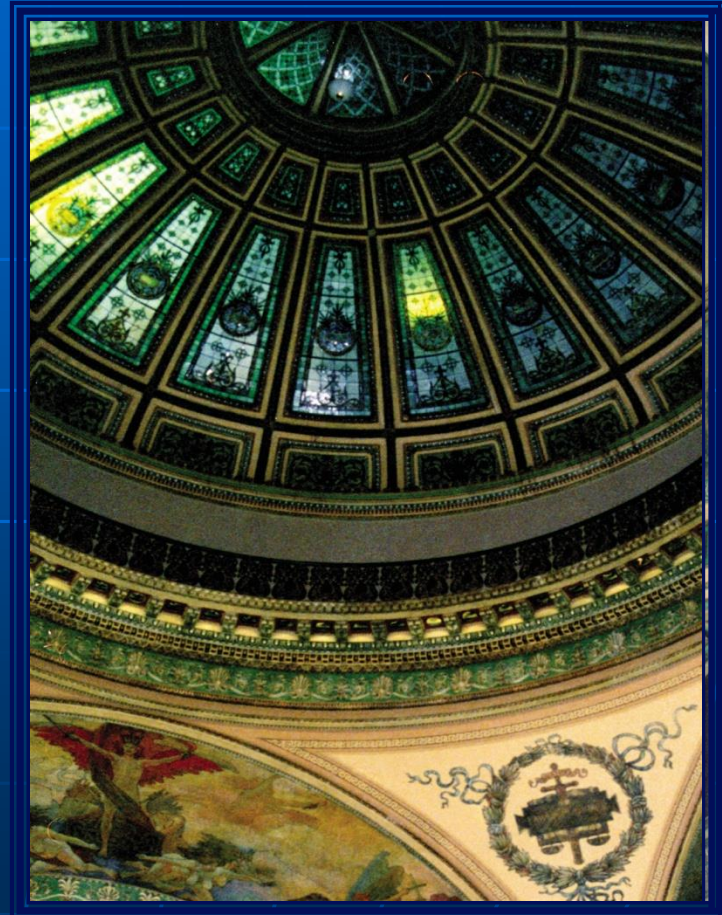
40,000 sq. ft. facility at 2281 US-34,  
Fairfield, Iowa

Restoration vs. Repairs



ST. PETER'S, SAN FRANCISCO, CA

Restoration is to make like new



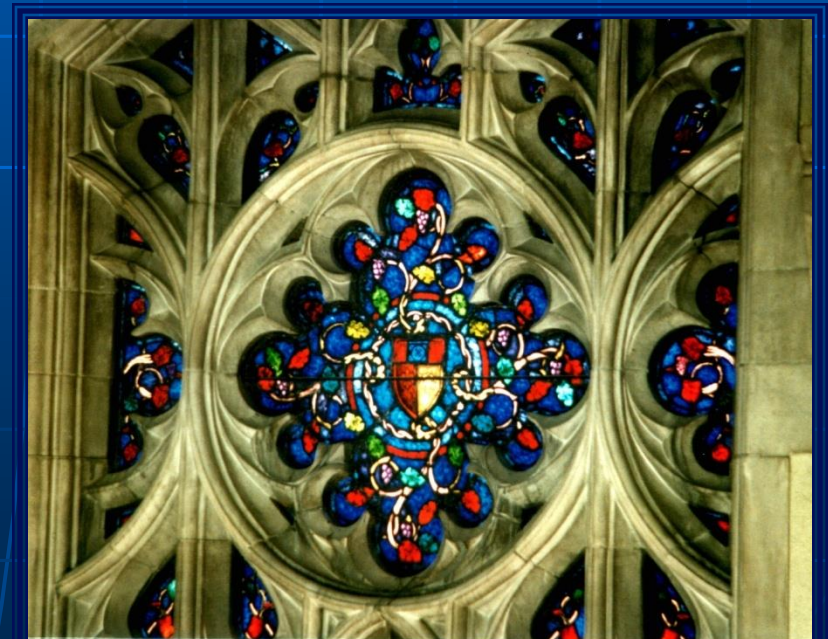
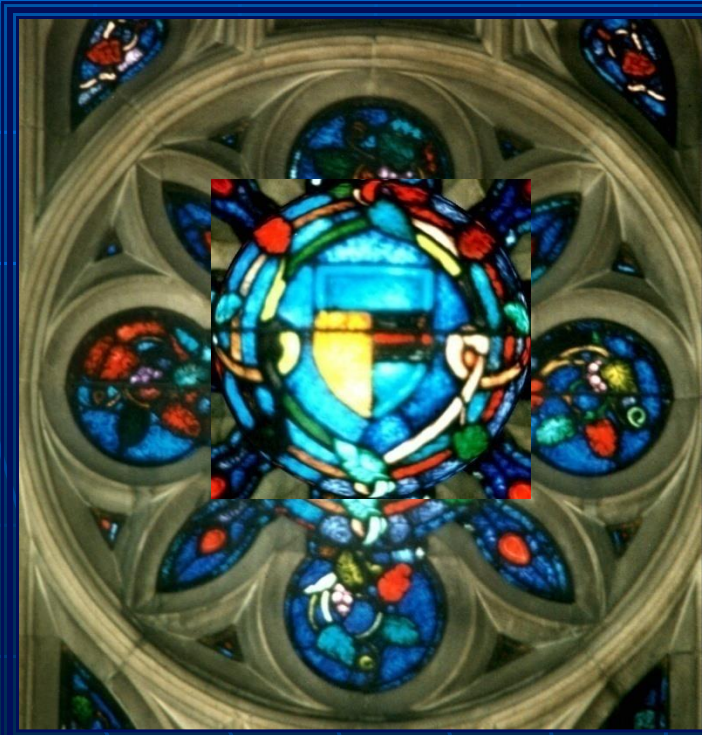
ALLEN COUNTY COURTHOUSE, FT. WAYNE, IN





## RESTORATION –RELEADING WHY DO WINDOWS FAIL?

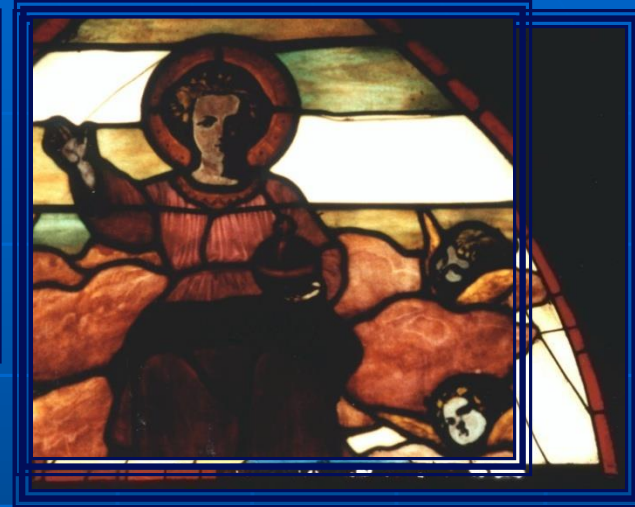
- Age and Materials
- Structurally weak design
- Oversized panels -- Panels over about 12 square feet are prone to failure
- Improper reinforcing system
- Stained glass windows with many small panes are weak and, in designs like concentric circles, are prone to premature bulging







# STRUCTURAL ELEMENTS AND TECHNIQUE



- Small straight rows of rectangular or square glass panes and diamond patterns are prone to bulging, unless they are fabricated into a special woven lead matrix tucked and soldered to the heart of the lead came
- Improperly designed exterior glazing systems lead to premature failure



- Paint failure from improper kiln firing of glass, unstable formulas, or washing stained glass windows with acid based cleaners such as vinegar





## Lead Came

Many American stained glass windows through the 1950's were made with pure drawn or milled lead. This lead usually lasts 70 to 100 years before serious metal fatigue sets in. Drawing or milling can stress the pure lead.



Europe's great cathedral stained glass windows were made with cast lead with impurities (trace elements). Some of the lead in these stained glass windows lasted much longer than those made with pure drawn or milled lead.

The most prestigious cathedral, Ely Cathedral, first half of the twelfth century, England.





## DAMAGED LEAD CAME

Today we call some of these impurities alloys (tin antimony, silver, copper). We add them on purpose. We extrude our lead. Pure drawn or milled lead has an elongated molecular construction, which results in lead that is less subjected to expansion. Extruded lead has a greater density of construction and is subject to greater expansion than pure drawn or milled lead; therefore, it must be stretched prior to use in a stained glass window to prevent premature bulging.



### Symptoms of failure:

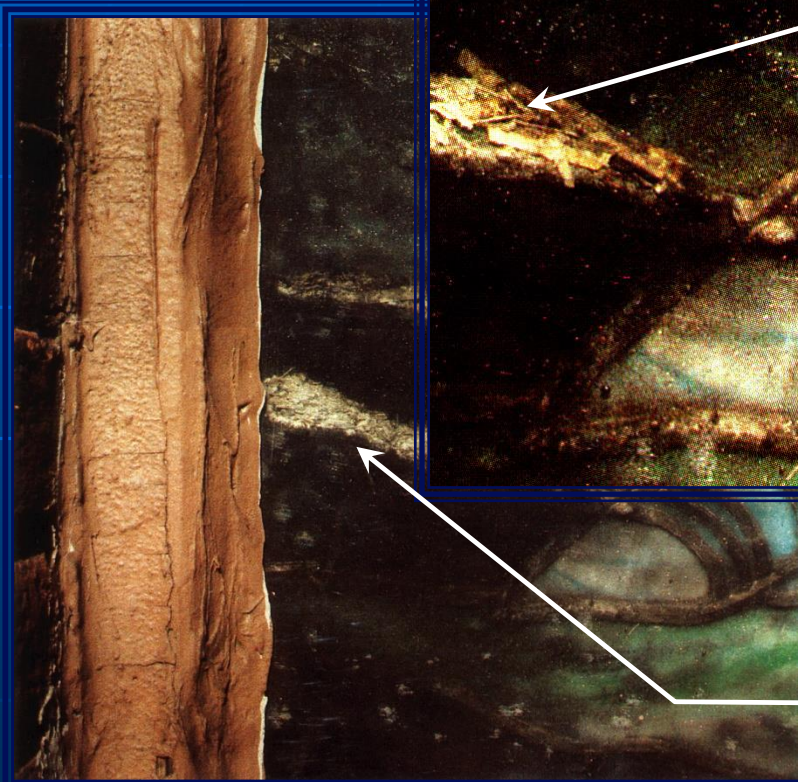
- Cracked and broken solder joints
- White powder on the surface of the lead (oxidation)
- Cracks in the surface of the lead came
- Expansion and contraction cycles can cause deflection of the flute...(bulging)
- Serious deterioration of glass painting

**Note: Preserve as much of the historic stained glass as possible when releading**





## WHAT DAMAGES LEAD ?



**This damage is from improperly designed and installed protective and exterior glazing systems**

Condensation moves from inside the stained glass window to the space between the stained glass window and protective covering. Bacteria grows in the hygroscopic dust, secretes acid, attacks wood, metal, glass, etc.

The white smudge at the left center of this panel used to be lead came. When the unvented protective glazing was installed, it was placed flush against the stained glass. In cold weather, water condensation accumulated in the air space and oxidized the lead to powder.





# WHY STAINED GLASS WINDOWS BULGE ?

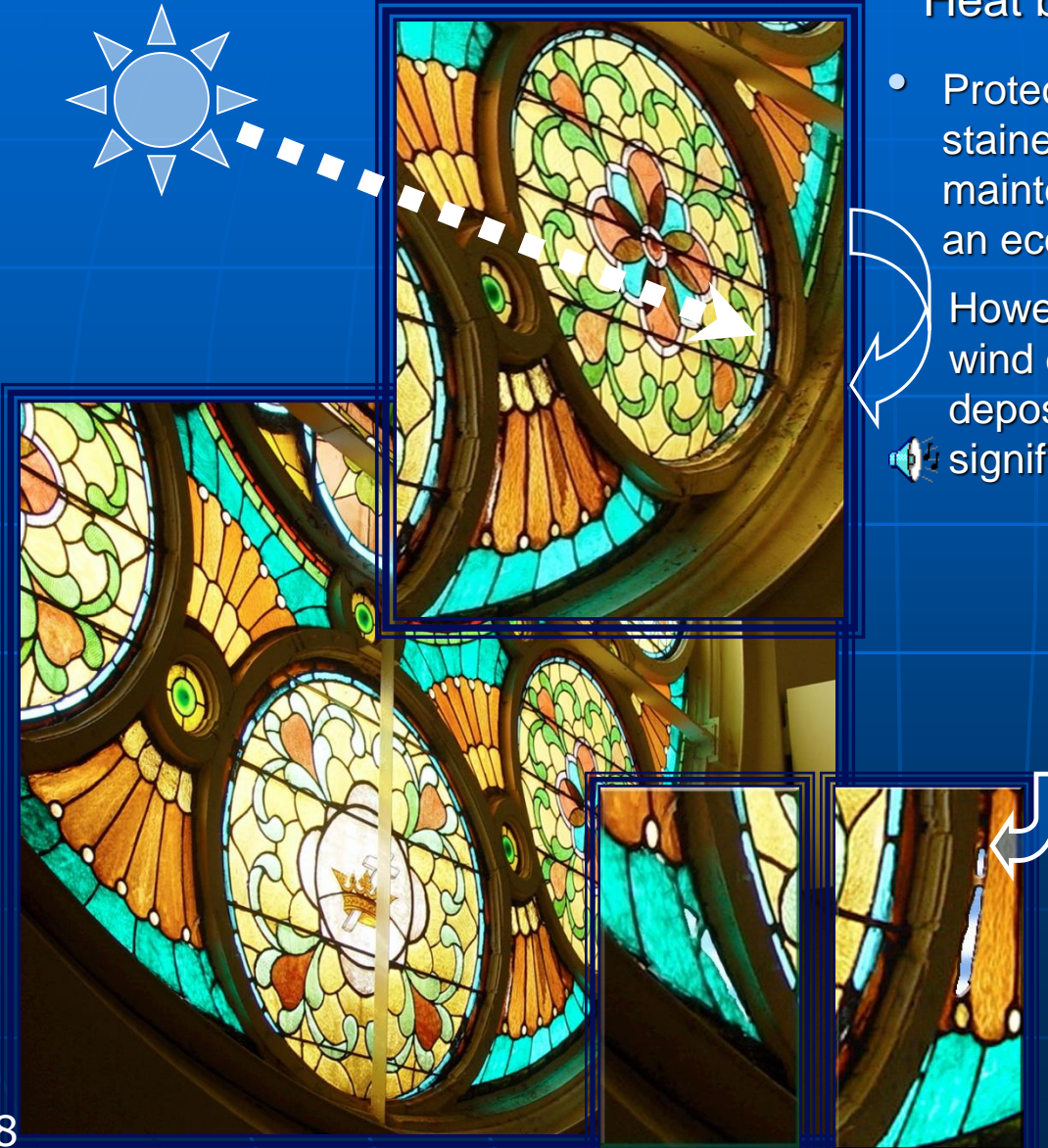
Heat build up

- Protective covering does not conserve stained glass windows, is not a substitute for maintenance, repair and restoration, and is not an economic benefit in terms of R-value.

However, stained glass windows leak in wind driven rain and condensation deposits water into the building along with significant air infiltration.

- Designs with concentric circles, diamonds, and other grids made with flat came, are weak if not tucked and woven. Half round lead has more strength.

- Lead came has a low modulus of elasticity and must be stretched prior to use. If not, it will contribute to premature bulging.

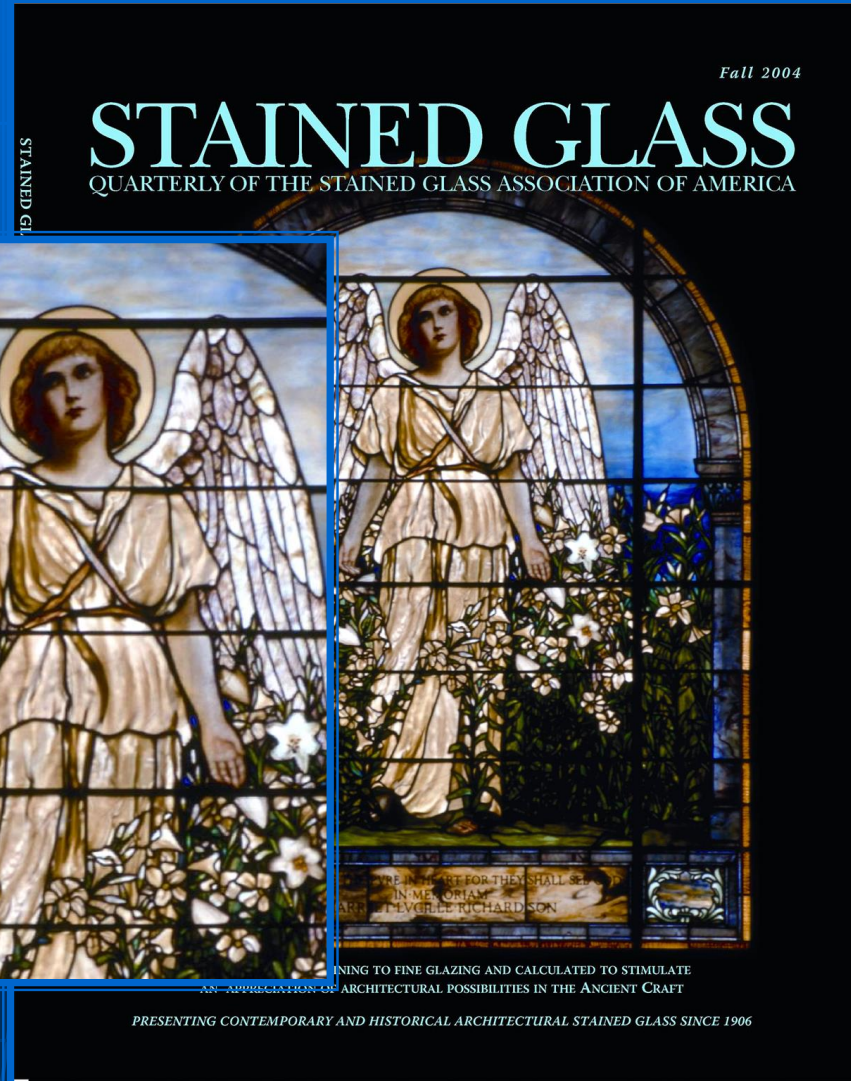
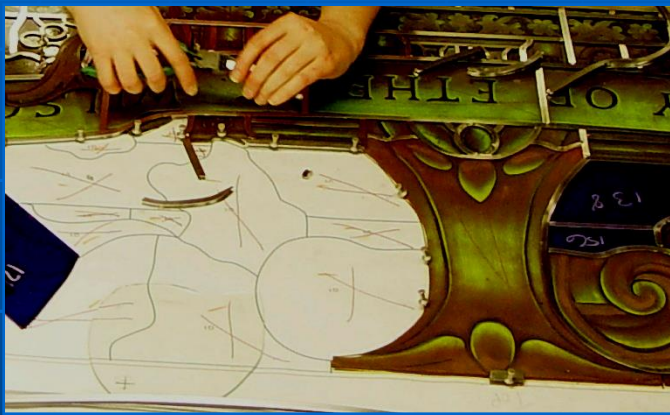






# RELEADING

- Releading is the disassembly, cleaning, and rebuilding the stained glass window with an all new lead matrix, conserving the original stained glass.

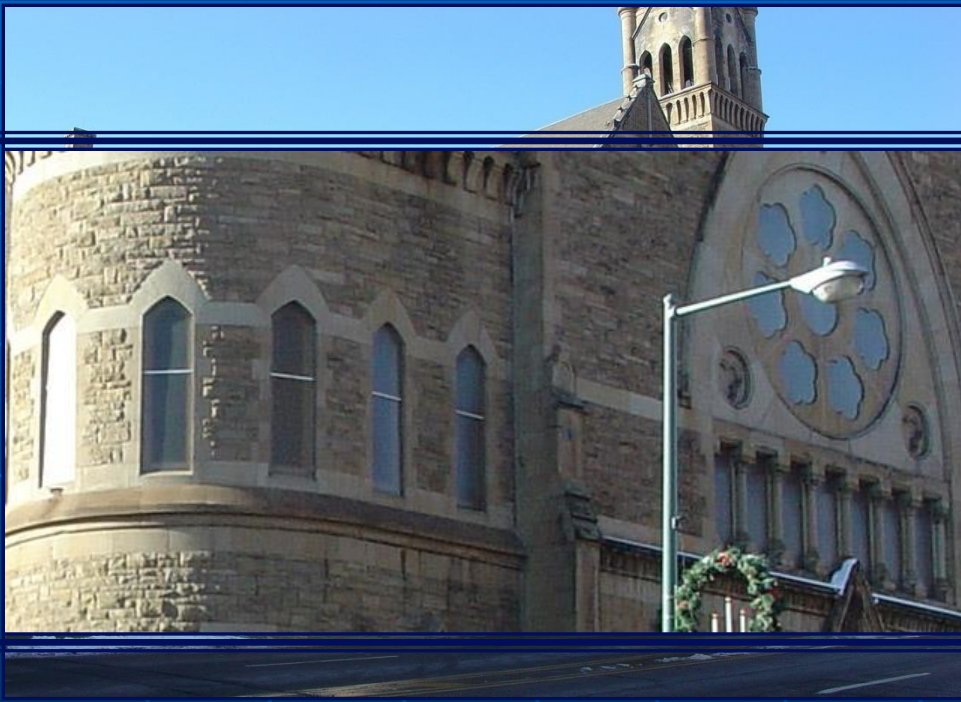






## NATIONAL PRESERVATION STUDY

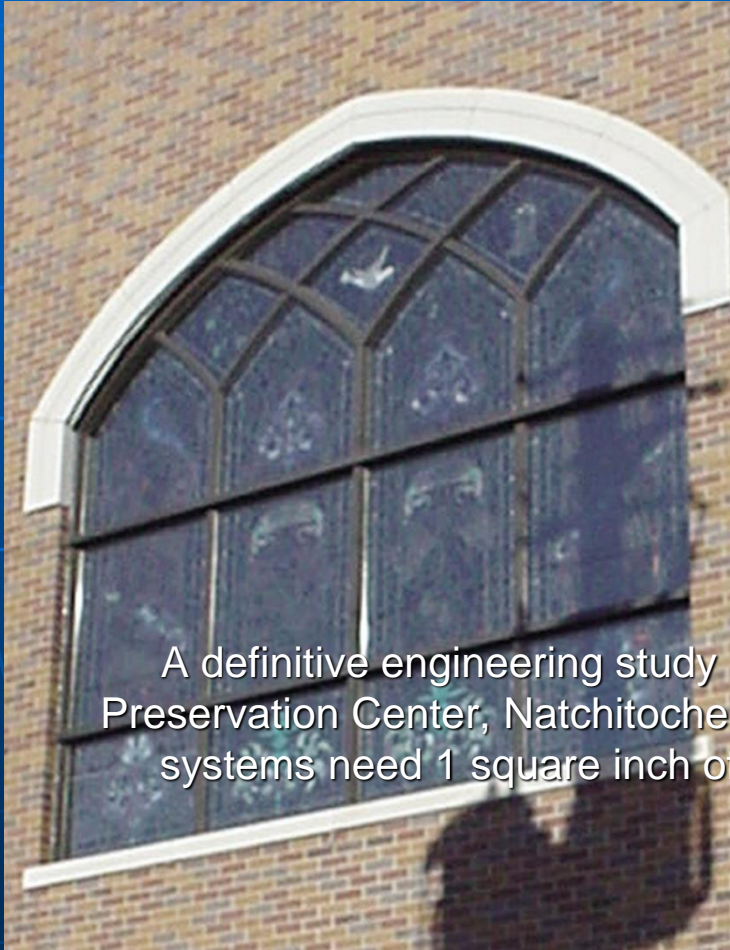
According to a 1996 study for the National Preservation Center in Natchitoches, Louisiana



More damage has probably been done to stained glass windows from improperly designed exterior glazing, or protective covering systems than from all the fires, vandalism, and storm damage combined. Poorly designed protective covering systems also detract from the architectural integrity and beauty of the building.



## WHY PROTECTIVE COVERING?



People are not used to water from condensation and leakage in their buildings today. There is no going back to single-glazed systems for most clients.

Properly designed protective covering systems protect stained glass from vandalism and storm damage.

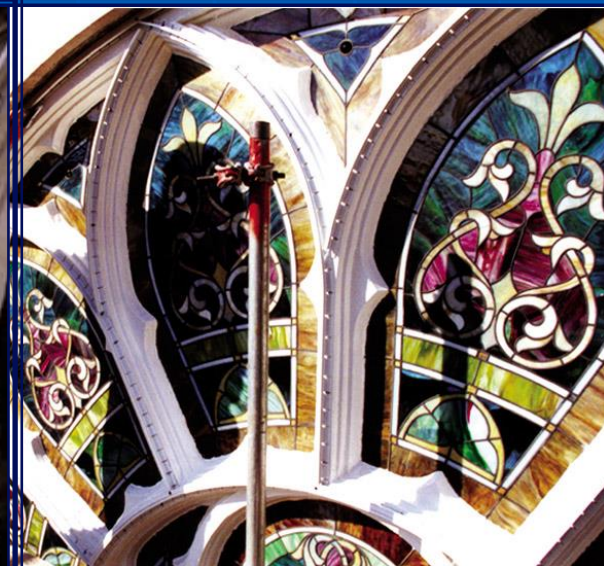
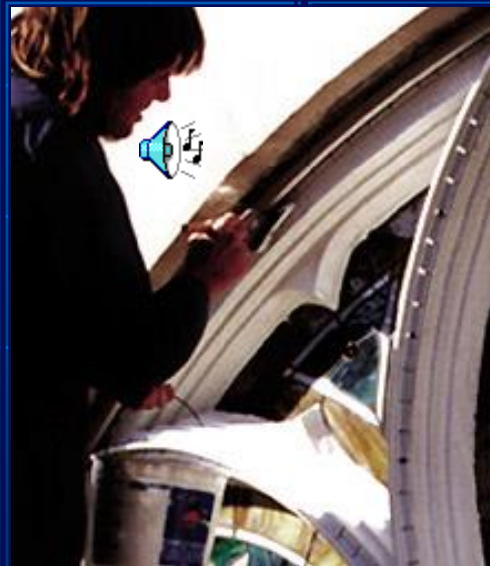
A definitive engineering study on protective covering, June 30, 1996 for National Preservation Center, Natchitoches, Louisiana, shows stained glass protective covering systems need 1 square inch of venting for every 16 square feet of stained glass.





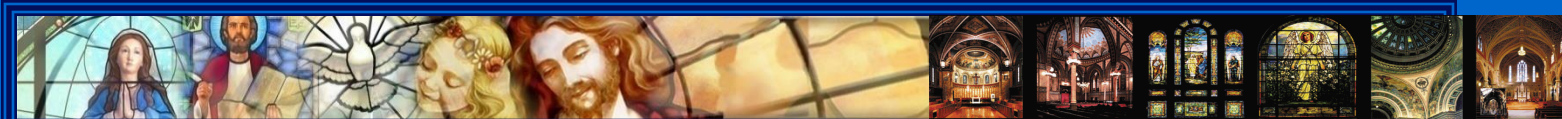
## PROTECTIVE COVERING FOR STAINED GLASS WINDOWS

It is important to design the protective covering with proper venting for conservation of the stained glass window and to compliment the window frame to preserve the architectural integrity and beauty of the building.



**Above and left:** First United Methodist Church, Iowa City, Iowa installation of the protective covering framing bent to match the original wooden stained glass window frame.





# VENTING NEW THERMAL BARRIER ALUMINUM AND WOOD FRAMES



Above: Air flow with bug screen and rain guard Precision Flow® ventilation systems in our new wood frames.



Above: Our Precision Flow® aluminum thermal barrier framing system designed to hold stained glass windows and insulated glass units.



**U.S. Patent #7,607,267 B2**

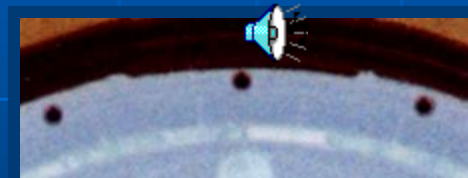




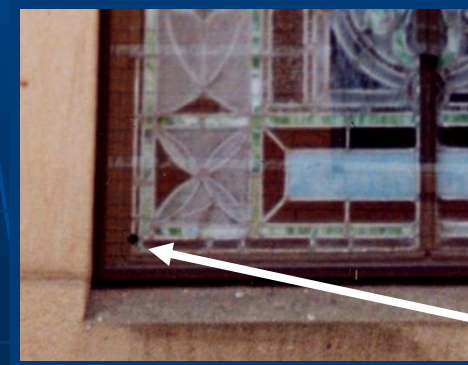
## AFTER MARKET VENTING



Vent with bug screen and rain guard added.



- You add ventilation to your existing protective glazing system.
- Replace loose sealant as required.
- Clean glass or plastic with appropriate cleaners.
- Retain weep system at base of protective covering.



Vent







## WOOD FRAMES

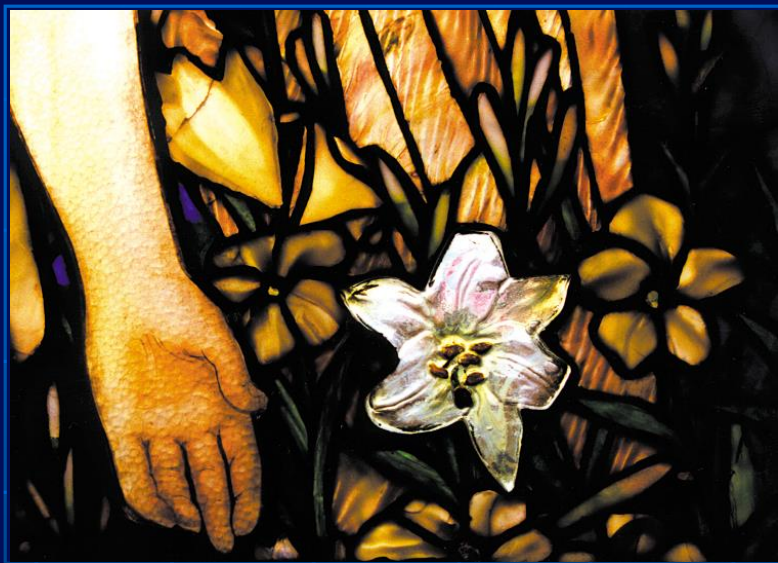


**New and replacement frames should be made from a mahogany type of wood, the heart wood of eastern white pine or equivalent 100 year rot resistant wood.**



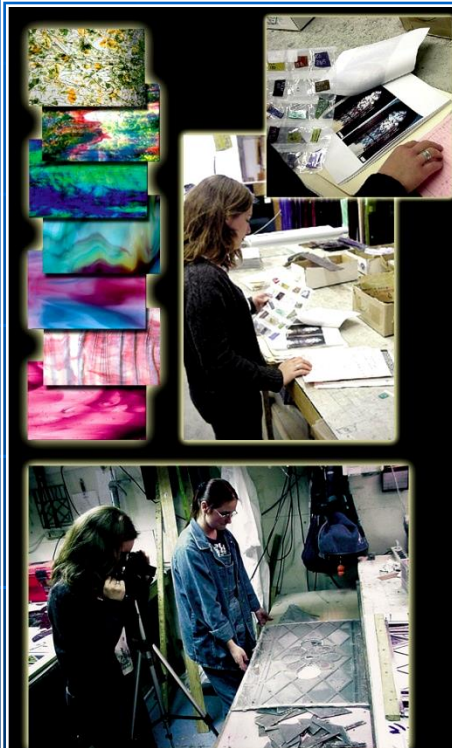


# CLEANING MAINTENANCE



Cleaning stained glass windows:

- Tiffany window with 7 layers of glass requires
- Use Ph neutral soap such as Triton X or Orvis horse
- ✓ Disassembling the
- Never use a cleaner with vinegar (attacks glass paint) or ammonia (in the long term corrodes lead)
- ✓ ingredients
- ✓ Reassembly



TESS BOVARD AND CARRIE THOMAS TAKE PHOTOGRAPHS OF EACH STAINED GLASS PANEL OF THE DAMAGED WINDOWS IN THE RESTORATION PROJECT. DOCUMENTING THE DAMAGED WINDOWS CURRENT PHYSICAL STATE AND APPEARANCE.





## FRAME & PANEL STRUCTURE MAINTENANCE & REPAIR

- Reputty where putty on T-bars or window frame is loose or missing.
- Keep frames rust free and painted.
- Replace or restore rotted wood.
- Replace loose or missing glazing cement.
- Keep reinforcing bars attached to the stained glass window.



FIRST PRESBYTERIAN CHURCH, DAVENPORT, IA





# STAINED GLASS MAINTENANCE & REPAIR

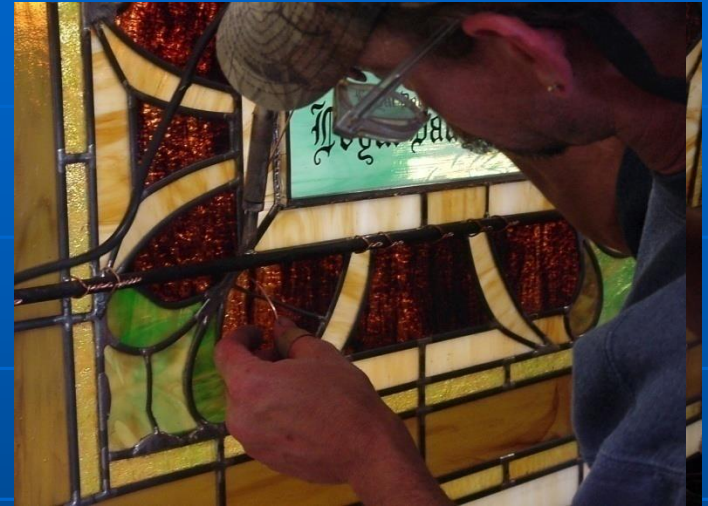


- Replace broken and missing stained glass panes
- Repair cracked panes
- Reattach loose reinforcing systems
- Recement stained glass window
- Touch up deteriorated sections of glass painting in place with cold paint
- Flatten and shore up bulged areas in a stained glass window when the lead came is in good condition





# RE-ENFORCING BARS & BROKEN GLASS



Replace Reinforcing Bars



Replace broken glass panes





# DOCUMENTATION

**Documentation includes:**



- **Photographing the windows**
- **Measuring panel sizes**
- **Measuring rebar placement**
- **Determining lead sizes**
- **Taking glass samples**
- **Selecting glass**
- **Making rubbings**
- **Making material list**







# CAUTION -- THE MAIN INGREDIENT IN TRADITIONAL GLAZING CEMENT IS LEAD OXIDE



LEFT: Glaziers cementing a panel from St. Luke's Tiffany "Job" stained glass window.

Right: A Craftperson performs the final cleaning after reinstallation of Tiffany's "Job" window at St. Luke's United Methodist Church in Dubuque, Iowa.







## SAFETY AND ENVIRONMENT



### Recycle Lead



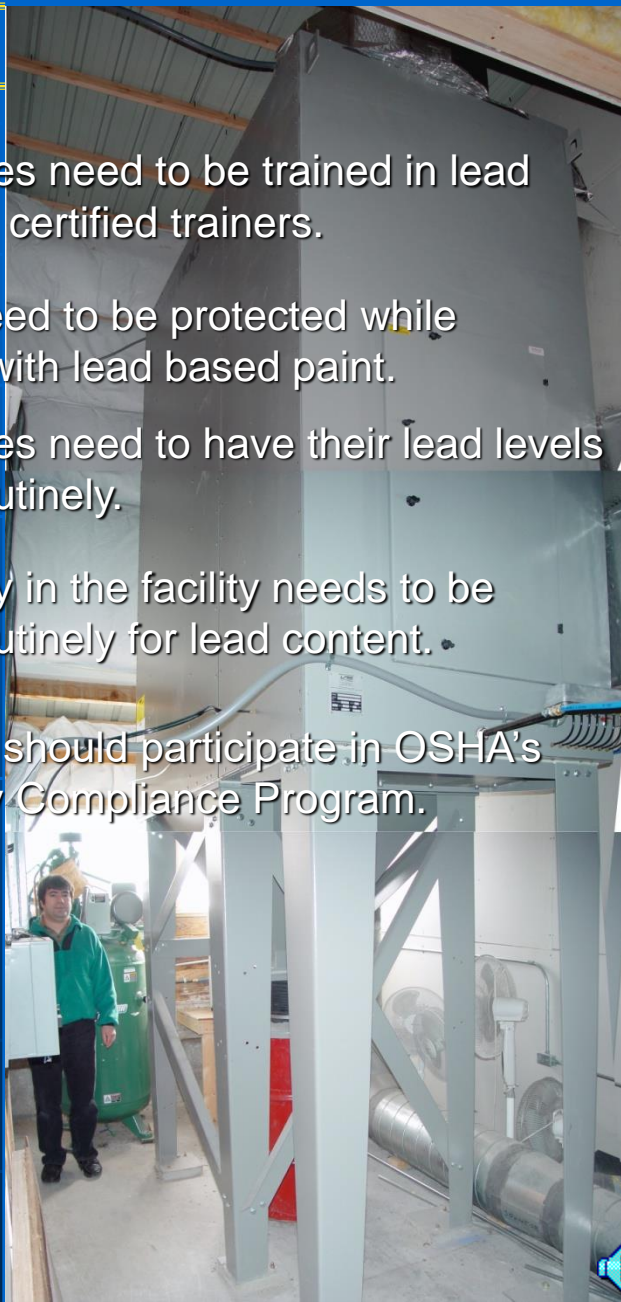
- The traditional glazing cement ingredient is lead oxide.
- Disassemble in soak tank to keep the lead oxide from being airborne and breathed by craftsman.
- Used water is stored and shipped to toxic waste water treatment facility
- Client is ultimately liable for proper disposal of lead.
- Passing the middle man (salvage companies) assures there is no mishandling. We have shipped 14,000 lb. of scrap lead came directly to the lead smelter in New York State in the past.
- This protects the studio and the client from very large E.P.A. fines for improperly disposing of lead.



## PAINTING DEPARTMENT



- Employees need to be trained in lead safety by certified trainers.
- Artists need to be protected while working with lead based paint.
- Employees need to have their lead levels tested routinely.
- Air quality in the facility needs to be tested routinely for lead content.
- Facilities should participate in OSHA's Voluntary Compliance Program.







# MINNEAPOLIS, MN City Hall Stained Glass Restoration by BENEFITS OF BOVARD STUDIO, INC. STAINED GLASS



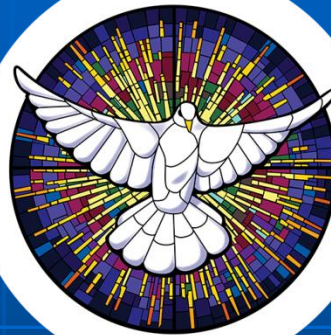
- 60 Talented Stained Glass Craftspeople, Artist, 2 Engineers and Staff Resulting In Top Quality Craftsmanship and Produce Performance.
- The Staff Have a Proven Track Record and Experience To Complete Complex Restoration Projects On Schedule
- Courtroom Cleaning and Timely Service
- Patented Framing and Protective Covering Systems To Conserve Stained Glass
- Accurate Master Spec Program
- Safety and Environmental Safety Programs To Protect Our Employees and You and Your Client From Liability.

This concludes The American Institute of Architects  
Continuing Education System course.

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**BOVARD**



**STUDIO**

Ron Bovard  
800-452-7796

Conference for Catholic  
Facility Management  
("CCFM")



Contact Information:  
Andrew Guljas  
(317) 525-7176