

Specifying Stained Glass

Stained glass is a general term covering all forms of glass used in a decorative manner, primarily for windows, but also for a myriad of secular uses prevalent today.

Inasmuch as the stained glass craft is an adjunct of architecture, this Association favors the principle of architectural direction in the selection of artisans or studios and the commissioning of stained glass projects.

Products of SGAA artisans are ideas and concepts that are translated into site-specific designs satisfying the requirements of the project, budget and schedule. We believe that project success is better assured when a studio is selected not on the basis of a "square foot" bid but rather by virtue of artistic ability, imagination, past success and, of course, willingness to work within the project constraints of time and money. Consultation and design-progress review with the architect, client and artisan should take place before construction documents are complete. Early and regular review sessions are welcome; such will save time and prevent the needless cost of design adjustment.

Therefore, we believe that ideal conditions fostering mutual confidence and the best practical procedure will prevail when only one craftsman studies the problem with the architect and client. Should such a craftsman fail to provide a satisfactory solution, we believe that he should withdraw, thus permitting another craftsman to fully cooperate with the client.

If the prospective client wishes proposals from more than one craftsman, we earnestly recommend the following procedure:

1. A personal discussion is held with each craftsman invited that determines the client's likes and dislikes,

and to arrive at a general theme and style. If a special sketch is required, the artist will then be able to create the appropriate design.

2. The client makes known any budget restrictions. Any one of our members will gladly assist in setting up a practical budget.

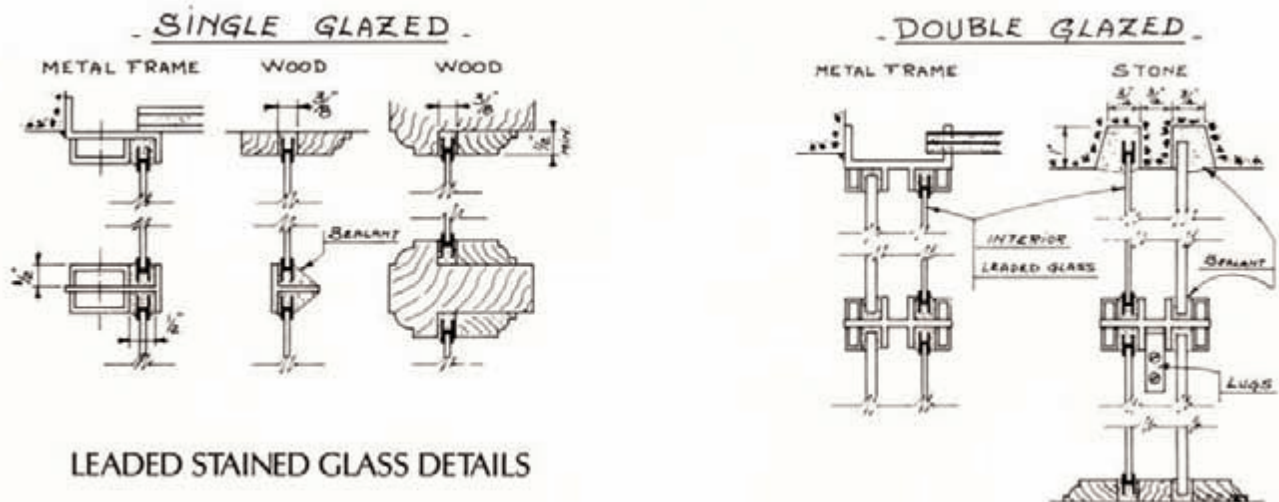
3. The names of the craftsmen invited to make proposals are made known to all concerned.

Consultation between architect, client and craftsman should begin before contract documents are finalized. Early cooperation will assure a well-integrated design that considers all architectural, structural and interior building elements.

Historically, SGAA artisans prefer that their agreement be directly with the client, fully separated from the general contract; however, all are vitally concerned with the full satisfaction of the client and can adapt their process to fit the project.

Leaded Stained Glass

The Process: The preparatory sketch is translated into full-size mechanical drawings (cartoons) and further into actual patterns to be used to cut the glass. Once the patterns have been prepared and assigned color, the glass is cut into the myriad pieces required to build the window. When the design requires detail painting or ornamentation of the glass surface, it must be done with pigments designed specifically for stained glass. Once applied, the pigment is fired in a kiln to the proper temperature for the respective pigment, usually between 1000 and 1250 degrees Fahrenheit, thus assuring absolute permanency. The pieces of glass are joined together with lead came (H-shaped strips) and soldered at their intersections on



LEADED STAINED GLASS DETAILS

both interior and exterior surfaces of the assembled panel of stained glass. Varying widths of lead came are often used to add to the window's decorative effect as well as enhance its strength.

To prevent leakage, a mastic waterproofing material is inserted between the glass and the flange of the lead came. This process, often called "cementing," is required on both interior and exterior surfaces of the panel and is paramount in weatherproofing as well as stiffening the panel. It is recommended that panels be stored on a flat surface for a minimum of two weeks prior to installation, thereby allowing them to properly cure.

Reinforcing bars, regardless of the type, are typically fastened or mechanically engaged at regular horizontal intervals to the frame, sash or other substrate into which the panel is installed. These surface-applied bars further strengthen and support the installed panel of leaded stained glass. Round bars usually measuring $\frac{3}{8}$ inch in diameter, tied to the panels with twisted copper wires, are the most flexible and resilient, and therefore allow for the greatest amounts of thermal movement. Where this system is not suitable, galvanized-steel flat bars can be soldered directly to the surface of the leaded glass panel.

Installation: It is recommended that leaded glass be installed into frames designed specifically for that purpose.

Various types can be considered and include wood, aluminum, steel, bronze and stone. Regardless of the type, the most important consideration is that they are capable of supporting the unique qualities of the type of stained glass that is being installed. When possible, glazing beads should be used in conjunction with modern, flexible sealant systems to allow for flexibility as well as mechanical engagement of the installed panels of glass.

The stained glass studio should be consulted as to the best type of frame for the project at hand, the location and placement of division bars, and mullion configuration that will work best with the intended design. This information should be finalized prior to ordering the window frames or sash (usually supplied by the general contractor on a new building) into which the stained glass will be installed.

In general, the type of frame selected needs to be capable of supporting stained glass weighing approximately four pounds per square foot and configured with mullions, allowing sub-division of larger areas into panels of approximately 12 square feet or 14 linear perimeter feet. In addition to the overall structural requirements, the frames or sash must include a glazing rebate that measures $\frac{3}{8}$ " to $\frac{1}{2}$ " wide by $\frac{3}{8}$ " to $\frac{1}{2}$ " deep and allows the panels of stained glass to engage into the frame or sash a minimum of $\frac{1}{4}$ ". An allowance of $\frac{3}{32}$ " to $\frac{1}{8}$ " between the stained glass panel and the frame is typical.

Glazing Sealant: It is highly recommended that all sealant be of the non-acetic gas-forming or neutral-cure variety and that it be chosen based on the composition of the materials and substrates to be sealed. Appropriate bond-breaking tape and ethafoam backer rod should be used as required to achieve the flexibility necessary for expansion and contraction of the finished installation.

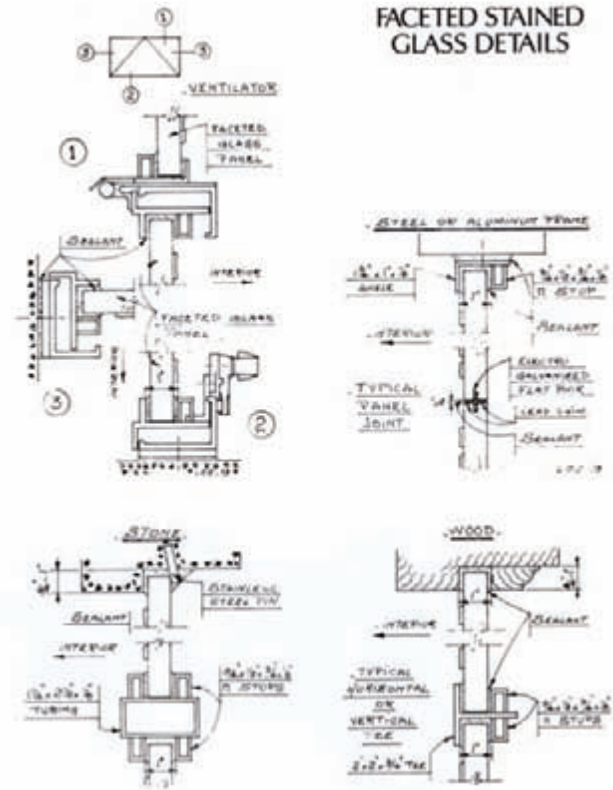
**Faceted Stained Glass
(Dalle de Verre)**

Process: A twentieth-century innovation in the art of stained glass introduced the use of glass dalles measuring approximately 8" x 12" x 1". These dalles, cast in hundreds of colors, can be cut into shapes and used, in combination with an opaque matrix of epoxy resin $\frac{5}{8}$ " to $\frac{7}{8}$ " in thickness, to create translucent windows and walls of great beauty.

The epoxy used in the casting of faceted glass panels must be a specially formulated slab-glass-setting compound consisting of epoxy resin and hardener. The material must be able to withstand temperatures of +130 degrees Fahrenheit on the exterior surface and a simultaneous +70 degrees Fahrenheit interior surface (air conditioned), and allow for humidity changes of 6% to 100%. In addition, cast panels must be water resistant on tests of 25 lbs. per square foot static air pressure while $2\frac{1}{2}$ gallons of water pass over the surface of the panel for one hour.

The design and physical opening size determine size limitations. However, individual panels should not exceed 16 square feet. The height to width of a single panel should not exceed a 4:1 ratio. Large openings must have horizontal supports to carry the weight of the stacked panels. Thickness of the epoxy matrix should not be less than $\frac{5}{8}$ " for unstacked panels. When they are to be stacked, a minimum epoxy thickness of $\frac{3}{4}$ " is recommended, with the joints between the panels sealed with a flexible glazing sealant.

Installation: Faceted glass can be installed in openings and mullions of masonry, metal or wood, provided that the system is designed to receive the thicker panels and carry the



load of approximately 10 to 13 pounds per square foot. The stained glass studio should be consulted well in advance of finalizing the contract documents for the appropriate frame type for the project and location of any division bars and mullions, so as to coordinate them with the design before ordering frames or sash.

Clearance of $\frac{3}{16}$ " is recommended between the frame or substrate and panel edge to allow for proper expansion and contraction of the completed panel. Neoprene spacers (durometer 40 to 70) can be used as needed to insure proper clearance.

Glazing Sealant: Faceted glass panels should be set into a non-hardening material such as butyl, acrylic, silicone or polysulphide sealant, which should be used both as a bedding and finish bead. This will provide a weather-tight seal between the faceted glass panel and the frame or substrate into which the panel is installed. For spaces of more than $\frac{1}{4}$ " between the substrate and the panel, filler such as ethafoam is recommended under the sealant bead to allow for flexibility.

Protective Glazing

Exterior Protective Glazing: Properly made and installed leaded, stained and faceted glass does not require exterior protective glazing to make it waterproof; however, if properly installed in conjunction with stained or leaded glass, protective glazing may afford some protection against vandalism and external damage. Because of its high resistance to breakage, faceted glass does not need protective glazing. If protective glazing is to be included as part of the project, it must be decided early in the building program so that proper framing and installation details can be developed to eliminate many of the negative effects normally associated with its installation.

Clear, laminated safety glass and tempered glass are superior to acrylic or polycarbonate plastics as protective glazing. The plastics craze and yellow in relatively short periods of time, while glass remains clear, preserving a clean appearance to the building exterior.

Current research dictates that protective glazing be vented, thereby alleviating the possibility of excessive heat buildup and the trapping of condensation. The specific method of venting this enclosed space varies from installation to installation due to many diverse conditions, ranging from the type of frame system being used to the climatic conditions and microenvironment of the building. Before considering the inclusion of protective glazing, it is advised that the advantages and disadvantages as well as the appropriate installation method be discussed with the stained glass craftsman.

Protective glazing is sometimes installed as an afterthought over existing stained glass windows and frames, usually in such a fashion that is insensitive to the architecture of the building and without regard for potential harm to the stained glass. Systems of this type normally include installing the glazing material in a bed of sealant or butyl tape along with ethafoam backer rod and then face-glazing the material with a silicone sealant. This system can be detrimental to the stained glass and supporting frame and is not recommended

by the Stained Glass Association of America. In the event protective glazing over existing stained glass windows is determined to be a necessity, systems are available to safely install the needed protection with minimal disruption to the aesthetics of the building. Please refer to the Stained Glass Association of America's *Standards and Guidelines for the Preservation of Historic Stained Glass Windows* for further discussion of installation of protective glazing.

In general, protective glazing should be installed in a designed system originating concurrently with the stained glass, not included as an afterthought. When included, it should be installed in such a fashion that provides inter-cavity ventilation between the interior installed stained glass and the exterior installed protective glazing. The space between the layers of glazing should be as close to $\frac{3}{4}$ " as conditions allow. It is recommended that glazing materials, regardless of type, be a minimum of $\frac{1}{4}$ " thick, installed in a fashion that allows the material to freely expand and contract within the system and that provides for mechanical engagement of the material to the framing system.

Glazing Sealant: It is highly recommended that all sealant be of the non-acetic gas forming or neutral-cure variety and that it be chosen based on the composition of the materials and substrates to be sealed. Appropriate bond-breaking tape and ethafoam backer rod should be used as required to achieve the flexibility necessary for expansion and contraction of the finished installation.

Specifying stained, leaded and faceted glass — as well as protective glazing — can be as much of an art as the creation of the windows themselves. The requirements for installation are in most cases unique to the material and the project at hand and require considerable advance planning. The guarantee for a timely and successful project is laying the proper groundwork early on. Just as the foundation of a building dictates its strength, consulting with a stained glass artist before the building is started will lay the foundation for a cost-effective and successful stained glass project.

