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## Stained-glass windows – modern manufacturing techniques

### Introduction

Glass is a material that works well in the art of creating stained glass for several thousand years. The possibilities of operating with its clarity, color, and also a way of shaping and decorating is still an object of fascination for artists using this material. Thanks to the penetration of natural or artificial light we obtain very interesting visual effects for example optical like gleam, change of shade, or glitter. Therefore, using stained glass we can influence on the character of surroundings thus creating official or intimate atmosphere. Thanks to that they are often used in cathedrals or churches.

Stained-glass windows have their own mysterious charm that lies in the play of light in the crystal structure of the glass. Depending on the angle and intensity of light, the picture a person see can changes, this is the reason why stained-glass are amongst leading decorating techniques in architecture. The design of stained glass can be unique so that it can be used almost everywhere, harmonizing with the style of the environment.

Stained glass design was developed in the Middle Ages, but it should be remembered that these were the only sacred stained glass. In those days they played not only a decorative role, but also educating of the population unable to read. Through the pictures presented, people could be familiarized with the history of the saints. Nowadays, we can see the blooming art of stained glass and they are becoming more popular and appreciated.

### Techniques of production of stained glass

#### Traditional Stained Glass

The technique currently used in geometric composition is the same that has been used since the Middle Ages. In this techniques lead profiles of different width are used. The individual parts are placed in convex or flat, C- or H-shaped slats, and

the contact slats are soldered. Profiles, although being relatively flexible, enable to frame the tiles with medium or large sizes of simple shapes. Types of glass used in this technique are: colourless, transparent, translucent or ornamented with texture. This technique is not time-consuming nor expensive, it can be used in places where fragments are under continuous tension.

### Tiffany's technique

In 19th century there was a revival of handicraft, stained glass were in bloom again. The technique developed by Louis Comfort Tiffany played a ground-breaking role in the history of creation of stained glass. Thanks to his endurance and perfection, but also a new production solution, stained glass of various complicated shapes consisting of many tiny parts appeared. Tiffany in his workshop produced glass not existing on the market at that time. Innovation of his creations lied in the fact that colour was inside the glass, therefore there was no need for final amendments. Another innovation was the way glass was connected. The use of copper foil enabled very precise thin connections that were soldered with tin. Stained glass created with this technique should not be mounted in places under vibration or strong tension because of low flexibility of connections.



Fig 1. Concept of stained glass



Fig 2. Created stained glass

### The English technique

It is not a typical technique but a way to imitate stained glass. Works are done using a single piece of glass on which coloured pieces of foil are placed. Solders are also imitated using pieces of foil.

### Bevele

It is a bevelled glass, which is glued to a flat surface of glass. Bevelling is an extraordinary type of grinding relying on creation of wide bevel on the edge of glass.

A collapse of glass surface proceeds as a result of it. Thanks to that, an elegant and stylish look is gained.

## Used tools

Creation of stained glass requires special tools. They are simple in construction and by design they must be convenient to use. While working with glass most of the work is done by hand therefore a proper selection of tools is needed. It is a good idea to go to a specialized company where all necessary information can be obtained and various tools can be tried, especially the ones that are convenient for our hand.

Every beginner is able to buy all necessary tools enabling the creation of professional stained glass of complicated shapes. However, it should be remembered that even the best tools will not substitute for experience gained during work on different projects. While working on our own a lot of patience is needed, especially self-teaching through trial-and-error method. However, if we want to speed up this process and avoid making basic mistakes we can take one of the courses offered by stained glass workshops. All the information about them can be obtained on websites of companies.

## Safety rules during creation of stained glass

On each stage of creation safety rules are very important; by obeying them we can be sure that nobody will be hurt. It is a good idea to think about safety rules before commencing work. It is advisable to wear a thin, long-sleeved blouse, long trousers, shoes covering toes and arrange hair in a bun if they are long. All the jewellery should be taken off of hands. These safety measures are to protect the body from accidental cut or burn.

Keeping everything in order in the workshop will make the work easier but what is most important, it will help to preserve safety rules. There should be no drinks nor food, glass should be secured, stored in a place free from falling, being kicked or trampled. At the same time we should be able to reach it easily. Table on which surfaces of glass are cut should be clean, laid out with paper or a mat. All the tools not used at the moment should be hidden. No longer needed fragments of glass should be collected and sorted by size. Bigger fragment should be stored in a proper place, smaller ones that are not suitable for use should be thrown away. It should be remembered that while collecting pieces, a pair of protective gloves should be worn to avoid accidental cuts.

Instructions should be read before using tools and the tools should be used according to their purpose, for example a glass-cutting knife should be used only for cutting glass. It is important to remember that we want the tools to serve us long. While cutting, breaking or grinding the glass we should wear protective glasses. We should refrain from bringing our face close to the glass as even a small piece of glass can split off and cause damage to our face or eyes. Before using a polishing machine its technical state should be examined. We care about proper lighting of the workspace and follow all the rules described in handbook. Similar rules apply to the

soldering process. Before soldering the state of soldering machine should be examined and all resources necessary for soldering should be collected. While soldering we concentrate on the activity according to the technological process. Soldering machine should be placed on a special mat. Solder paste, patina, and detergents should always be kept in original containers. After finishing the work the workspace should be cleaned, all equipment should be turned off and unplugged.

A well equipped first-aid kit should be kept in the workshop in a visible, easy to access place. The first-aid kit can be used in case of accident and – in case of a severe body damage – help the injured before medical help arrives.

### **Common errors during creation of stained glass**

Mistakes can occur on every stage of work, therefore focus and accuracy is needed. Cutting glass needs some skills but we should not be discouraged by first mistakes. There are a few rules that should help us to get precise cuts. Cut should be done at once, done with a steady hand and relatively energetically. Common problems are described below.

If the glass did not break off then most probable reasons are:

- Knife pressure was too weak;
- Not enough force was used during tapping of the glass;
- Wrong placement of the surface of glass in pliers during breaking;
- Too weak clutch on pliers.

If the glass broke in a wrong place then most probable reasons are:

- Too much force was used during tapping of the glass;
- Cutting with a knife was done in a wrong place.

Sticking the pieces of glass with a copper tape is a very important process preceding soldering. If the tape does not stick to bottom, upper and side edge of glass, the tape is cracked or there are problems with sticking it then most probable reasons are:

- Cracked tape suggests that the glass was not polished properly;
- Troubles with sticking of the tape appear when the glass was not cleaned well, there may be dirt or fat on it;
- Wrong selection of tape to the glass may pose problems during soldering, each standing out fragment may lead to wrong solder or thickness on joint.

Soldering is a very important stage of creation of stained glass where aesthetics matters. However, if the connections are not up to expectations the most probable reasons are:

- Too big distance between soldered elements;
- If islets appear then not enough flux was used;
- If the tin does not spill then the soldering machine was not heated enough;
- Soldering should be done with fluent moves otherwise visible unaesthetic trails may appear or thickness on joints with thinner lines nearby.

If there are any smudges left after creation of stained glass then the stained glass needs clearing a few times a times for a few days to reach expected outcome.

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## Abstract

Glass is a material that works well in the creating of art stained glass for several thousand years. Stained-glass windows have their own mysterious charm that lies in the play of light in the crystal structure of glass. The publication contains information on the stained-glass techniques, tools used for their creation, as well as the safety rules and errors.

**Key words:** stained glass, stained-glass techniques, tools

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