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GLASS IN ARCHITECTURE AND SCULPTURE

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Annotation. The use of special glass (stained glass, etc.) in modern decor is becoming relevant. Its use is functional and aesthetic. The purpose of special window, door, finishing surfaces is diverse: they are rich decorations of buildings and individual rooms, they replace glass and panels and let in light, they make it possible to isolate the premises of the first floors from prying eyes and provide the necessary information about a specific volume or detail. Glass in modern times is one of the most demanded building materials in architecture and art. Modern computer technologies make it possible to shorten the design process of individual structures, ensembles, cities, small architectonics, including sculptural forms. However, numerous construction and artistic features of glass steel were restored in the second half of the twentieth century. Even the process of realizing a creative idea can be shortened with the use of new computer technologies. Each sketch-idea with the help of a special program can be considered by the author for all projections. The resulting copy can be made using computer technologies, which are in great demand. This study examines the historical aspects of the use of glass and stone in art. Due to its ability, a special light-transmitting surface can serve as an excellent zoning technique. Only a stained-glass window is able to create a special light-air environment, a changeable and unpredictable play of light. Technological processes for the manufacture of stained-glass windows and other interiors and exteriors associated with glass and stone materials were carried out throughout the life of the master and in relatively small volumes due to objective reasons. Modern technologists of this kind of activity (production of sculptural volumes, stained-glass windows, paintings on a glass surface, business cards, signs, items of local information lighting) face a specific problem, which, with a positive solution to many of these issues, will ensure the production of glass and stone products of high quality and on the required scale.

Keywords: glass, building material, glass surfaces, glass structure, stained glass windows, modern technologies, sculpture.

Problem statement. Many modern literary sources of information are analyzed, which highlight the possibilities of using glass in architecture, construction and art (sculpture) in order to reveal the hidden possibilities of glass as a building material.

Analysis of the latest achievements and publications. In modern times, glass is a versatile building material in demand. Quite a lot of publications have appeared in this direction, in which the designated construction and artistic possibilities are considered. The authors analyzed the most information sources in this direction and got good results (Anatoly Mikhailovich Gushchin - Candidate of Technical Sciences, Associate Professor, Odesa, Ukraine; Vasily Petrovich Larshin - Academician, Ukrainian Academy of Economic Cybernetics, Doctor of Technical Sciences, Professor, Odesa, National Polytechnic University, Ukraine).

Glass is currently one of the most demanded building materials in architecture and art. The history of its creation and the development of technological manufacturing processes goes back to thousands of years of antiquity.

One of the first artificial materials, glass, was obtained in Ancient Egypt by melting a mixture of soda and sand (Fig. 1). Initially, products were cut out from the resulting mass, then they learned how to make molds for the molten mass and immediately received ready-made images. And it was only light plastic [2, p. 420; 15].

Fig. 1. Glass vessel - Egypt, XIV century BC (made by blowing method)

Craftsmen of Mycenae in 1150 BC invented red glass for household items [2, p. 42; 15]. In the 30s. BC. Syrian artisans discovered the glass blowing technology, which made it possible to produce bulky objects for everyday use. From the Syrians this technology came to the Romans, from them to Medieval Europe [2, p. 62; 15]. They independently learned to cook glass and began to make the first glass products [2, p. 469, 422; 15]:

- Phoenicians (first half of the first millennium BC);
- Celts - the middle of the first millennium BC, (patterns include symbolic images of animals, plants, gods, birds, people. Fig. 2).

Fig. 2. Celtic glassware

In modern Europe, colored glass was widely used in the huge stained-glass windows of Gothic temples in external enclosing structures. Gothic stained-glass windows are complex plot, geometric or plant-themed compositions. For their manufacture, a special difficult technology was developed: each element of the pattern was «put on» in a lead frame, which was soldered to the adjacent parts of the entire composition. This was the so-called «soldering technique» [2, p. 9, 10].

The Renaissance era returned the role of load-bearing structures to the outer walls of buildings, and the «soldering technique» went down in history. However, glass remained in demand as a building transparent material (glazing of building openings), in medicine, biology, astronomy, jewelry, as a visual increase in elements and phenomena.

The Italian engineer Juz Company invented the lens grinding machine in 1664. Four years later, Isaac Newton was able to make a reflector telescope with his own hands (1771), passing a sunbeam through a glass prism, divided it into a spectrum of colors (the phenomenon of light dispersion) [1, p.136-137].

Thirty years later, the inventor Thomas Severi received a patent for a glass grinding machine [2, p.465; 15].

The above advances in the use of glass formed the basis for further improvement of its properties and processing methods for multifunctional use in various fields of human activity.

Purpose of the research: to reveal the comprehensive possibilities of glass as a building and artistic material.

Objectives: to show in what directions it is possible to find additional use of glass as a building and artistic material.

Main text. The history of glass art. Products from glass are widely used in modern architecture and art. These are glass surfaces of facades of high-rise buildings, flooring in museum halls and constructive solutions for bridges in interiors of all types of buildings (stained glass windows, partitions of internal spaces), in the manufacture of sculptures and small architectural forms [1,6-9,13-14].

The revival of glass as enclosing architectural structures took place in the pavilion building at the First World Exhibition of Human Achievements in Science and Technology. The building was built in Hyde Park (London, 1855, Fig. 3).

Fig. 3. Pavilion- Crystal Palace, 1851 year

In preparation for the first World's Fair in London, a competition was held for the design of the main building, where 246 projects were presented. The winner was Joseph Paxton, who built

mostly greenhouses. The structure of the «crystal palace», as it was dubbed by the London satirical magazine «Punch», was 563 m long, 124 m wide, 30.5 m high, and was a metal frame with enclosing glass outer walls with a total area of 84,000 m^2. Then it shocked the world community. It is no coincidence that for the trade fair in New York (1853) the image of the London pavilion is repeated in the same designs [2, p. 218; 5], but the architecture of the second half of the XIX century was carried out mainly in traditional designs. Glass as the building envelope the exterior walls was gradually applied to the end of the XIX century before the First World War, and especially after, from the beginning in Germany (architect Walter Gropius), then in the USA (architects - Walter Gropius, Ludwig Mies vander Rohe), in Europe - Charles Edouard Le Corbusier, as well as in the work of other architects. Glass became much more widespread as the enclosing structures of high-rise buildings after the Second World War. In modern times, sheet transparent and opaque glass is widely used in architecture along with reinforced concrete and steel [6- 9,11,12]. This is not its only function. Nowadays, its functions in art are much more diverse: stained-glass windows of various types and various manufacturing techniques, volumetric sculptures and interior items manufactured using various technologies.

Stained glass manufacturing technology. Currently, stained glass windows occupy a special place in interiors, where they reflect all historically established architectural and artistic styles. Nowadays, the styles of stained-glass window decoration are as follows: classic, gothic, modern, abstraction, avant-garde, antiquity, Byzantine, Egyptian [3, p. 11-13]. To them should be added: Chinese, Japanese, African, South American (Fig. 4).

Fig. 4. Notre Dame de Paris (Notre Dame Cathedral)

Translucent designs benefit not only from bright sunlight, but also from the soft tones of the sunset and sparkling evening lights. As for the artificial lighting of these structures, it was found that such lighting gives the material a frozen expression, it cannot cause that play of light and shadows, those light and color effects that natural lighting creates, endlessly changing throughout the day and throughout the year. It is possible to use special installations with synchronously changing artificial lighting, and this already refers to the area of expensive equipment and, of course, justified effects.

France is the country in which the most memorable and well-known monuments of early Gothic stained glass art appear today.

Varieties of stained glass: wall panels, table surfaces, stained glass windows and doorways, ceilings, chandeliers, lamps, floor lamps [3, p.15]. Stained glass techniques are also diverse and well known to specialists: - classic (type-setting) stained glass; - SGO technology; - fusing technique (sintering); - casting (Murano glass); beveled stained glass; - mosaic technique; - painting on glass. These techniques are very laborious and take a lot of time to manufacture [3, p. 14-15].

Volumetric glass sculpture is becoming more and more widely used, including in the natural environment of parks. Sculptors of the city of St. Petersburg are showing great interest in

it, developing new technologies for making glass sculptures and the strength of the glass itself [3, p. 1-12] but all of these technologies are very laborious and require a lot of time (Fig. 5).

Fig. 5. New possibilities of glass plastics by artist V.K. Makovetskiy

At present, lighting pendants and holograms are used to perceive the artistic expression of architectural monuments and sculptures. These techniques are very effective, but only in the dark. Often this solution is supported by the appropriate musical accompaniment. Spectators get an unforgettable sight. During the Christmas holidays in the historic center of Lyon (France) in the evening hours such light and music performances are usually staged. But the play of bright colors on the glass facades of modern skyscrapers only in the dark, even accompanied by music, is already a well-known technique that ceases to emotionally affect the audience. Unique effects around the clock can be created by such techniques as the inclusion of various kinds of reliefs and counter-reliefs in a solid glass facade. At the same time, for the effectiveness of the impact on the viewer, requiring less energy costs. The artistic images of these objects were performed by leading architects and artists of their time, such as Jean Goujon, Charles Cameron, Carlo Rossi, Andrei Voronin. Talented craftsmen perfectly mastered the technique of diamond carving on stone and on a special (crystal) glass surface. They skillfully carried out carving according to the sketches of the great masters. But these creative processes were very laborious, uneconomical, requiring a huge investment of time (Fig. 6) [5, p. thirty; 10].

Reliefs of the «Fountain of the Innocent». 1547-1549. Marble. Louvre, Paris.

Crystal and marble products, vases, sculptures, and bas-reliefs were an integral part of the interiors of the 18th-19th centuries. These items are well represented in many museums and described by many researchers [5, p.34-35; 10].

Conclusions and prospects for further research. All the above-mentioned technological processes for the manufacture of stained-glass windows and other interiors and exteriors associated with glass materials were carried out during the life of the master in relatively small volumes due to the above objective reasons.

Modern technologists of this kind of activity (production of stained-glass windows, painting on a glass surface, business cards, signs, items of local information lighting, and so on) are faced with a specific problem, which, with a positive solution to many of these issues, will provide:

- the quantity and quality of glass curtain wall systems and with the possibility of using various reliefs;
- the use of significant minimum technologies for labor costs in the manufacture of volumetric glass sculptures on the territory, for example, in garden areas and interiors;
- production of stained-glass windows using large areas and the use of new natural and artificial building materials with light transparent, scattering, absorbing properties.

Fig. 6. Northern Renaissance: Jean Goujon. Nymphs

The future creativity of architects and sculptors is in close connection with computer technology, when the main process of the comprehensive development of an idea is carried out with personal technology, and an experienced master who is the author supervises the creative work.

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СКЛО В АРХІТЕКТУРІ ТА СКУЛЬПТУРІ

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Аннотація. Застосування спеціального скла (вітраж тощо) у сучасному декорі стає актуальним. Його використання носить функціональний та естетичний характер. Призначення спеціальних віконних, дверних, оздоблювальних поверхонь різноманітне: вони являються декоративною прикрасою будівель та окремих приміщень, замінюють шибки та фільонки, пропускають світло, дають можливість ізолювати приміщення перших поверхів від сторонніх поглядів і дають необхідну інформацію про конкретні об'єми чи деталі. Скло в сучасності – один із найбільш затребуваних будівельних матеріалів в архітектурі та мистецтві. Сучасні комп'ютерні технології дозволяють скоротити процес проектування окремих споруд, ансамблів, міст, малих архітектурних, у тому числі і скульптурних форм. Однак численні будівельно-мистецькі властивості скла відновлювались в другій половині XX ст. Навіть сам процес втілення творчої ідеї може бути скорочений з використанням нових комп'ютерних технологій. Отриманий екземпляр можна виготовити за допомогою комп'ютерних технологій, які зараз користуються

великим попитом. У даному дослідженні розглянуті історичні аспекти застосування скла та каменю в мистецтві. Завдяки своїй здатності спеціальна поверхня, яка пропускає світло, може служити прекрасним прийомом зонування. Тільки вітраж здатний створити особливе світлоповітряне середовище, мінливу і непередбачувану гру світла.

Технологічні процеси виготовлення вітражів та інших предметів інтер'єрів та екстер'єрів, пов'язаних зі скляними та кам'яними матеріалами, виконувались впродовж усього життя майстра і порівняно не більшими обсягами через об'єктивні причини.

Перед сучасними технологами такого роду діяльності (виготовлення скульптурних обсягів, вітражів, розписів на скляній поверхні, візитки, предмети локального інформаційного освітлення) стоїть конкретна проблема, яка при позитивному вирішенні багатьох зазначених питань забезпечує виготовлення скляних та кам'яних виробів високої якості і в необхідному масштабі.

Ключові слова: скло, будівельний матеріал, скляні поверхні, скляні структури, вітражі, сучасні технології, скульптура.