Façade Art Glass in Three Contexts: Urban Landscape, Elevation of the Building and Its Interior

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Abstract. The aim of this publication is to define the effect of façade art glass on the architectural space. The façade art glass – unlike stained glass – has a pronounced visual presence in three compositional structures of an architectural space: It is seen as part of the urban landscape, the form and façade of the building, as well as its interior. The dissertation describes the characteristics of each of these areas. The wide range of impact of monolithic art glass on the perception of the architectural space is connected not only with the application techniques, but mostly with the specific image structure, which dictates how double-sided layers are made that are seen both with the light shining at them and coming from behind them. This paper lists several strategies used to create double-sided layers. Monolithic art glass is a relatively new phenomenon, and its influence on the surroundings is still being discovered with each new project. An image put on glass becomes an integral part of the building it adorns and is key to a number of important aspects. As an artistic element, it affects how the building’s aesthetic values are seen – determining its’ expression, symbolism, nature and colour scheme – as well as becomes integrated into the façade. As a divider, it plays a part in the modification of the passing light, determining how the interior, and indirectly also the exterior, is seen.

1. Introduction
Contemporary art glass used in façades is one of the more interesting art forms to be found in architecture. It derives from the concept of stained glass, a technique that had been part of architecture for centuries, initially in sacred buildings, and then moving to secular ones. In the mid-20th century, along with the aesthetic changes that were taking place in architecture as well as art, a need arose to replace stained glass with other techniques that would be more in keeping with the latest aesthetic trends. The key limitations of stained glass were related to the fact that it was not fully exposed in the features of an architectural structure. A stained glass image could only be seen when backlit, meaning that in daylight one was only able to look at it from the inside of the building (Figure 1a).

In the 1980s, as a result of growing changes in visual arts, stained glass underwent a significant transformation, and searching for its modern version became the main preoccupation of many stained glass makers and designers. Numerous projects were built, and although technologically they were still in the stained glass tradition, in terms of concepts and aesthetics they were already part of current artistic trends. Limitations of this art form could no longer be ignored, and individual experiments conducted at art studios led to the creation of a new phenomenon named monolithic art glass.
The chief problem that needed solving with regard to the quality of glass images was how to eliminate the so-called lead band, which in stained glass performs the function of a structural element and has serious artistic consequences. By separating itself by means of a black line when backlit, it gave the image a specific character, not seen anywhere else in art. The line constituted a graphic framework providing artistic harmonisation and discipline to the image. In order to avoid excessive exposure, the image required suitable saturation. Over the years, several techniques were invented which enable artists to create images devoid of areas encircled with the said lead profile, and therefore being visually homogenous.

There was now a need to develop techniques for transferring images onto façade glass so that the image could be fully integrated into the building’s façade. A building envelope made in this way would present the art both when lit from the front as well as backlit (Figure 1b). Graphic techniques characterised by a key advantage of enabling easy copying of a previously prepared image proved to be suitable for this purpose. Screen printing – one of printmaking techniques that enables creation of monochromatic glazing – was seamlessly adapted for this purpose. Following numerous technical and technological experiments, equipment for printing on glass was built, which could be used for working on multi-colour glazing. Initially, print quality was a problem, and it proved to be difficult to evenly spread the pigment or to achieve high quality of transparent surfaces, image colour stability \(^1\) or resistance to mechanical damage. After a while, however, satisfactory performance was achieved.\(^2\)

Art glass constitutes a significant artistic element of architectural space and is fully integrated into the visual structures of a building: in the urban context, as part of the façade, and inside the building. This makes art glass an art form that has a significant effect on the architectural space. Some of the projects where monolithic art glass techniques have been used in fully glazed buildings, and which support the above thesis, include the University Library in Cottbus, Germany; the Ryerson University building in Toronto, Canada; the Netherlands Institute for Sound and Vision in Hilversum, the Netherlands; and the La Defense office complex in Almere, the Netherlands. In each of these projects, a different technique was applied, resulting in differing effects on the external and internal image of the building. It also means that the way these buildings function within their surroundings varies slightly from one to another.

2. Façade art glass
The wide-ranging influence of art glass is linked to its aesthetic properties, location, as well as applied techniques and materials. In fully glazed buildings, due to the scale of its exposure, art glass significantly influences a building’s image and reception, both from the outside as well as inside. Glass present in the building’s envelope determines how light enters the building and modifies its properties: colour and intensity. The visual perception of a building’s façade wall is closely dependant on the lighting conditions, which change as the day progresses and as the viewer moves around. An image integrated into the façade and consciously formed on glass should be adapted for viewing in varying lighting conditions, both in daylight and at night. The research material compiled below is a review of the artistic and compositional possibilities provided by art glass that makes up façades of different spatial forms. The examples were selected to present as fully as possible the methods applied in a given location.

The double-sided way in which façades are viewed is associated with the strategy applied in the construction of glazing projects as well as selection of correct materials. Using them creatively led to the development of several different methods of constructing double-sided walls. In the examples below, some of these methods can be observed: creating an image based on a halftone with the

\(^1\) Related to the UV resistance of the layer.

\(^2\) The latest Dip-Tech technology enables high quality printing that can be used on façade glass.
simultaneous use of coating pigments (Figure 3, 7), the use of semi-coating materials (Figure 4), and the use of dichroic layers (Figure 5). In the selected research material, layers with varying artistic properties can be observed; meaning those that change their visual properties as the viewer changes their position relative to the façade and the direction of light. These are dichroic layers, relief façades, and double-layer façades.

**Figure 1.** Relationship between the direction of light and visual reception of a glass façade: a) Stained glass – affecting the interior in daylight; b) Monolithic glass – double-sided layers; in daylight, they are viewed in the urban context as part of the façade and inside the building. The blue arrow denotes the direction of light; the red arrow denotes the viewing direction of a glass façade.

2.1. Urban context

Architectural structures which are either fully glazed or glazed in a large part become a distinctive element in their surroundings. A glass layer visible from a distance will make a building dominate its urban space, regardless of the shape and location of that building. The clearest graphics are those in white and other bright colours.

A glass façade acts as an element that identifies the building with its function. This effect is transferred onto the surroundings. Graphic elements are incorporated into the system of meanings and codes of the surroundings, creating new associations (Figure 2b). Graphics which involve a certain narrative act as the means to convey statements, which manifest themselves within an urban space. A glass façade may be a demonstration of the social status, it may deliver a certain message or display aesthetic tastes [1], and it also carries information about the place and time.

**Figure 2.** Ryerson University, Toronto a) The building in the urban context; b) A closer view of the façade. [2]

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3The semiotic approach, which recognises the city as a place where communicative phenomena occur. They are understood as the creation of messages based on conventional codes, [3]
Frequently, a distinctive glazed structure becomes a landmark in an urban space (Figure 2a), helping people to establish their location [4] and move around the area. An architectural structure can also be used in other ways, for instance, as a meeting point.

Keeping in touch with a building from afar [5] determines the way it functions visually within the structure of the immediate and wider surroundings, and also its relationship with the closest buildings with regard to their shape and form as well as other traits such as size, massiveness, colour, transparency and texture. Architectural structures covered with art glass are often put up in locations where they are detached (Figure 3a). Their visual dominance is not only the result of their size and shape, but it is also determined in a significant way by the form of glazing and its expressiveness. This in turn is linked with the properties of the glass façade, image form, and light sensitivity.

In the urban context, the techniques that have the strongest effect and are used most often include the graphic techniques of screen printing and digital printing. A unique artistic rendering of an image, combined with suitably selected means of shaping the glass wall, significantly influence the perception of the building. Usually, glazing is part of a compositional exercise, the aim of which is to put emphasis on the building’s shape (Figure 3b). In partly glazed architectural structures, it is common to use mixed techniques that combine façade graphics with other cladding materials.

![Figure 3. The Cottbus Technical University Library (Herzog & de Meuron, 2004): a) Street-side view; b) Façade seen from 5 metres away. Photos: A. Lipowicz-Budzyńska](image)

2.2. Reception of glass in relation to the building’s façade

Analysing buildings from a closer perspective, in terms of their shape and façade, it can be seen that in the majority of fully glazed buildings, the decorative form of the image put on the glass façade has been juxtaposed with a simple spatial shape [5, pp. 170] of the architectural structure. The size and proportions of graphic elements have been adapted to the size and proportions of respective structures. An image printed or reflected on glass provides an ornament that enriches the façade, and becomes one of the elements of the compositional exercise, the purpose of which is to add variety to the building’s exterior (Figure 4a) or to emphasise one of its parts. Many procedures are aimed at making the façade surface more attractive, set the rhythm, or emphasise an area within the functional structure, for example, the entrance.

Some of the fully glazed buildings have the façade designed as their skin, creating artistic as well as practical consequences. The artistic layer unites the façade visually and obscures existing horizontal divisions and auxiliary elements of the building. The applied ornament is the factor that visually materialises the glass wall and controls integration of the spaces on both sides of the glazing.
A glass façade may be a carrier of certain values, which, as they manifest themselves in the façade, permeate into the surrounding space outside and inside the building. Architectural values\(^4\) have been described as a set of traits that determine qualities which represent value to the viewers and users, and satisfy their certain needs [6]. The most important factor influencing the reception of a façade present in an architectural space is light; especially, with bright layers. A façadewith a high degree of luminance reacts significantly to light [7] changes occurring as the day progresses. As regards colour layers, depending on the colours used and the transparency level of applied materials, changes in the intensity of scattered light and sunlight have a strong effect on the reception of colours.

\(^4\)The general list was compiled by Andrzej Basista with a division into the following qualities: usefulness-related, cultural (ideological, political, social, historical, customs-related, educational), aesthetic, ethical, religious, [1, pp. 55-87]
clearly seen (Figure 3b). Relief layers also change their visual properties as the viewer moves relative to the façade and the direction of light (Figure 4b).

2.3. Reception of glass façade inside the building

Semitransparency of a glass wall has consequences for the interior. In every building, it looks different. In glazing with screen printing on, where the image is constructed with the use of a halftone (Figure 3b) or bigger geometrical features (Figure 6a) which are prepared using white enamel, the printed image acts as a white curtain. The glazing not only obscures the view into the interior from the outside, but also enables partial integration of the interior into the surroundings.

One of the basic functions of glazing is controlling the intensity of light going into the building. It also provides partial protection against sunlight and overheating of the interior. In coloured and transparent glazing, the glass layer acts as a filter for the light going into the interior. It considerably influences the perception of the interior and the way we see space, as well as any objects that are present there. Light that travels through a glass façade casts a colourful shadow on the walls and the floor. The shadow changes its shape over the course of the day, and interacts with the compositional features of the interior.

In this context, the most frequent interference phenomena are those occurring between two layers of glass covered with an image that is created of a halftone (Figure 6b). Geometrical layouts, which can occur, for instance, between some fine spots, move along with the viewer. Both monochromatic as well as coloured glazing, act inside the building as a decorative wall, incorporated compositionally into the structure of the interior’s concept.

3. Glass roofs and skylights

Glass roofs and skylights are slightly different. Located in a building’s envelope where they cannot be seen from the outside, they do not contribute to the external image of an architectural structure. However, they have a considerable effect on the interior. Due to their location, they are exposed and seen from anywhere in the building, even if the space is large (Figure 7a).

An artistic layer located in a skylight or roof dominates the interior, and is a significant artistic feature defining the interior’s character (Figure 7b). In a complex space, this is a factor that aesthetically integrates the interior. In numerous applications, the space is affected not only by the form of glazing but also the aesthetics of light effects that occur as a result of sunlight falling on the glass surface.
Light streaks arrangement that changes over the course of the day, together with their colour, shape, size and dynamics, constitutes a decorative element.

![Figure 7. Swimming pool, Saxon State Baths, Bad Elster (Behnisch & Partner, 1999): a) view of the interior, b) skylight. Photos: A. Lipowicz-Budzyńska](image)

### 4. Functional features of a glass façade

A façade built of art glass fulfils several functions in a building, and directly influences the comfort of using a space. In fully glazed structures, covered with art glass, the glass façade acts as the building’s skin. The distance between two glass layers that are moved apart acts as a buffer. Ventilated space stabilises temperature inside the building. It protects against temperature fluctuations that could be caused by excessive penetration of sunlight, as well as against sudden temperature drops in wintertime in case it suddenly becomes very cold. The technique used most commonly in the solution of this kind is screen printing. Putting a bright enamel layer with the use of screen printing on the glazing’s external surface creates protection against sunlight and overheating of the space. A bright coating surface of a screen print reflects sunlight, and provides shade for the interior. The most effective protection is provided by two screen print layers placed on separated glass surfaces.

Screen print layers are used on retractable façade awnings, as well as blinds for skylights and glass roofs. Artistic glazing provides cover and a double-sided protection to obstruct the view. At the same time, it controls the integration of the spaces on both sides. Such functional features come as a result of compositional and artistic solutions applied in a glass façade. This paper does not discuss functional features related to the use of other solutions.

### 5. Conclusions

Art glass projects applied in building facades provide confirmation of multidimensional impact on architectural space. Contemporary art glass, unlike stained glass, not only affects the inside of a building but is also fully visible from the outside and actively participates in creating the external image of the building.

It can be said that art glass, similar to architectural structures, functions on three visual levels: it participates in the urban structure, constitutes the dominant feature of the façade, and influences the building’s interior, where it performs numerous functions. In each context, reception of art glass may be different, and glass may have distinct functions. The effects are strongest in fully glazed buildings or those in which the artistic glazing takes up a significant part of the façade. A key feature in the case of façade glass is the conscious forming of the building envelope’s transparency, as it determines the double-sided reception of a glass image and the scope of influence within an architectural space.
An important part in the reception of architectural space is played by glazing’s visual characteristics – its shape, dynamics, composition and colours – as well as the means through which an image exerts its influence. These means are the result of correct selection of the application technique and of the strategy used to shape a given part of the building’s envelope. This is most clearly manifested in architectural structures in which glazing was developed at an early stage of the design, and therefore it was associated with the design’s artistic and spatial concept. The appearance of new art glass techniques, including those enabling architects to freely create large façade glazing projects, enriched the existing range of artistic means used in architecture, thus equipping architects with new tools with which they could shape the environment.

References
[1] A. Basista, Architecture and values, Universitas, Kraków, pp. 249-279, 1996.
[2] https://www.dip-tech.com/printed-glass-projects/canada-toronto-ryerson-university
[3] U. Eco, Absent structure, KR Publishing House, Warsaw, pp. 376, 1996.
[4] A. Kantarek, On the orientation in the city space, Cracow University of Technology Publishing House, Kraków, pp. 91, 2013.
[5] A. Basista, A. Nowakowski, How to read architecture, Universitas, Kraków 2012, p.10.
[6] W. Stróżewski, Around the Beauty, Universitas, Krakow, pp. 152-166, 2002.
[7] B. Weller, S. Unnewehr, S. Tasche, K. Härth, Glass in Building: Principles, Applications, Examples, Brikhauser, Bassel, pp. 33, 2009