

# Modern translucent structures in multistory residential buildings

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**Abstract.** The relevance of the problem under investigation is due to is connected with a limited number of methods and means to enhance the architectural expressiveness of multistory residential buildings with the use of translucent structures. The purpose of the article is to enrich the creative tools of architects and construction engaged in the urban living environment. To solve this problem, a purposeful scientific review of the world experience of modern architectural and compositional solutions of multistory residential buildings with the use of translucent structures was carried out. It allowed to identify a certain typology of means of enhancing architectural expressiveness. The main result of the article illustrates the classification of these tools in terms of their visual perception and construction positions. The articles will be useful for a wide range of professional users.

## 1. Introduction

The range of architectural and composition tools and techniques, which are used modern architects involved in the formation of the living environment of large towns and cities, is quite wide and varied [6]. However, many of emerging high-rise apartment buildings and multi-complex with using glass become quite typical. Their architectural appearance is very monotonous and even with a high quality of construction is not conducive to the formation of a visually interesting and expressive urban environment. The reason for this is the limited number of actually used methods and means of architectural expression with translucent structures. On the one hand, this problem is existed because there is no unified classification of tools by using translucent structures and there is a low degree of study in the question of their applicability to the facades, on the other hand, the climatic conditions and fire safety conditions for multistory residential buildings which are should be considered imposing a number of restrictions. A purposeful scientific review was allowed to identify a number of possible ways to use different types of translucent constructions. The result of this analyze are present in table of classification by groups with according to their expressiveness. This classification of architectural translucent structures of multistory residential buildings is compiled with considering the climate, technology and fire and anti-vandal security requirements, which are mandatory for use.

The article is aimed to enriching creative tools of architects and designers who involved in creating the urban residential environment by using of modern architectural and composite solutions based on glass constructions. Scientific review suggests a classification of tools and techniques both in terms of their visual perception and in terms of their construction.



The result of this analytical review is given recommendations for use different translucent structures in the construction solutions for multistory residential buildings in terms of their grades on the scale, bulk plastics and other visual characteristics, taking into account the specifics of window technology and construction in the region. Article submissions will be useful for a wide range of professional users.

## 2. Materials and Methods

In preparing the material of the article it was analyzed over 50 contemporary built objects in the world, which expressiveness is formed by various applications of translucent structures. At each site were analyzed translucent structures as a means of its harmonization: its significance and matching the architecture of the building [5,8]. In the classification of translucent means of expression of multistory residential buildings are conditionally divided into 4 large groups according to the extent and degree of their visual perception (table 1).

### 1) *Continuous larger planes and volumes.*

A distinctive feature of this group is the psycho-emotional perception of these fragments and details as a large element, the scale of which is commensurate with the building as a whole. This group includes the following types:

- 1.1. Linear continuous plane transparent and translucent fill;
- 1.2. Filling large stained-glass height over 2 floors;
- 1.3. Three-dimensional volume of the transparent / translucent fill;
- 1.4. Linear plane formed on a large geometric figure;
- 1.5. Bend- linear surface [4].

### 2) *Holes (windows).*

A distinctive feature of the emotional impact of translucent apertures lies in their nuance - contrasting Color combination and the perception of scale (value) relative to other elements, and the shape and arrangement of openings by way of the facade plane [3].

- 2.1. The scale and shape of the opening;
- 2.2. The placement of openings in the facade;
- 2.3. Elements in the form of ribs, folds, etc.

### 3) *Balconies and hinged elements*

- 3.1. Accommodation balconies and (or) loggias on the facade;
- 3.2. Hinged elements (like a double facade, visors, decorative elements);

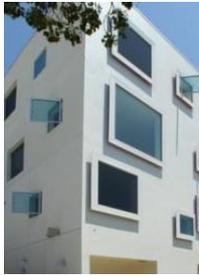
### 4) *Color as a means of increasing expression of translucent structures.*

A distinctive feature of this group - its universality. Tools of this group may be useful as an addition to the two above groups, and individually.

- 4.1. Glass color and surface treatment, the degree of specularly;
- 4.2. Color construction elements and bindings.

**Table 1.** A classification translucent structures in multistory residential buildings according to the extent of their visual perception

(a)

	Continuous larger planes and volumes	Holes (windows)	Balconies and hinged elements	Color
	1	2	3	4
1	<p>Linear continuous plane transparent and translucent fill</p>  <p><b>Figure 1.</b> Residential complex on Mosfilmovskaya st. Moscow, Russia.</p>	<p>The scale and shape of the opening</p>  <p><b>Figure 6.</b> An apartment house E3. Berlin, Germany.</p>	<p>Accommodation balconies and (or) loggias on the facade</p>  <p><b>Figure 9.</b> Residential complex "Iceberg", Aarhus, Denmark.</p>	<p>Glass Color and surface treatment, the degree of specularity</p>  <p><b>Figure 11.</b> Residential complex "Panorama". Moscow, Russia.</p>
2	<p>Filling large stained glass height over 2 floors</p>  <p><b>Figure 2.</b> House by housing corporation Ymere. Oostpoort, Amsterdam.</p>	<p>The placement of openings in the facade</p>  <p><b>Figure 7.</b> Residential complex "Habitat 15". Hollywood, USA.</p>	<p>Hinged elements (double facade, visors, decorative elements)</p>  <p><b>Figure 10.</b> Residential complex "Copper House". Moscow, Russia.</p>	<p>Color construction elements and bindings</p>  <p><b>Figure 12.</b> Residential complex "Les Patios Erdre Porterie". Nantes, France.</p>
3	<p>Three-dimensional volume of the transparent / translucent fill</p>  <p><b>Figure 3.</b> Residential complex "Segen". Boulogne-Billancourt, France.</p>	<p>Elements in the form of ribs, folds, etc</p>  <p><b>Figure 8.</b> Residential complex KfW Westarkade. Frankfurt, Germany.</p>		

(b)

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- 4 Linear plane formed on a large geometrical figure



**Figure 4.** Residential complex "Ascension". Covington, USA.

- 5 Bend- linear surface



**Figure 5.** An apartment house «520 West 28 Streets». New York, USA.

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### 3. Discussions

During the last decade glass construction industry has made a huge breakthrough, which are given for architect a bright and multivariate range of products. It was making it possible not only to improve the quality of living spaces, but also visually enriches the facades of buildings. However, with the growing popularity of glass building and the desire to free up the space visually external walling, architectural construction methods have become a limited number of traditional construction solutions [1,2,7]. Byway in translucent structures often leads only to use these solutions, greatly simplifying the architectural concept. Problem №1 for the development of knowledge in this area: direct interaction architect and producer and joint participation in the development of innovative character. As an example, many of the German IT market offer a solution demanded by many practicing architects. "Front wall installation system" system allows the window almost flush with the front plane in the insulating layer, while the now widely used classical solutions, installation and fastening of the window profile in a support structure, buried by a significant amount due to the finishing layer , insulation and distance to secure the seat (figure 13).



**Figure 13.** "Front wall installation system" on the facade. Munich, Germany

Thus, the leading question of linear solid planes that decision takes place to replace the traditional solid glass. Many companies, including in the Russian market, sell frameless glazing.



**Figure 14.** "Self frameless system" on the facade

This method makes it possible to solve the glazing of balconies and loggias: instead of the classic profile decision on the top and bottom rails are installed, which is free to move safety glass (figure 14). In case of the angled windows, this method cannot be applied in connection with ventilated butt joints. In this case, applied classical "profile" solution. The frame structure is made of a translucent thin aluminum sections colored in a color close color glass. A further embodiment of application of translucent elements, partially realized in the territory of Russia - translucent plate and hinged elements. The concept of double facade in high-rise residential buildings modified and allows applying locally translucent panel of transparent, translucent and Colored glass. An interesting example is a house in Basel, France (figure 15). Stained glass panels are fixed to a metal cable. Metal ropes are tensioned from the base to the top of the building like the string on which the glass panel is fixed.



**Figure 15.** Residential building in Basel, France

Basic solutions used in the architecture of the different types of buildings listed in the classification, are unique, individual character in the architecture of residential buildings. The classification is not a rigidly fixed list of resources and can vary and be modified for individual projects. The focus was on the possible ways of solving the architect of the objectives and achievements of expressive architectural and artistic appearance (decision) of a residential building. Tools and techniques identified by the study of many objects of architecture, applied both individually and collectively. Classification is a free architectural tool with standard structural solutions except where noted.

#### 4. Conclusions

Given the specifics of the construction of multistory residential buildings and construction features in these translucent elements, you can draw attention to the following. The first group of "*continuous larger planes and volumes*" is applicable in residential areas, which should be seen from a distance, where the viewer can simultaneously absorb the entire volume or facade. This also applies to the issue of continuous glazing of balconies and loggias, where they are collected in groups. Translucent filling is permissible in terms of the formation of secure privacy zone in a residential area of rooms: through the glass distinguishable only the outlines of people or objects. Large stained filling recommended as a center architectural art composition in places device stairway embedded public premises and commercial premises first - second floors, residential roof superstructures. Linear geometric planes formed on a large figure, it is permissible to use as a decorative and functional to generate individual reception art solutions on the facade. Bent-linear surfaces are a typical individual decision, applicable in a number of exceptional projects requiring significant economic and technological costs.

Openings for installation of translucent structures (windows and balcony blocks) are the main functional unit, and determines the degree of illumination flats, and in high-rise residential buildings usually ask its basic character and rhythm. Depending on the shape, arrangement and pattern layout multiscale width and height of the windows creates cutting solid walling. The visual perception depends on the scale and nature of the coating.

Significantly different in visual perception - elements in the form of ribs, folds, screens. Their peculiarity lies in the fact that the element translucent structure removed from plane wall and defining here becomes perception volume and shape of these elements.

Balcony or attachments using translucent structures form a special shape architecture residential home, especially when using colored glass. These elements may be in the form of a continuous protection of a balcony (loge) of elements-plates which close the bypass air conditioner unit on the front, a decorative colored elements, such as, for example, performed in a building "Lumière" in St. Petersburg (Russia) (figure 16).



**Figure 16.** The residential complex "Lumière" in St. Petersburg, Russia

Architectural and structural glass has certain physical, optical and chemical properties. Using glass in the rear housing should consider a number of additional requirements, which, in addition to indoor climate, provide anti-vandal and private security of premises. The degree of light transmission and light reflection glass is in a residential building of particular importance. With varying degrees of retro-reflection glass is perceived differently, which also significantly affect the perception of architectural -Artistic appearance of buildings. At present, many companies are trying to develop a unified color range for architectural glass. Development of production lines has allowed to produce vandal-proof, heat-insulating and other types of glass.

Such compositional devices as color framing structural members of window openings and window casements drawing-in viewer perceived mainly at a close approach to the building; the development of these cells, special attention should be paid to the high density of buildings, chamber space within it. Although the general nature of the perception of the object as a whole, they are also able to affect just this influence will not be pronounced, and sometimes not even aware audience.

The above-mentioned varieties of composite products based on glass constructions, which can be used in architecture, multistory residential buildings, may have more new and interesting options for the development of construction industry technology, this classification is only the main direction, indicating the general nature of the work to the facades. Any conceived by architect tools and techniques for its object, should take into account the hierarchy of scale gradations in its perception.

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