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FUNCTIONALITY, COMFORT OF USE OR FACADE ONLY

FUNKCJONALNOŚĆ, KOMFORT UŻYTKOWANIA CZY TYLKO FASADA

Abstract

The analysis of selected works of contemporary architecture draws attention to the external image of architecture in relation to the actual assessment of given forms, their functions, but also the contextualisation of buildings. Positive feelings generated by the reception of the external form of the building, often turn out to be misleading and incompatible with the comfort of use initially offered. Research methods, which indicate the effectiveness of comparative analysis of model spatial objects, can serve to improve the design quality and consequently influence the final holistic picture of architecture, honest and reliable, that will not need be veiling – even as beautiful as the works of Christo and Jeanne-Claude.

Keywords: architecture image, design effectiveness, convenience

Streszczenie

Analiza wybranych dzieł architektury współczesnej odnosi się do ich zewnętrznego obrazu i faktycznej oceny funkcji, formy, także kontekstualizacji budynków. Generowane odbiorem zewnętrznym pozytywne odczucia, nierzadko okazują się niezgodne ze wstępnie oferowanym komfortem użytkowania. Metody badawcze, wskazujące skuteczność analizy porównawczej modelowych obiektów przestrzennych, służyć mogą poprawie jakości projektowej, implikując ostateczny, holistyczny obraz architektury szczerzej i wiarygodnej, nie potrzebującej woalowania – nawet tak pięknego, jak dzieła Christo i Jeanne-Claude.
Słowa kluczowe: obraz architektury, skuteczność projektowa, wygoda

1. INTRODUCTION

Does the architect's strategy remain the same throughout the design process? Does the completed architectural object confirm the original assumptions of the designer, in line with the idea, vision and goal, which should inevitably be the comfort of the recipient? These are questions that bother observers of architecture, its users, but also the architects themselves.

Reality writes various scenarios, some closer to the truth, others definitely heading towards the illusory architectural imaginations of the expected worlds. Icons of architecture – symbols of the time surrounded by an aura of popularity and countless likes on social networking sites, are often unmatched design dreams of architecture adepts, and for an ordinary citizen they are often a destination or a subject of artistic expression. As a social showcase they increase the prestige of the investor. Being within the framework of current fashion trends, they are evidence of good taste, high standard of existence, and indicate the sophisticated tastes of the user. They are like a beautiful woman, who is best admired from a safe distance. Can a tempting look offer an equally attractive interior? Can the Triad of Vitruvius contain the truth of its assumptions? How to reconcile durability, usability and beauty to meet the requirements of all stakeholders?

In relation to architecture, it is interesting whether what attracts the designer as the creator of an outstanding object, allowing a positive appearance in the opinion of the rest of the professional environment, is equally attractive to the future user, and in what limits falls within and how this attractiveness is understood. In the area of research on the effectiveness of comparative analysis of model spatial objects, the focus should be on aspects of the relationship between external and functional values, so that comfort and beauty, in relation to architectural objects, do not remain in mutual opposition.

2. EXPERIENCE OF ARCHITECTURE

Romuald Loegler notes: “As long as architecture is only directed towards usability, it is only it, usability. And this does not mean that it is also the fulfillment of the aesthetic needs of man.”¹ Today, a different thesis can be put forward with regard to many contemporary objects: as long as the architecture is only directed towards the aesthetics of originality, it will remain only it. If the designers focus on the visual values of the object’s facade, the object can only remain a facade. Perhaps beautiful, but hiding behind it problematic spaces that do not fully meet the requirements of the investor or user.

For several centuries a sinusoidal directing of attention in opposite directions has been observed, i.e. towards functionalism, excluding concern for aesthetics, or on the contrary, focusing exclusively on aesthetic experiences. The latter do not always result from the expectations of the recipient, they are often the result of the prevailing fashion or individual style of the designer. Already Vitruvius pointed out that the foundations of good architecture are the combined issues of function, form and their quality, which with the perfection of sounding in one whole, will satisfy both sides and the recipient and the designer. The form of a facility is usually determined by specific objectives, but also by needs, so functional solutions should meet those needs. Creating an attractive architectural form that meets the requirements of the aesthetics of the designed space does not exclude the existence of an object offering both comfort and functional efficiency.

So, what conditions should be met to achieve an architectural consensus?

They will certainly be open-minded perceptions and empathy, guaranteeing understanding of each other’s needs. A newly built architectural object is each time a kind of event – it

¹ R. Loegler, *Tworzenie architektury – od wolnej myśli do skonsolidowanej formy*, Architecturae et Artibus, 2016, vol. 8, no. 2, pp. 32–37.

is like a book with dedication, given to a particular person. It is a gift given to people, the city and the world. Being an attentive, open-minded observer who refers with empathy to the articulated aesthetic and functional priorities, tying everything together with a buckle of professional experience and technical knowledge, we will fit into the Vitruvius triad.

Contrary to the opinion of Loegler, who claims that the beauty of a building is connected with this something, that is, aesthetic experience, which according to him is “one of the conditions of our humanity,”² it is worth adding here that thinking about the comfort of a man using an object is even more a manifestation of our humanity. Before buying an exclusive car in a showroom we can be inside it, courtesy of the staff. Smell the new upholstery, touch the steering wheel, check its size and ergonomics of the interior. We can experience the vehicle space offered to us and check if the charming form goes hand in hand with the comfort of use. “Nothing remains as deep in the memory as experience”³ – so it is necessary to get an insight into the space we are going to be in, on which sometimes (like a car) not only our comfort but also our safety may depend. Experiencing future architecture before its implementation is much more difficult in this context – the average user does not have the right tools (imagination, necessary technical knowledge) to make an objective assessment. He is doomed to the materials given to him by the designer – and yet the building, like the above mentioned gift, is at this stage usually wrapped in top-class visions.

Using modern digital tools, colourful images are generated, inviting interaction. They lure with light, good quality finishing materials, where in the glass sheets we register the passing time dressed in clouds, and the green even rustles dancing in gusts of wind. The painting. A beautiful picture of our future, in which, as soon as we replace the characters on the presented views, we will be happy and as perfect as the architecture presented on them. But how much can you rely on the truthfulness of the visualizations attached to the project? Will the image seen, which is the most important form of communication in the design process, be faithful to the original, with which the meeting will take place after the indicated time? Will the design assumptions, emotions and images provided by the computer-generated graphic representations of the object remain the same?

In the commercial spectacle, the role of the second character is played by marketing effectiveness. He can mumble, camouflage, carefully avoid any less representative fragments, too small, too large, not adequately lit. In a world dominated by economics, there is often no room for an individual approach to the needs of the future user, to provide an opportunity for a personal experience of the space in which they will function. This is related to many factors, the simplest of which is usually the lack of a sign of equality between the investor and the future user of the designed object.

At this point, it is also worthwhile to consider the issue of sincerity of graphic representations and the ethics of their creation. The designer usually faces the need to meet the economic and aesthetic needs of the investor (who is his direct employer) and the real needs and convenience of future users of the facility (who are often anonymous at the design stage). His knowledge, intuition and professional experience should help less experienced members of the design process to recognize the real value of the future facility and speak on behalf of those who cannot do so alone at this stage. The trust in perfectly executed

² *Ibidem*, p. 32.

³ T. Dyckhoff, *Epoka spektaklu, Perypetie architektury i miasta XXI wieku*, Karakter, Kraków 2018, p. 185.

but unrealistic images of the designed building is much more affected by its consequences for the investor and the future user of the building. Their perceptions of space may differ significantly from what they have been able to read from them.

Design reliability requires the involvement of all the designer's senses in the design process. They should provide him with a set of guidelines, thanks to which the created spaces will better adapt to the real needs of future users. In the *Second Book of Architecture*, Palladio writes "about the ornamentation and comfort that private buildings should be designed to accommodate."⁴ The word "convenience" used in the text is nowadays rarely used by architects. And yet, that's where the essence of architecture lies. As well as "dignity", which should be the main measure of the quality of the architecture recipient's feelings. Decent, stable, decent, prestigious – these are terms that bring positive associations with a comfortable architectural space. These should be referred to when designing a space with a human mind. Many of today's architectural objects can be said to correspond to their purpose, but it cannot always be added that they are also convenient for their users. This category, almost colloquial, against its simplicity carries important content and meaning.

3. ARCHITECTURE – THE TRUTH OF THE OBSERVER AND THE TRUTH OF THE USER

An architectural object, like any space surrounding a person, has an emotional impact, both on the passive observer and on the user. The impact is not the same. The observer is mainly satisfied with the visual experience, while the recipient, who uses the space to be used, experiences it with his whole self. The way we perceive architecture visually depends largely on the type of material it is made of, its form and context. The geometric form "is dominant, penetrates all areas, its action is visual and psychological."⁵ Originality and modernity, however, do not have to and even should not remain in the foreground, displacing human comfort and psychophysical conditions in the design process. An example of the extravagant architecture still arousing interest today is the estate of cubic houses designed by Pieta Blom (toxic space). Built in 1977 in Rotterdam, it does not meet the basic functional requirements. An apartment cube tilted by 45 degrees, set on a cuboidal pylon, is a bizarre space that is difficult to arrange. The buyers, fascinated by a different form, complained about the inconvenient use of the interior after living there, but most of all they felt headaches and dizziness. To the person used to the standard position of the floor, walls and ceiling felt lost, the perception of the space was disturbed, not to mention about the use comfort.

The sensibility of architecture requires a comprehensive analysis of the way all building components interact with the space user. It should be remembered that stimuli from different sources (sound, smell, light, texture, colour) collectively resonate longer and more intensely than single, abstracted in the laboratory signals. For this reason, the right functional layout and the right choice of finishing materials, both outside and inside the building, are crucial for the user's comfort. Comfort understood not only in the context of ensuring appropriate parameters of air quality – its temperature, cleanliness and humidity,

⁴ A. Palladio, *Cztery księgi o architekturze*, PWN, Warszawa 1955, p. 75.

⁵ F. Léger, *Funkcje malarstwa*, PIW, Warszawa 1970, pp. 83–88.

but also in the context of comfort, dignity or not very popular, psychological comfort of the user. Carefully thought-out design provides the recipient with a positive feeling. In textures, colours, acoustics, rhythms are the elements of the puzzle that can be a perfect complement to life – like a set design that perfectly complements the subsequent acts of the show. The key to success is skillful control of the whole assumption. An experienced architect should pay equal attention to all the elements of the project, being aware of their comprehensive significance. The user, as the name suggests, uses the object, and the designer's task is to ensure that it can function efficiently and comfortably (“dignified”) in it. The design process is, among other things, “a search for a form that reflects the inner content of a building” and “a form that allows to express beauty” and arouse emotions, thus drawing “the observer into the current of the creator's thoughts, reality and the truth about his life.”⁶ Considering the needs of the other actor in the game – the user of the building – one should look at the question of his truth. Beauty and visual forms grew from different tastes and currents, have never been and are not objective truths. Their value is determined by individual preferences and the current fashion. They're unmeasurable. In opposition, there is comfort of use and functionality of the architecture, as perceptible, tangible components of it. It is easy to assess whether a given space fulfils its purpose and meets the expectations of the recipient, considering, for example, workplaces in terms of their position, orientation or usable area intended for specific activities.

True art of design, it is architecture that grew out of the involvement of imagination and vision in the creative process. Architecture that satisfies the aesthetic needs of observers, but at the same time carefully leans over man, the recipient of a given work, over his emotions and existential needs, going far beyond the primitive desire to provide shelter from unfavourable weather conditions. It is an art that combines inseparably visual needs with utility needs. True architecture is not only an eye-catching image (even if it could pretend to be an icon), but also, or perhaps most importantly, an object in which form (beauty) and function (comfort of use) are intertwined, creating an inseparable whole.

4. PASSIVE CONSTRUCTION AND COMFORT OF USE

In recent years, passive construction has been popular, which undoubtedly stems from environmental awareness and possible savings associated with the use of buildings. It requires the use of specific, high quality building materials as well as advanced technologies and energy systems. In the interdisciplinary design processes in the field of passive construction, the scale often leans towards specialist industries whose task is to determine optimal heat management. The design process becomes an interdisciplinary activity, in which specialist designs of internal installations receive equal importance as the architectural form. Target technical parameters of the building affect the location and amount of glazing, heat loss is minimized by increased thickness of the thermal insulation layer. The advantage is a compact form with a repeatable façade, equipped with a number of automatic systems that limit the user's freedom in the name of thermal comfort of the building (zone ventilation and air conditioning of floors, blinds regulating excessive heating of rooms, non-open windows, etc.). The aesthetics of facades often influences the functional

⁶ R. Loegler, *op. cit.*, p. 34.

arrangement of interiors – the prototypes of such solutions can be found in the work of architects operating in Chicago in the late 19th and early 20th century. Although it is difficult to call the buildings being constructed at that time passive, their cubic shape with a steel structure marking the characteristic facade divisions still sets popular design trends today – especially in the case of office buildings. The above trend, combined with the need to limit heat losses and to meet high requirements for obtaining an adequate amount of usable space, sometimes leads to the design of interiors (workplaces, flats) that are insufficiently illuminated, although – in accordance with the applicable regulations. This applies especially to narrow, vertical windows reaching the floor, cut out in relatively thick walls. This type of glazing makes it possible to reduce the width of rooms, while maintaining deep tracts. Vertical windows beautifully frame views and are a subtle allusion to historical solutions.⁷ However, one must not forget that this solution, although aesthetically attractive, limits the real possibilities of room arrangement. In office buildings, workplaces usually enter into the light of the opening – generating an unsightly “clutter from under the desk” for passers-by, in apartments, the problem usually concerns single bedrooms (children’s rooms), which are necessarily arranged with furniture in a “railway wagon” manner, and the lower part of the window is usually obscured to avoid excessive insight from outside. In addition, vertical windows concentrate the illuminated zone in a narrow strip on the floor, primarily near the opening, leaving part of the room unlit. When analysing the influence of the shape of window openings on the quality of the interior and comfort of use, it is worth asking ourselves whether slender window openings, which otherwise frame the exterior beautifully, have the same aesthetic value as the usable one?

Also, the compactness of passive building blocks, which is ideal when simple and uniform, with as few elements sculpting the monolith as possible, can create very interesting architectural compositions, is sometimes problematic to use. A graceful, proportional and seemingly well-designed building, however, given the functions to which it is intended to be used, for example residential and office buildings, can be a disappointment. The deliberate elimination of balconies, loggias and, as a consequence, leisure functions in favour of reducing the operating costs of the entire investment proves disastrous for the user, often resulting in a desire to change the choice of premises.

Three truths can collide here: the truth of the designer, the truth of the observer and the truth of the user. Each of them will be able to see in the concept of values and flaws presented above, but it is worth remembering that the user of a given space will struggle the longest with negative effects of the design decisions taken. Narrow windows do not provide too much direct or indirect light reflecting from the surface of the walls, as this light will not always have a chance to reach them. It is usually a narrow beam of light in a fairly dark room, which creates eye-opening contrasts, juxtaposing brightly lit surfaces with dark ones. A dream photographic setting. Grasp the contrast, cutting the plane. Grasp it and leave it framed, which hung on the wall of a suitably adapted office room, will please the eye of everyone. However, in a room intended for work, it is worthwhile to focus on solutions that will support the employee, rather than increase his or her fatigue and adversely affect concentration.

⁷ In the modern era architects were criticized for using horizontal windows, because they were associated with something “inhuman” – vertical windows were combined with an upright human figure, which according to critics was a much more “appropriate” solution.

5. COLOUR IN INTERIORS

The same applies to finishing materials used in modern construction. Fashionable raw concrete, grays and whites, polished surfaces do not always have a positive effect on user comfort.

“In architecture, the problem is [...] colour and its dynamic function, whether static, decorative or storming. [...] The wall covered with paint becomes a living surface.”⁸ The texture, the size of the space, its proportions, the whole composition, are powerful means of the perception of space. Modern technologies of design processes, digital production of high quality prefabricated elements, generate excellent quality images stimulating human reactions to a form or its part.⁹ Finishing elements, both indoors and outdoors, are of great importance, they attract attention, arouse interest and calm down the smoothness of their structure. Often, in an unpredictable way, they can act as a depressor or annoyance to the recipient. An example of the so-called colour abuse can be used in the main hall of the Castle Culture Centre in Poznań.¹⁰ The deep red coated tube, located in the central part of the space mentioned above, fits perfectly with the severity of the concrete constituting the context. Visitors accept the space, praising the originality of the form, but those working inside complain about tiredness. Red light causes acceleration of breathing and heart rate, a clear increase in blood pressure and an increase in the frequency of eyelid blinking, physiologically affecting the nervous system. This is also confirmed by Mączyńska-Frydryszek, Jaskólska-Klaus, Maruszewski,¹¹ who claimed that a few hours of being surrounded by intense red irritates the conjunctiva of the eye and causes tearing. Red is a dynamic, eye-catching colour, it stimulates the psyche the most.¹² Overwork, incorrect choice of colour, incorrect material combination, faulty lighting, oversizing of dimensions, testify to the lack of design imagination, negatively influencing the perception of space by man and his psychophysical state.

Also, the arrangement of architectural interiors in shades of green, seemingly soothing, can have a disastrous effect. The psychological significance of green is a soothing effect on the human nervous system, it calms down, reduces stress. Using the wrong tone of colour may result in a negative reception. In the offices of one of the well-known banks in the country, the walls were covered with greenery, strongly referring to the colour of the company logo. Dark, saturated greenery of the interiors and equipment had a negative effect on employees who, after a few hours in the workplace, complained about the feeling of depression, sadness, lack of energy and apathy.¹³

The shades of green mixed with blue (“mint green”) colour evoke optimistic associations, associating with calmness and an open attitude to listening to others. This kind of green colour can be observed in hospital interiors. The neutrality of the applied mint tone generally

⁸ F. Leger, *op. cit.*, pp. 122–126.

⁹ J. Młodkowski, *Aktywność wizualna człowieka*, Wydawnictwo Naukowe PWN, Warszawa 1998, p. 314.

¹⁰ K. Słuchocka – the research conducted in 2016 on a group of 20 people staying in the hall temporarily and on a selected group of attendants, staying more than 5 hours in the “tube”.

¹¹ A. Mączyńska-Frydryszek, M. Jaskólska-Klaus, T. Maruszewski, *Psychofizjologia widzenia*, Akademia Sztuk Pięknych, Poznań 2001, p. 163.

¹² K. Sobczyńska – the research on the influence of particular colours on human feelings and emotional reactions, conducted between 2016 and 2017 on a group of 40 students of the Faculty of Architecture and 40 visually impaired people.

¹³ K. Słuchocka – research conducted in 2016 on a selected group of bank employees based in Poznań.

meets the assumptions, which should ensure the design effectiveness of the assumed assumption. The patient's attitude should therefore be positive, calm and serene, however, colour overuse causes overload and monotony, and colour repetition implies irritation or excessive boredom and lack of motivation. There may also be a synergistic colour transfer phenomenon when a given shade, regardless of its location, is associated with hospital space, which usually means illness and anxiety.¹⁴

6. CONCLUSION

The issues indicated above do not constitute the full spectrum that the architect should take into account during design. The issues related to the proper selection of finishing materials in the context of their social acceptance (raw concrete, glass as the favourite materials of modern architects, are not always equally well received by laymen), detailed problems related to interior design, analysis of ergonomic conditions were not addressed.

The issues mentioned in the study already clearly indicate that designing objects, not only those with a specialized purpose, requires coordination of many industries, including the compilation of technical issues with contemporary research in psychology and sociology. A contemporary designer is a person with many faces, and the success of a designed object is very often the result of the actions of multi-person teams.

The presented image of architecture in relation to its actual assessment, considered in terms of form, function and comfort of use, leaves unambiguous conclusions, indicating frequent inconsistencies between the architecture of beauty and the comfort of the person for whom it is created. It is, after all, the art of shaping space in order to satisfy precisely its needs, but the perception of many architectural structures does not always go hand in hand with expectations, bringing unexpected consequences. The old saying that "not all gold that shines" makes sense in relation to architecture. Every time, whether it's picking up the keys to a new apartment or crossing the threshold of an office, company or store, the recipient should be enchanted by the creation of interiors, their compositional and material perfection, and not disappointed by the overwhelming ergonomic shortcomings or limitations resulting from economic assumptions. Direct users of a given space, whose needs should be met in an integrated and harmonious way by the designer, usually prefer spaces that are legible, understandable, as well as useful and not without charm.

The value of effective design lies in meeting the needs of all parties involved in the design process, a holistic perception of the goal, i.e. the human being, and an empathic attitude towards it. Black on white, without distorting reality, simply frankly – so that the power of the created forms could form the basis of a true, open for the future existence.

References

- [1] Dyckhoff T., *Epoka spektaklu, Perypetie architektury i miasta XXI wieku, Karakter*, Kraków 2018.
- [2] Kaszuba J., Sobczyńska K., *To see the space. Zobaczyć przestrzeń*, Wydawnictwo Dygresje, Poznań 2016.

¹⁴ K. Słuchocka, *Opinion of people spending a lot of time in hospitals due to their health condition, research* Poznań 2016.

- [3] Léger F., *Funkcje malarstwa*, PIW, Warszawa 1970.
- [4] Loegler R., *Tworzenie architektury – od wolnej myśli do skonsolidowanej formy*, Architecturae et Artibus, 2016, vol. 8, no. 2, pp. 32–37.
- [5] Mączyńska-Frydryszek A., Jaskólska-Klaus M., Maruszewski T., *Psychofizjologia widzenia*, Akademia Sztuk Pięknych, Poznań 2001.
- [6] Młodkowski J., *Aktywność wizualna człowieka*, Wydawnictwo Naukowe PWN, Warszawa 1998.
- [7] Palladio A., *Cztery księgi o architekturze*, PWN, Warszawa 1955.
- [8] Słuchocka K., *Toxic space, transparent space, identity space* [in:] E. Pruszwicz-Sipińska (ed.), *Architecture & Health*, Wydział Architektury Politechniki Poznańskiej, Poznań 2015, pp. 227–237.
- [9] Świt-Jankowska B., *Wizualizacja architektoniczna jako współczesne narzędzie pracy architekta*, PhD thesis, Wydawnictwo Politechniki Poznańskiej, Poznań 2011.

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