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OPTICAL ILLUSIONS IN SACRAL SPACE

ZŁUDZENIA OPTYCZNE W ŚWIĘTEJ PRZESTRZENI

Abstract

The study attempts to trace the techniques and means of using optical illusions in sacral space of ancient temples, which are the subject of architectural heritage and modern trends, analyse the world samples and works of Ukrainian architects. In order to systematize the collected empirical data, it is divided into three main groups: optical illusions in the three-dimensional structure of sacral space, monumental painting, and lighting effects in the interior and exterior environment. Detection results of the study can be an application tool for using the laws of optical illusions to organize the sacred spaces of modern temples.

Keywords: sacral space, optical illusions, architecture, temple, painting, light

Streszczenie

W badaniach podjęto próbę prześledzenia technik i środków wykorzystania złudzeń optycznych w przestrzeni sakralnej na podstawie starożytnych świątyń, które są obiektami dziedzictwa architektonicznego i współczesnych trendów, przeanalizowano światowe próbki i dzieła ukraińskich architektów. W celu usystematyzowania zebrane dane materiału empirycznego zostały podzielone na trzy główne grupy: złudzenia optyczne w trójwymiarowej strukturze przestrzeni sakralnej, monumentalne malarstwo, efekty świetlne w środowisku wewnętrznym i zewnętrznym. Wyniki badań mogą stać się narzędziem wykorzystywania praw iluzji optycznych do organizowania przestrzeni sakralnych współczesnych świątyń.

Słowa kluczowe: przestrzeń sakralna, złudzenia optyczne, architektura, świątynia, malarstwo, światło

1. INTRODUCTION

Optical properties of visual sight have long been used to enhance the aesthetic perception of works of art or architectural structures that artists have skillfully used since ancient Egypt, Rome and Greece. The development of this trend in works of art can be traced to the present day. *Optical illusions* are an optical deception of our brain: eyes see the image of one object, but the brain transforms it in its own way.

The main types of optical illusions are: color perception, depth of space, silhouette. In the architectural environment illusions are present in both interior and exterior decoration. The main locations are on the walls, ceilings, floor, facades, etc.

The most common typical form of illusions is hyperbolization of depth and space, which allows to form imagery and stylistic principles and to show author's specialities of placing art schemes on an already given plane and in three-dimensional filling.

Another issue is to create the illusion of large-scale internal space, in the context of the overall spatial organization of the sacral interior, inside churches and small chapels by using

monumental painting. Monumentalists created a large number of paintings that are illusory expanding and modifying the architecture and space of the temple.

One of the formative elements of sacral space is light. Penetrating mainly from above, the streams of light change the parameters of space; establish a certain architectural and spatial hierarchy, which corresponds to the symbolic construction of the temple. Light causes unexpected visual effects, which creates a corresponding mystagogical mood, enhances the recipient's illusory perception and metaphorical nature of space[1].

2. ILLUSIONS IN THREE-DIMENSIONAL STRUCTURE

A significant number of brain processes are involved in the visual perception of the image. First of all, the analysis of the location of the main facets and angles, volume, colour structures & positions of light sources begins. In many cases, this analysis is subconsciously inaccurate – there is a correction of visual images. Optical illusions lead to distorted (25% or more) results of the evaluation of real geometric parameters.

Using optical illusions in architecture in general, and in three-dimensional construction of sacral spaces in particular, is not new. Ancient architects used various geometric techniques of three-dimensional construction, which allowed the architectural structure of the temple to look in accordance with its purpose. From the oldest megalithic structures: Stonehenge, Britain; works of ancient antiquity – Parthenon, Greece and so on.

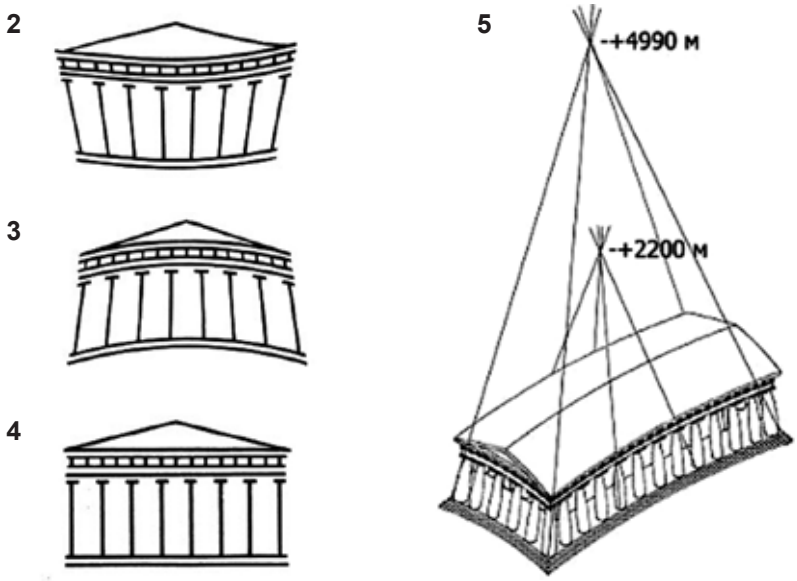
One of the most notable examples is the Parthenon in Athens, Greece, built more than 25 centuries ago. The large number of subtle techniques used by the architects of the Parthenon makes it look straight standing and harmonic (viewer's perception is right). Slightly wider corner columns, pillars that bend inward, entasis, and a floor that is 6 cm higher in the center – all in order to give the Parthenon a lasting beauty, which can be seen even in its current state (Ill. 1–5).

Ill. 1. Parthenon, Athens, Greece

[1] L. Gnatiuk, M. Terletska, *Aesthetics shaping sacred space*, Theory and practice of design. Technical aesthetics, 2017, no. 11, pp. 42–55, DOI: 10.18372/2415–8151.11.11876

The theorist of proportions of the 20th century *Le Corbusier* said that *"the Parthenon is more than architecture, it is a sculpture"*[2].

Indeed, a careful study of the Parthenon is found in its structure, as in the human body, there are no straight lines. The lines of the Parthenon are filled with life and plasticity.



Ill. 2. Optical illusions of perception of the Parthenon: look as if the construction lines were strictly horizontal and vertical
Ill. 3. Optical illusions of perception of the Parthenon: in fact
Ill. 4. Optical illusions of perception of the Parthenon: view due to optical corrections
Ill. 5. Optical illusions of perception of the Parthenon: graphical diagram of the inclination of the columns and the curvature of the lines are greatly exaggerated

2.1. TEMPLES OF UKRAINE

Volodymyr Sichynskyi describing one of the major shrines of the Ukrainian Greek Catholics St. George's Cathedral in Lviv (1744–1762) wrote – "… the architect Meretin used ingenious ways of illusory alleviation of all upper condignations, according to the optical laws of lightness, airiness and spatial vibration, completion of the structure in the form of parapets and lanterns that 'burn' and melt in the air, as if connecting with the sky itself – an inaccessible realm"[3]. This analytical characteristic fully reveals the successful application of the principles of spatial illusion in architectural practice.

Sacred architecture of Ukrainian region of Boykivschyna (Boyko region) impresses with the originality of proportions, in particular optical illusions, deliberately used by builders to create a sense of psychological elevation of the domes (Ill. 6). The feeling of immensity of space is enhanced by the fact that the walls are set with a slight slope inward

[2] Le Corbusier, *Le Modulor I*, Ed. de l'architecture d'aujourd'hui, Boulogne 1950.
[3] V. Sichynskyy, *History of Ukrainian art. Architecture*, vol. I. New York.: Shevchenko Scientific Society in America, 1956, pp. 132–134.

and face log lines that are approaching in kinks, then rise up, creating a multiple of perspectives, the illusion of movement and great height (Ill. 7).

The highest perfection in the organization of internal space and its manifestation in the geometry of forms is achieved in the five-story cruciform temples. Their tops with oblique inserted sails, directed to one point in the corners between the arms (rectangular volumes located on the sides of the central part of the building), rely only on the outer walls and seem to float in the air (Church of the Ascension in the village of Berezna, Chernihiv region, artiste Panas Sholudko, 1759). This effect was achieved not so much by the physical size of the temple, as by artistic illusory means. The masters abandoned arches, sought to merge the space of five domes into one, and domes were boldly and simply constructed with sails (pendants, elements of the dome structure, providing a transition from square shape to the circumference of the drum of dome) (Ill. 8).

Otherwise, the same problem was solved by an unknown architect of the Trinity Church in the village of Pakuli, Chernihiv region (1710), also a five-dome structure with faceted log houses in the base. The central dome is more pronounced; its quadrangle (square in plan, the carcass cage) is raised to the second hall (a structural element of the completion of a wooden temple, which is a combination of a steep quadrangular or octagonal log house with a truncated pyramid) of the side dome. In the interior, it had its own features: arch cutouts are raised to the base of the sails, so that the transition from the main frame to the dome created an amazing game of space and intersection of planes in different angles of figured arch cutouts (Ill. 9).

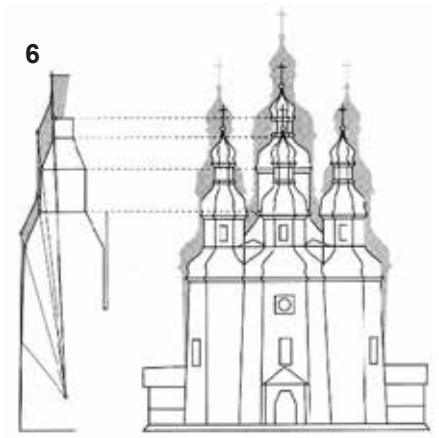
Such architectural and artistic solution to high-altitude expanding of the interior of wooden churches, which embodies the principles of harmonic architecture is unique across world architecture. Nowadays, to accomplish such tasks is possible only by using modern technology of monolithic reinforced concrete.

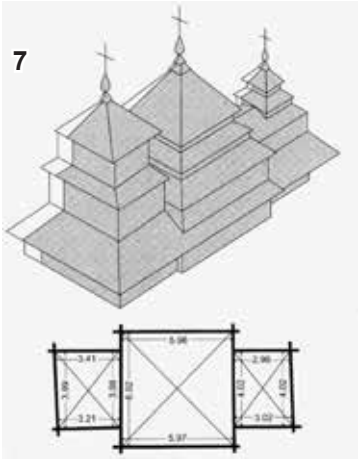
G. Pavlutsky[4], professor at the University of St. Volodymyr, wrote in 1905 that

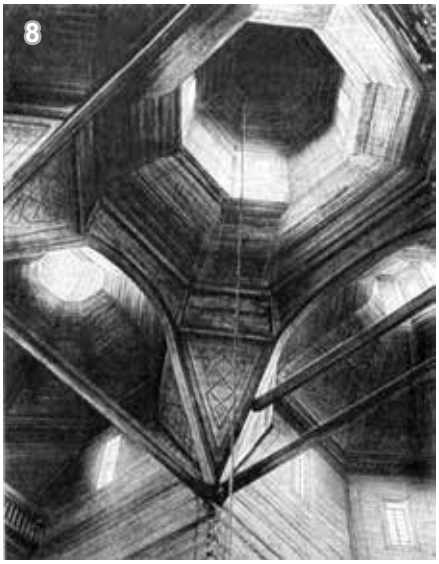
> none of the well-known European art-historical schemes can be applied to Ukrainian wooden churches. They can be attributed neither to the Gothic, nor to the Renaissance, nor to the Baroque. They in itself make up the style. This style naturally follows from the building material. This style has remained unchanged for centuries. Historical styles have influenced our churches, but have not changed the national style and its artistic character. Ukrainian wooden church building is a national art because it has combined and reworked all foreign elements, both Byzantine and Western.

An illustrative increase in the interior of Ukrainian wooden church is the ability to evoke a sense of height in the viewer, the impression that the church is much higher than in reality. High-altitude opening of space was carried out due to the slope of the walls and foldings. The proportionality of the three tops placed in one line, which stretched the entire volume along the east-west axis, was achieved by extending the transverse dimensions of the halls. Successfully organized visual perception and impression – the optical illusion – of a small wooden church created not only the scale of the building in relation to a human, but also in relation to the environment.

[4] G. Pavlutsky, *Antiquities of Ukraine: Wooden and stone temples*, Imperial Moscow Archaeological Society, Kyiv 1905.







Ill. 6. Illusory increase of the interior of the church by tilting the walls (Intercession Church in Romny, Sumy region, 1764), by Y. Taras[5]

Ill. 7. Illusory correct proportions (Church of St. Michael in the village of Uzhok Transcarpathian region, 1745), by Y. Taras[6]

Ill. 8. Interior of the Church of the Ascension in the village of Berezna, Chernihiv region, artiste Panas Sholudko, 1759, photo by G. Logvyn[7]

Ill. 9. Interior of the central, western and northern tops of the Trinity Church in the village of Pakuli of Chernihiv region, 1710, photo by S. Taranushenko[8]

[5] Ya.M. Taras, *Ukrainian sacral wooden architecture: Illustrated dictionary-reference book*, IN NANU, Lviv 2006.

[6] *Ibidem*.

[7] G.N. Logvyn, *Wooden architecture of Ukraine (XIV–XIX centuries)*, [in:] Yu. Aseev, M. Grytsay [et al.], *Essays on the history of architecture of the Ukrainian SSR: Pre-October period*, Kyiv 1957, pp. 200–231.

[8] S.A. Taranushenko, *Monumental wooden architecture of the Left Bank of Ukraine*, Kyiv 1976.

3. OPTICAL ILLUSIONS IN MONUMENTAL ART

For the first time, wall paintings marked by a tendency of the spatial persuasiveness of images were created by ancient Greek masters and later developed in ancient Rome. A new stage in the evolution of murals came in the Renaissance, where artists achieved a deep realism of images in their works. Renaissance wall painting is characterized by tendencies of illusory expansion of real space. There are many examples of architectural and sculptural imitations. In the forced perspective is used to make the object appear farther than it really is. The following method can be used: gradually reduce the scale of objects proportionally to the increasing distance from the observer. It creates the illusion that the size of these objects decreases due to their remote location.[9]

The illusion of a large space in the apse of St. Mary church in San Satiro (Santa Maria presso San Satiro) in Milan, Italy (Ill. 10). In fact, the space is about one meter deep (Ill. 11).

Ill. 10, 11. Santa Maria in San Satiro, Milan, Italy

3.1. PAINTINGS OF THE CHURCH ALONG WITH UKRAINE

During the Renaissance, the tendency to use optical illusions became very popular in among the Lviv architects[10]. The tendency of creating illusory spaces by murals instead of just plain walls is characteristic of the Baroque style: Cathedral of St. Andrew, the Church of the Apostles Peter and Paul, the Church of Archangel Michael (Ill. 12). Murals of classicism were dominated by images that mimicked sculptures in the technique of grisaille. Eventually principles of monumental painting transformed into one of the most popular art – trompley (from French *trick of vision* – a technique in art, which creates optical illusion of volume shown in two-dimensional plane of the object).

We can see such optical illusion in the interior of the Church of St. Peter and Paul. There is an imitation of architectural details, decorative objects and illusion of sculptural modeling. There is also an angel on the bracket that holds the cap under the arches of the left nave and illusory balcony, on the arch side of the nave (Ill. 13). Illusions in the interior help to get

[9] M. Luckiesh, *Visual Illusions: Their Causes, Characteristics and Applications*, Project Gutenberg 2011, p. 184.

[10] Yu. Biryulov [et al.], *Arkhitektura L'vova: chas i styli XIII–XXI st*., Tsentr Europy, Lviv 2008, p. 720.

rid of many shortcomings, and in general can make the environment unique and extremely interesting, at least for our eyes and perception.

Such optical illusions are actively present in the ornamental and figurative compositions of the polychromies of the famous Galician monumentalist Modest Sosenko.

Ill. 12. Plafond of the Church of the Archangel Michael in Lviv
Ill. 13. Painting of the Church of the Apostles Peter and Paul in Lviv

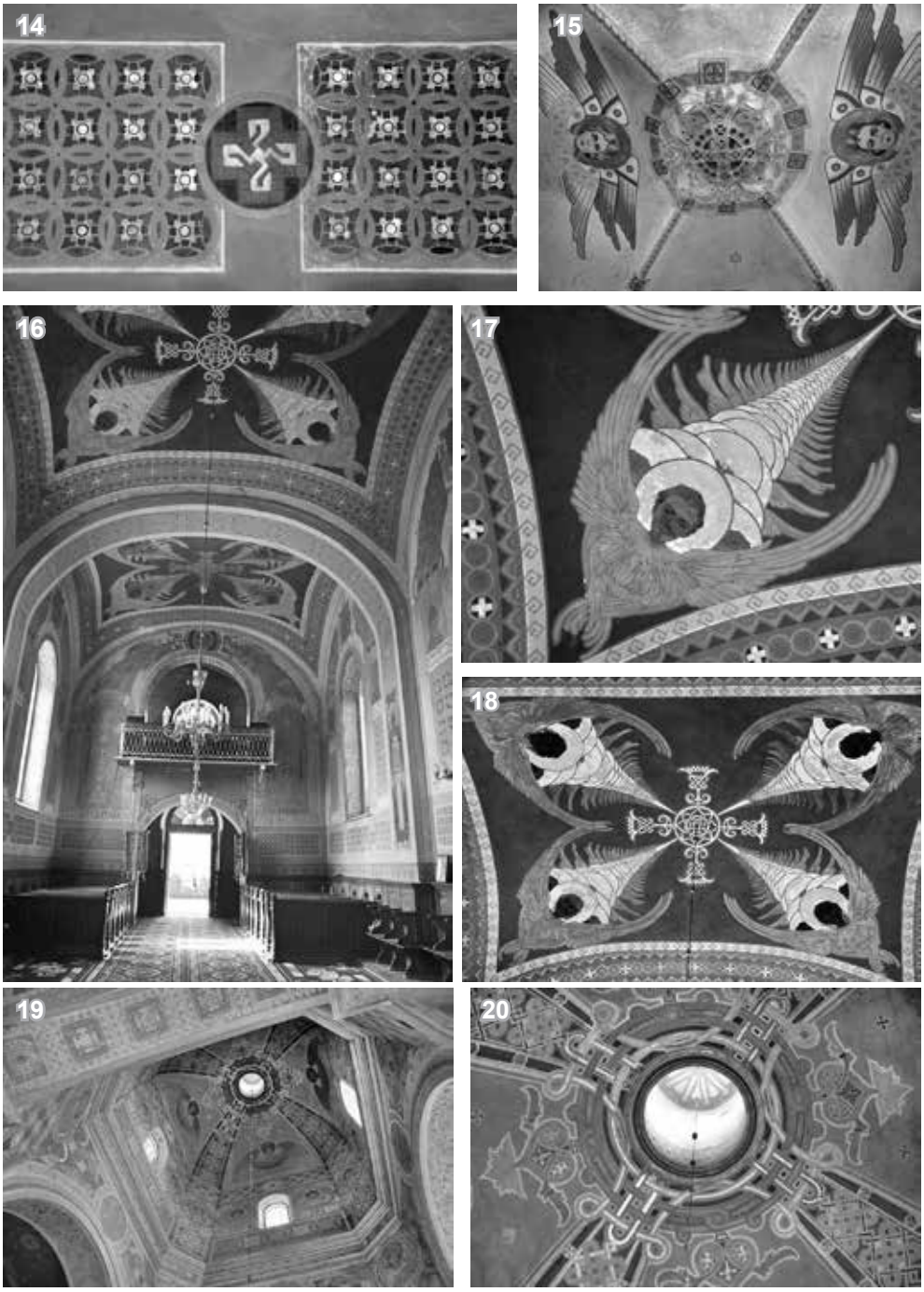
In his monumental paintings M. Sosenko used principles of optical illusions well-known and approbated for centuries long. These methods, technics, means and instruments of monumental art were used to create the interior environment of sacral architecture. The artist created an illusion of three-dimensional figures that are exiting the physical structure of the wall. 3D drawing[11] of chapels, architectural details are perceived as real elements of the sacral interior of the Church of St. Michael the Archangel, Pidberiztsi, Lviv region.

The illusion of volume is used in numerous modular ornamental patterns, striped ornamental schemes, where the main line is "shaded", creating the effect of wood carving or three-dimensional polychrome decorative panels, etc. (Ill. 14–15).

Perspective hyperbolization – almost horizontal sails of the vault visually acquired a steep angle (Ill. 16–18). This effect is obtained by reducing mutually similar elements of the ornament to the center of composition and different coloristic techniques.

Illusion of depth and formation of two-plane image and figurative metaphor of "infinite dome" (Ill. 19–20): with the help of complex mathematical calculation of background segments perspective reduction the effect of depth on static and planar figurative silhouettes of image (figures of Evangelists, saints, etc.) is formed. We see the illusion of high spacious dome that in reality is a flat surface.

[11] Art Lviv, *Modest Sosenko*, https://art.lviv-online.com/modest-sosenko/ (access: 20.05.2020).



III. 14–20. Painting of M. Sosenko, Church of St. Michael the Archangel, Pidberiztsi, Lviv region[12]

[12] Local History and tourist portal: Land, http://www.kray.org.ua/ (access: 20.05.2020).

4. LIGHT

Light is one of the formative elements in architecture. It is important for the perception of both external and internal space. For Christian architecture, light is one of the most important theological categories. The Gospel of St. John clearly states, "God is the Light…". The light in the interior of the church enhances the emotional perception and experience of the liturgical prayer.

Light in the sacred space of the temple becomes the unifying basis, one of the main tools of creating divine atmosphere. At the same time, it is the highest goal of such creation. The light that enters the temple mainly from above, determines the parameters of space, establishes a hierarchy, subordinates the constituent elements, introduces dynamics, creates the appropriate mood, and puts the temple visitor in a state of illusion, enhancing aesthetic experiences and causing unexpected visual effects[13].

The task of creating a grand light image in the space of the Church of St. Sophia of Constantinople (Hagia Sophia) (Ill. 21–22), associated with a special aesthetics of light, which largely determined its material tectonic structure. That is, the light composition becomes a kind of intangible "framework", which subordinates, not complements the stone shell of the building.

Ill. 21, 22. St. Sofia, Constantinople, Turkey

Today there are three types of temples construction across the world. First type is characterised by the degree of natural light interference in the interior space which indicates their significant separation from the environment, declaring introversion, depth in their inner world. Second type, characterised by dosing the incoming light, usually illuminating the main spaces or fragments of sacred space. The third group includes buildings that are fully open to the outside environment, combining internal and external spaces.

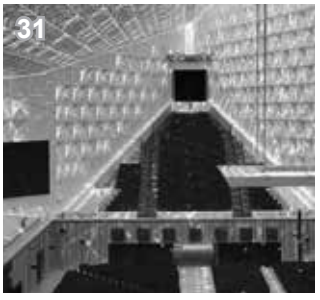
The first group includes, first of all, P. Zumtor's project of a small chapel of Brother Klaus, which from the outside (Ill. 23) looks like a sloppy silo tower, the gloomy interior is illuminated by natural light (Ill. 24) which pours down from an oval opening at the top of the building.

The space of the chapel is visually separated from the environment and only light and shadow attract the visitor's attention. Similar lighting of sacred spaces is observed in the works of Japanese architect Tadao Ando in Temple of Light, Ibaraki, Japan (1989) (Ill. 25). In many modern monumental and minimalist temples, the interior of which is devoid of

[13] A. Siwek, *Światło jako czynnik kształtowania architektury współczesnych świątyń chrześcijańskich*, Zeszyty Naukowe Politechniki Śląskiej. Architektura, 2006, no. 44, pp. 205–210.

architectural details that often evoke a sense of emptiness, the only creator of sacredness is natural light.

Another meaning of light was declared by artists of the recent past, for whom the space of architecture is a ratio of abstract concepts. The avant-garde world of art interprets light in a new way. Le Corbusier in the Church of Saint Pierre in Firmin, France (1960–2006) (Ill. 26) and the Chapel of Notre Dame du Haut in Ronshan (Ill. 27–28) preferred semi-dark spaces; he was not a supporter of excessive lighting of sacred interiors.



Ill. 23, 24. Chapel of Brother Klaus of Peter Zumtor, Wahendorf, Germany
Ill. 25. Temple of Light of Tadao Ando, Ibaraki, Japan[14]
Ill. 26. Church of Saint Pierre of Le Corbusier in Firmin, France[15]
Ill. 27, 28. Chapel of Notre Dame du Haut of Le Corbusier in Ronshan, France[16]
Ill. 29–31. Crystal Cathedral of Philip Johnson, California, USA[17]

[14] Temple of Light, http://artishock.org/architectura/aziya/hram-sveta-yaponiya (access: 20.05.2020).
[15] *Fondation Le Corbusier*, https://frenchparis.ru/fondation-le-corbusie (access: 20.05.2020).
[16] *Ibidem*.
[17] *CREDO*, https://credo.pro/2013/10/104334 (access: 20.05.2020).

Light, a symbol of God's presence, penetrates the space of buildings through small slits in the walls. Light accentuates separate spaces and elements of the chapel. In the radiance of divine light, a statue of the Mother of God appears on the altar wall. Large temples, such as the Cathedral of the Virgin in Naviges, Germany (1969), can also be significantly "darkened". Light in such temples is a universal means of identifying the function of architectural space, a factor that provides an atmosphere of concentration and meditation, suitable for contemplation and prayer.

The architectural image of the building from the outside is formed as a "well-thought-out flawless play of volumes in the light"[18].

The gradual illumination of sacred objects reached its apogee in a number of modern parish churches and chapels for believers of various denominations. In temples such as Philip Johnson's Crystal Cathedral (Ill. 29–31), transparent walls boldly are let in. The light that fills the space of the nave acquires a new mystical expression and openness to all, regardless of faith.

Light is the traditional and main creator in the temple environment and of its sacred space, architecture and mystical mood. It remains almost the last clear carrier of metaphysical and theological content.

4.1. LIGHT IN MODERN CHURCHES OF UKRAINE

The architectonics of the traditional Christian church is based on its symbolic light structure. Due to the permanency of religious essence of its components it remained relatively unchanged during the formation and development of sacred architecture.

Modern interpretations of light seen in the St. Basil the Great Church – the traditional dome, symbol of the sky, replaced by a glass vault (Ill. 32–33). More traditional space to form a light came when designing the Patriarchal Cathedral of the Resurrection of Christ (Ill. 34–35).

5. CONCLUSIONS

Optical illusions in the creation of sacred space have long been used as a facilitator that helps to stop, pause, meditate about the reality around us, reality we would like to see, or reality which the architect wants us to see.

From a number of specific examples, it follows that the masters took into account the optical illusions in the construction of sacred space. By changing the size (intentional elongation, contraction or tilt of the planes), they neutralized the unwanted perception, creating a sacred space that symbolizes the presence of Heaven on the earth.

Architectonics of a traditional Christian church combines both the importance of light as an essential carrier of this structure and the factor of materialization of theological symbols and archetypes in the architectural expression of form, which could variate depending on changes in ideological and artistic landmarks, on search and development of their own regional means of expression.

The art of optical illusions has no indifferent spectators, it encourages mental work, evokes emotions. Often people react to illusions with humor, and this can also be considered a positive result, because the architect is called to design a harmonious and pleasant environment.

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[18] Le Corbusier, *W stronę architektury,* Fundacja Centrum Architektury, Warszawa 2012, p. 80.

Ill. 32. The play of light in the church of St. Basil the Great of the UGCC, Kyiv, Ukraine
Ill. 33. The vault in the church of St. Basil the Great of the UGCC, Kyiv, Ukraine
Ill. 34. Patriarchal Cathedral of the Resurrection of Christ of the UGCC, Kyiv, Ukraine
Ill. 35. Design of the dome in the Patriarchal cathedral. Christ Risen Church, UGCC, Kyiv, Ukraine[19]

Many temples are being built in Ukraine now. But the topic of optical illusions, unfortunately, is hardly paid attention to. In designing modern temple interiors, little attention is paid to surfaces of the walls under the frescoes and the iconostasis in general. It is important to pay attention not only to facades, but also to the appearance of the whole interior.

It is important that interior of sacred space in modern temple buildings comprehended and is designed in mutual communication with the outside environment.

[19] *Patriarchal Cathedral of the Resurrection of Christ*, https://sezamka.kiev.ua/photos_1_1_78_1002.html (access: 20.05.2020).

The use of the method of optical illusions in the design of the architectural environment provides unlimited space for imagination and the opportunity to create in each case a unique, inimitable piece of spatial art.

Visitors of the temple should feel themselves in space not entirely earthly and not entirely heavenly, but in a space which is a mediator. That is one of the main purposes of temples. And to recreate such a space, all means must be used: the ritual, the architecture, the images, and the light drama, and optical illusion.

References

[1] Art Lviv, *Modest Sosenko*, https://art.lviv-online.com/modest-sosenko/ (access: 20.05.2020).

[2] Biryulov Yu. [et al.], *Arkhitektura L'vova: chas i styli XIII-XXI st*., Tsentr Europy, Lviv 2008, p. 720.

[3] *CREDO*, https://credo.pro/2013/10/104334 (access: 20.05.2020).

[4] *Fondation Le Corbusier*, https://frenchparis.ru/fondation-le-corbusie (access: 20.05.2020).

[5] Gnatiuk L., Terletska M., *Aesthetics shaping sacred space*, Theory and practice of design. Technical aesthetics, 2017, no. 11, pp. 42–55, DOI: 10.18372/2415–8151.11.11876

[6] Hnidets R., *Architecture Ukrainian churches. The design and shape: teach. Handbook*, Publishing House of the National University "Lviv Polytechnic", Lviv 2009, p. 144.

[7] *Land*, http://www.kray.org.ua/ (access: 20.05.2020).

[8] Le Corbusier, *Le Modulor I*, Ed. de l'architecture d'aujourd'hui**,** Boulogne 1950.

[9] Le Corbusier, W stronę architektury, Fundacja Centrum Architektury, Warszawa 2012, p. 80.

[10] Logvin G.N., *Wooden architecture of Ukraine (XIV-XIX centuries)* [in:] Yu. Aseev, M. Grytsay [et al.], *Essays on the history of architecture of the Ukrainian SSR: Pre-October period*, Kyiv 1957, pp. 200–231.

[11] Luckiesh M., *Visual Illusions: Their Causes, Characteristics and Applications*. Project Gutenberg 2011, p. 184.

[12] *Patriarchal Cathedral of the Resurrection of Christ*, https://sezamka.kiev.ua/photos_1_1_78_1002.html (access: 20.05.2020).

[13] Pavlutsky G., *Antiquities of Ukraine: Wooden and stone temples*, Imperial Moscow Archaeological Society, Kyiv 1905.

[14] Prybeha L., *Wooden churches in the Ukrainian Carpathians*, Technology, Kyiv 2007, p. 168.

[15] Sichynskyy V., *History of Ukrainian art. Architecture*, vol. I. New York.: Shevchenko Scientific Society in America, 1956, pp. 132–134.

[16] Sichynskyy V., *Ukrainian wooden construction and methods of its research*, vol. CXLIV–CXLV, Praha 1926, pp. 157–170.

[17] Siwek A., *Światło jako czynnik kształtowania architektury współczesnych świątyń chrześcijańskich*, Zeszyty Naukowe Politechniki Śląskiej. Architektura, 2006, no. 44, pp. 205–210.

[18] Taranushenko S.A., *Monumental wooden architecture of the Left Bank of Ukraine*, Kyiv 1976.

[19] Taras Ya.M., *Ukrainian sacral wooden architecture:* Illustrated dictionary – reference book, IN NANU, Lviv 2006.

[20] Temple of Light, http://artishock.org/architectura/aziya/hram-sveta-yaponiya (access: 20.05.2020).

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