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ILLUSIONISTIC GAME OF LIGHT – THE ART OF SHAPING OF REALISTIC SPACE

ILUZJONISTYCZNA GRA ŚWIATŁA – SZTUKĄ KSZTAŁTOWANIA REALISTYCZNEJ PRZESTRZENI

Abstract

Vital daylight, not entirely predictable and not entirely perceptible, dependent on many external factors, kaleidoscopically changeable, harmonizing with a designed, often a metaphoric composition of closings and openings of space, has an effect on human emotions and human experience of architecture. The more predictable artificial light, diversified in terms of colour, intensity and direction, complements the picture of the object's form after twilight and of the scenography of its interior. This natural dynamics of staged light and shadow perversely complements the deceptively real and also illusionist urban and architectural space. This article deals with the author's research on the modelling of space by means of this unusual and ephemeral "immaterial matter" and on the results of the research; on the art of creating by means of light.

Keywords: light, shadow, space, illusion, emotions

Streszczenie

Witalne światło dzienne, nie do końca przewidywalne i uchwytne, zależne od wielu czynników zewnętrznych, kalejdoskopowo zmienne, współgrające z zaprojektowaną, często metaforyczną kompozycją zamknięć i otwarć przestrzeni, wpływa na ludzkie emocje i doświadczanie architektury. Bardziej przewidywalne światło sztuczne o różnej kolorystyce, natężeniu i kierunku uzupełnia obraz formy obiektu po zmierzchu i scenografii jej wnętrza. Ta naturalna dynamika wyreżyserowanego światła i cienia decyduje o dopełnieniu, przewrotnie: złudnie prawdziwej i iluzjonistycznej zarazem, przestrzeni urbanistycznej i architektonicznej. O autorskich badaniach i ich wynikach badań modelowania przestrzeni przy pomocy tej niezwyklej, ulotnej „niematerialnej materii”, o sztuce kreowania światłem traktuje ten artykuł.

Słowa kluczowe: światło, cień, przestrzeń, iluzja, emocje

1. INTRODUCTION

All material in nature, the mountains and the streams and the air and we, are made of Light which has been spent, and this crumpled mass called material casts a shadow, and the shadow belongs to Light.

Louis Isadore Kahn, an American architect, described in this simple way one of the most important tools used by creators of architecture. Thanks to light waves and our eyes,

we are able to perceive objects around us.¹ The integral part of a body is its shadow and this complementary, inseparable union builds a picture in our eyes. Proportions of light, umbra and penumbra activate the perception of shapes and the mutual relations of the colour of own and projected shadows bring out newly encountered bodies. They sharpen their contours or blur them.

The phenomenon described above is so obvious that it goes almost unnoticed while, in fact, its precise use is what provides the basis for creating good architecture.

2. MASTERS OF ILLUSION

The nature of elusive sunlight, including the reflected light, i.e. moonlight, is changeable despite the recurring rhythms of the seasons of the year or times of the day. Warm, soft and gentle, or sharp and strong light enables one to form a subtle game of light and shadow of a sculpture, body, its parts, details or interiors. Forms are not perceivable without light.

2.1. SCULPTING WITH LIGHT, ARCHETYPES

A gigantic machine for living in La Citta Nuova, designed by Antonio Sant'Elia, an Italian architect and futurist, emerges from a game of light and shadow played by expressive bodies of different shapes and textures.² *Metropolis*, a 1927 science fiction film directed by Fritz Lang, inspired by Sant'Elia's works, has delighted cinema lovers for almost a century³ with its avant-garde approach to light. Film frames built with glare and shadow give a sense of space remote in time. The scenography sketch for the film *Metropolis*, designed with subtle sensitivity by Erich Kettelhut in 1920, merely confirms the great importance of light in a motion picture. It builds mood and carries emotions.

The work *Kompozycja wisząca (1)*⁴ [Hanging Composition (1)] by Katarzyna Kobro, an excellent Polish sculptor linked with the inter-war avant-garde, shows what light means to a sculpture. A hanging elliptical form reveals a dramatic nature of space through the subtle structure of strong shadows and reflected light. In *Kompozycja przestrzenna (5)* [Spatial Composition (5)] of 1929, Kobro controls the intensity of monochromatic shadows of particular surfaces by means of light and shadow angle techniques; she interlinks them, forming a three-dimensional architecture of space. "Płaszczyzna w ten sposób interpretowana nie jest granicą ani powłoką, ale strefą rozproszonego, niematerialnego światła o cechach

¹ How important is the organ of sight – the human eye is surprisingly lightweight, it only weighs 8 grams while the sense of sight makes 80% of our perception!

² Several years later, Lech Niemojewski, a representative of the Polish avant-garde and modernism (like Sant'Elia), composed *Miasto Przyszłości* [City of the Future] (1925) while remaining consistent with the notions: cities, mass, machine, with bold concrete blocks of granaries and silos (1925). Until today, the bold futurist architectonic visions such as the city of La Citta Nuova, presented on Sant'Elia's original sketches, are visualised (e.g. by the Atkinson+CO studio) by means of advanced computer graphics.

³ The theme of the film does not always make the viewers delighted; this one is not optimistic and it is ahead of the times which, sadly, were to come.

⁴ The sculpture is also entitled *Konstrukcja wisząca I* [Hanging Structure I], it can be seen in the Museum of Art in Łódź thanks to a reconstruction made by Bolesław Utkin based on a preserved photography.



III. 1. Otto Piene, *Lichtballette* (1960), Museum of Contemporary Art in Herning, photo: J. Suchanek

III. 2. Jade Artistic Center in Beijing

III. 3, 4. Office buildings in Amsterdam and Beijing, photo: H. Michalak

identycznych z substancją przestrzeni”⁵ [A plane so interpreted is neither a borderline nor a layer but a zone of dispersed immaterial light with features identical to these of the substance of space] as in the best contemporary architecture by light masters such as Tadao Ando, Toyo Ito or Rem Koolhaas. The light coming out of the installation *Licht Ballet* (1960) by Otto Piene (Ill. 2), a German artist, uses an impressionist brush-like technique to apply light flares like perforated contemporary façades onto the interior walls of the Museum of Contemporary Art⁶ in Herning (Ill. 1). Piene enabled viewers to perceive space in a new way when creating *Grid Pictures* in 1957. Such light operation technique coming from movable sources of light is present in various periods of his creativity. By making background of a sculpture (in case of *Licht Ballet*: the ceiling, walls and floor) an important part of the way it is perceived, the artist expands its effect into a much larger space, similarly to Kobra. Apart from the static elements of the sculpture – installation, the kinetic elements used introduce the dynamics of the motion of lights into the way it is perceived. László Moholy-Nagy,⁷ a Bauhaus artist, who willingly employed simple, frequently transparent bodies, used a similar method to add poetic nature to his sculptures.

Light-and-shadow has always been used as a tool to create sculptures and architectonic works but there has been a shortage of good sources of artificial light, apart from natural light. Works by architects Ludwig Mies van der Rohe and Philip Johnson done on the Seagram Building, built in 1958, were supported by Richard Kelly. The building in which this American lighting designer used the concept of a “tower of light” seems to be levitating in space.⁸ Described and defined by Kelly’s space illumination methods: “ambient luminescence”, “focal glow” and “play of brilliants” have, along with the development of illumination techniques, marked the beginning of the contemporarily used harmony of an architectonic object and artificial light.⁹ The principles of fusing elements with the background or extracting them (Ill. 13), mirror reflections and refractions of light begin to play an increasingly important role in architecture and art.

The then highly avant-garde measures were more and more enthusiastically, willingly and equally effectively used by other artists. When James Turrell, an American artist, created *Afrum* in 1966, it became obvious that light would continue to be an even more unusual tool and an essence of Turrell’s artistic works for a long time and in an increasingly large space. In *Afrum*, a levitating white cube formed by two beams of light seems to be a real object, suspended in a corner of two vertical planes. In subsequent works, *Decker or Porter Powell*

⁵ J. Zagrodzki, *Katarzyna Kobra i kompozycja przestrzeni* [Katarzyna Kobra and the Composition of Space], PWN, Warszawa 1984, p. 127.

⁶ The work is one of the exhibits by the avant-garde group Zero. This art installation – sculpture was inspired by *Light Space Modulator* by an artist László Moholy-Nagy (1930) and *Ballet Mécanique* Fernanda Légera (1924), artists belonging to the aforementioned group.

⁷ A. Kotula, P. Krakowski, *Malarstwo. Rzeźba. Architektura* [Painting. Sculpture. Architecture], PWN, Warszawa 1971, p. 155.

⁸ According to the Architectural Forum Magazine, the Seagram Building has been one of the best illuminated buildings in the world until now.

⁹ The designer used his good working relationships with such architects as: Ludwig Mies van der Rohe, Philip Johnson, Eero Saarinen, Louis I. Kahn, I. M. Pei, Eliot Noyes, Richard Neutra, Gordon Bunshaft, Alexander Girard, Henry Dreyfuss and Florence Knoll to be the first to develop a real correlation between an architectonic design and a lighting design (M. Maile, *Richard Kelly: Die Definition einer modernen Architektur des Lichts*, ERCO Lichtbericht, 2007, vol. 82, p. 16, https://www.erco.com/download/en/media/lighting_report (access: 1.06.2020)).

(*White*) of 1967, the achieved light-and-shadow effects prove the effectiveness of using simple techniques and, despite having their beginning in small spaces of installations, the same actions have been continued in a wider landscape. Turrell's *Twilight Epiphany Skyspace* is no longer used only for viewing but it is also a venue for musical performances, scenography which adopts colours depending on the shades of sky. This interaction with the sun, moon and outer space seems to be a distinguishing feature of Turrell's works. The exhibition in the Israel Museum in Jerusalem is a living theatre of light and shadow in an ascetic landscape scenery; it is the essence of the artist's light-related actions. In *Space That Sees*, the sunlight coming inside through a square opening in the ceiling and the artificial light arranging the atrium with the night sky colours let the viewer of this show live a mystery play full of magic. Changeable weather conditions, sunlight angle, moving clouds projecting shadows on walls with changeable dynamics – this is an unusual spectacle.

2.2. MASTERS OF LIGHT

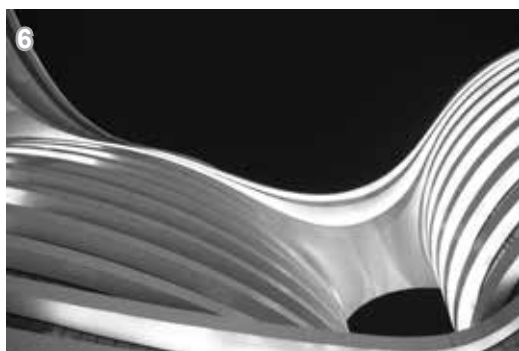
Treating an object like a sculpture and space like a multi-faceted scene recurs in numerous performances (Ill. 3–4). In the second half of the 20th century, new technologies provided the possibility of adding more object-human interactions to these artistic light techniques. In 1986, a magical and irrational Tower of Wind, a high-rise building illuminated with changing colours, designed by the architect

Toyo Ito, was built in the Japanese Kanagawa. Using small computers, sensors of motion and sound, the designer Kaoru Mende,¹⁰ uses light to activate several changeable images of the same object. Three years later, an ellipsoidal form, dynamically glittering with TV screens, a combination of light-filled vision and sound, is created. Egg of Winds (1989) designed by Toyo Ito in Yokohama reacts to wind blows by changing radio waves and accidentally selected stations being broadcast.¹¹ Therefore, other architects and designers of illumination began to use multimedia in order to operate light in yet another way. Along with the development of the kinetic architecture,¹² further new possibilities, related not only to the function but also to the aesthetic aspect of space, become available. The façade of the Brisbane Domestic Terminal Car Park was designed by Ned Kahn – an American artist in cooperation with Hassell Architecture in Sydney and Urban Art Projects. Thanks to 250 thousand aluminium panels moving in the wind, the entrance façade changes like in a kaleidoscope. Similar objects reacting to the force of wind were built in Singapore (Wind Arbor, collaboration of Ned Kahn and Moshe Safdie, 2011) where a cable mesh made of half a million hinge elements painted sensual images with living light by movement.

¹⁰ Mende designs illumination of buildings mainly in Japan and Singapore. He worked with many famous architects, including Tadao Ando. To erect the monument commemorating the victims of the atomic bombing in Nagasaki, in the National Peace Memorial Hall for the Atomic Bomb Victims (2003), he used 70,000 light spots moving in the wind as uniquely emotional means of expression (V. Laganier, J. van der Pol, *Light and Emotions. Exploring Lighting Cultures. Conversations with Lighting Designers*, Birkhäuser, Basel 2011, pp. 324–327).

¹¹ P. Winskowski, *Estetyka architektury a nowe media*, [The Aesthetics of Architecture and the New Media], K. Wilkoszewska (ed.) *Piękno w sieci. Estetyka a nowe media*. Universitas, Kraków 1999, p. 187.

¹² To learn more, read the article: J. Cudzik, *Kinetyka w architekturze* [Kinetics in Architecture], *Nowoczesność w Architekturze: Transformacja – Technologia – Tożsamość = Modernity in Architecture: Transformation – Technology – Identity*, 2012, vol. 6/3, pp. 63–69.



III. 5. Dynamics of daily light in the Phoenix Centre in Beijing

III. 6. Phoenix Centre interiors painted with light

III. 7, 8. Night appearance of Galaxy Soho in Beijing, photo: H. Michalak

Moving elements used on façades, also including pneumatic systems which push out the second skin of the building, are not the only method to achieve body image changeability through light. Paul Andreu, the designer of the National Theatre in Beijing, created a futurist ellipsoidal body¹³ by using the reflection in the water and the changeability of light (Ill. 10). This surreal picture is built, as in case of Phoenix Centre¹⁴ (Ill. 6–7) or Galaxy Soho, a design by arch. Zaha Hadid (Ill. 7–8), by the scale of the object, reflection (Ill. 11) and shadows which are cast from all directions, projecting the nature of the local landscape. The façade panels with pearl gloss finish reflect the colours of natural light. Similar effects were achieved on perforated façades and the marble roof of the National Opera House in Oslo which was designed by architects from Snøhetta.¹⁵ The building was awarded for the explicitly identifying motives which linked culture and location and also for the unusual, new and innovative style of the building.¹⁶

The other group of forms built with light are objects which are structurally transparent and ephemeral by being entirely or partly penetrated with light (Ill. 4–5, 9). Unusual flashes of light similar to the “play of brilliants” can be observed on the shell and the structure of the glazed parts of the Opera House in Harbin, designed by Ma Yansong, MAD Architects. The sculptural structure of every part of the building is visible in the form and the interior of the Olympic stadium in Beijing (Herzog & de Meuron, 2008), especially in the night colour-changeable picture (Ill. 12).

3. EXPERIMENTING WITH LIGHT¹⁷

The selection of materials, their interfusion, degree of transparency and the way in which the arrangement of the forms is composed determine the angle of light and shadow. These effects make bodies three-dimensional while the space gains or loses its depth.¹⁸ Light – you must learn it, experience it and taste it. Annual project-based classes with students are a good place to do that. The independent research workroom called *Architektura i moda* [Architecture and Fashion] for the students of the Department of Architecture of the Poznań University of Technology, a continuation of the project *MODULAR*,¹⁹ is a place of common experiments.

¹³ The body resembles the form of *Kompozycji wiszącej (I)* [Hanging Composition 1] by Kobro or Egg of Winds, the project by Toyo Ito, both described above.

¹⁴ The object was designed by arch. Shao Weiping, Beijing Institute of Architectural Design, BIAO UFO.

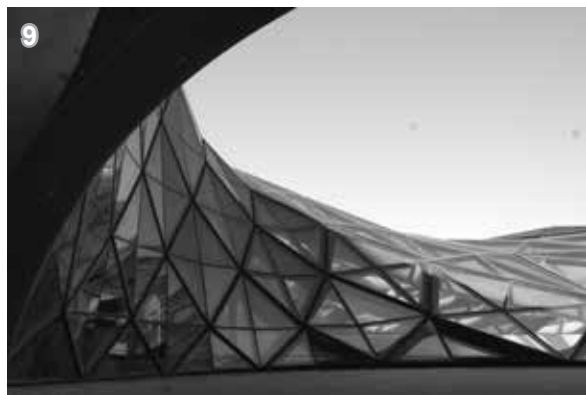
¹⁵ To learn more about the building, see: H. Michalak, J. Suchanek, *Light as a tool and as a material in architecture* [in:] B. Szuba, T. Drewniak (eds.), *Beauty and Architecture. Tradition and Contemporary Trends. Implementations*, Publishing Office PWSZ, Nysa 2018, pp. 207–208.

¹⁶ Its creators showed a practical and intuitive – a sculptor’s approach to the body modelling even though the building was rather planned to be a social monument than a sculpture (Snøhetta, *People Process Projects*, Forlaget Press, Oslo 2016, p. 266).

¹⁷ According to Norbert Werner Wasserfurth-Grzybowski, “Light is an encoded reality” [original Polish: “Światło jest zakodowaną rzeczywistością”] (N.W. Wasserfurth-Grzybowski, *The Light Code. Light Encodes Reality*, VIA-Verlag, Gütersloh 2018).

¹⁸ H. Michalak, *Modular. Moda i architektura*. [*Modular. Fashion and Architecture*], Wydział Architektury Politechniki Poznańskiej, Poznań 2016, p. 326.

¹⁹ The original project *MODULAR* was a product of a synergy of several aspects: the author’s fascination with logic, mathematics, geometry and fractals, order and modules, love for architecture, design and fashion, desire to learn the essence of light and shadow in the process of creating and modelling of space. The purpose of the research was an attempt to check whether it would be possible to create



Ill. 9. Opera House in Harbin

Ill. 10–13. Beijing: Opera House (Ill. 10), Galaxy Soho (Ill. 11), night illumination of the Olympic stadium interiors (Ill. 12) and an office building (Ill. 13), photo: H. Michalak

The objective of the research is to look for innovative solutions in the area of outfit design that can be implemented into the world of architecture. Presently, the author's research is focused

outfits from modules and whether the same modules used in the outfits could be transferred to the world of architecture (H. Michalak, *op. cit.*, 2016, pp. 8–10).

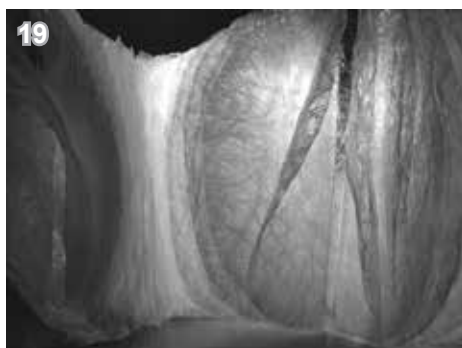
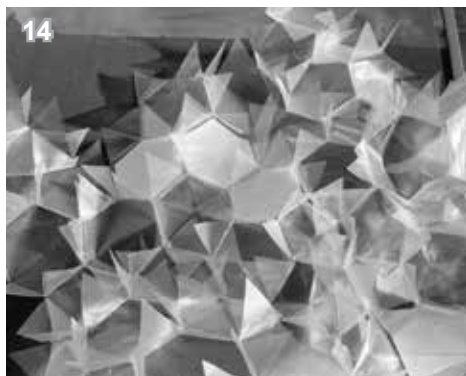
on the structure and architectonics of modular forms. Making a sculptural form of the outfit of various materials (plastic, resin, paper, foil, fabrics, meshes with different sizes etc.) is preceded with studies: searches for morphic analogies, studies of proportions of modules, analyses of their multiplications with a mathematical record of their repeatability and the definitive final form of the outfit. The concept implies potential mobility of all or some single elements, taking into account their kinetics and various degrees of flexibility of materials. The modules can not only change shapes by themselves but also be moved into other parts of the form. Module connection variants and computer generative designs based on a multiplication of the module in virtual space with the modelling of the kinetics of changes are developed. A special role in producing these creative forms is played by light and shadow compositions which come with layers of materials and are associated with the shape and architectonics of form, its degree of transparency, volume and the very dynamics of light (Ill. 14, 19). Modelling of the outfit is only a pretext to look at the designed form from the perspective of another discipline. The inspiring design process consists, in this case, in composing modular surfaces on a mannequin and transferring the formed shell onto a plane or other surfaces. This is related to experimenting: with bending, stretchability, stiffness, deformation strain, self-twisting etc. and reacting to the resistance of the matter. A way of experiencing that is equally important is the research on the way how light (through various sources and fittings, intensity, angles, colour temperature) determines our perception of space in order to individualise it. These are only some elements which improve the feeling for the form and determine the progress of the design process. Going away from the daily urban planning routine while designing the outfit allows for a distance which is apparent yet it brings designers much more freedom and ease of being formed through experience along with the pursuit of a comprehensible organic geometrical balance and structurally ordered unity of Louis I. Kahn.²⁰ Parallel to the creative process described above, there come ideas on how to shape e.g. an object form structure, module proportion and design, ceiling shape, wall texture. In case of the façade, using modular elements reacting to daylight can change the appearance of the building and not only strengthen the amount of light coming inside but also reduce the consumption of energy necessary to maintain the optimum temperature conditions inside the building.²¹ The external and internal sliding walls and moving suspended ceilings make it possible to change the surface and cubage of the building, which makes it more flexible and therefore usable.

4. REFLECTIONS AND CONCLUSIONS

In the world full of chaos, the calm experiencing of architecture, frame by frame, in motion by the user of space raises metaphysical reflections in the author. The fascinating duality of light, the mood produced as an effect of the dynamics of light thanks to the delusively

²⁰ Klaus-Peter Gast and Harmen H. Thies write greatly about the power of Kahn's masterpieces in the foreword to the publication (K.-P. Gast, *Louis I. Kahn. The Idea of Order*, Birkhäuser, Basel 2001).

²¹ Source: A. Jahanara, A. Fioravanti, *Kinetic Shading System as a Means for Optimizing Energy Load. A Parametric Approach to Optimize Daylight Performance for an Office Building in Rome* [in:] *eCAADe*, vol. 2, *Shock, Material Studies – Energy*, Sapienza University of Rome, Rome 2017, pp. 231–240, <https://www.semanticscholar.org/paper/Kinetic-Shading-System-as-a-means-for-Optimizing-A-Jahanara-Fioravanti/517e1c320e78c5986caa26cf8180dfafb8e98914> (access: 8.06.2020).



Ill. 14–19. Studies of light and shadow of the modelled architectonic structures using various materials and fabrics. Photography sources: stud. WAPP – authors of designs made under the supervision of H. Michalak in the academic year 2019/20. Ill. 14. A. Danak, A. Tkacz; Ill. 15. I. Kaźmierczak, O. Stańczak; Ill. 16. W. Zywert; Ill. 17. J. Stefańczyk; Ill. 18. P. Kamińska, I. Karolczak; Ill. 19. D. Kępczyńska, E. Konopska, W. Kuszyńska

real – irrational pictures, the plasticity of bodies – intrigue and deeply move. Entering and discovering veiled spaces is a feast, a mystic experience which not only gives an opportunity to sense the art but also brings spiritual benefits.

The continuous perfection and search for design skills and the ways to form light illusion – for the human being, these seem to be the architect's obligation even when it would be a "lie" about the actual space.

References

- [1] Cudzik J., *Kinetyka w architekturze [Kinetics in Architecture]*, Nowoczesność w Architekturze: Transformacja – Technologia – Tożsamość = Modernity in Architecture: Transformation – Technology – Identity, 2012, vol. 6/3, pp. 63–69.
- [2] Gast K.-P., *Louis I. Kahn. The Idea of Order*, Birkhäuser, Basel 2001.
- [3] Jahanara A., Fioravanti A., *Kinetic Shading System as a Means for Optimizing Energy Load. A Parametric Approach to Optimize Daylight Performance for an Office Building in Rome* [in:] *eCAADe*, vol. 2, *Shock, Material Studies – Energy*, Sapienza University of Rome, Rome 2017, pp. 231–240, <https://www.semanticscholar.org/paper/Kinetic-Shading-System-as-a-means-for-Optimizing-A-Jahanara-Fioravanti/517e1c320e78c5986caa26cf8180dfafb8e98914> (access: 8.06.2020).
- [4] Kotula A., Krakowski P., *Malarstwo. Rzeźba. Architektura [Painting. Sculpture. Architecture]*, PWN, Warszawa 1971.
- [5] Laganier V., van der Pol J. (eds.), *Light and Emotions. Exploring Lighting Cultures. Conversations with Lighting Designers*, Birkhäuser, Basel 2011.
- [6] Maile M., *Richard Kelly: Die Definition einer modernen Architektur des Lichts*, ERCO Lichtbericht, 2007, vol. 82, pp. 16–21, https://www.erco.com/download/en/media/lighting_report (access: 1.06.2020).
- [7] Michalak H., *Modular. Moda i architektura. [Modular. Fashion and Architecture]*, Wydział Architektury Politechniki Poznańskiej, Poznań 2016.
- [8] Michalak H., Suchanek J., *Light as a tool and as a material in architecture* [in:] B. Szuba, T. Drewniak (eds.), *Beauty and Architecture. Tradition and Contemporary Trends. Implementations*, Publishing Office PWSZ, Nysa 2018, pp. 201–214.
- [9] Snøhetta, *People Process Projects*, Forlaget Press, Oslo 2016.
- [10] Wasserfurth-Grzybowski N.W., *The Light Code. Light Encodes Reality*, VIA-Verlag, Gütersloh 2018.
- [11] Winskowski P., *Estetyka architektury a nowe media [The Aesthetics of Architecture and the New Media]*, K. Wilkoszewska (ed.) *Piękno w sieci. Estetyka a nowe media*. Universitas, Kraków 1999.
- [12] Zagrodzki J., *Katarzyna Kobro i kompozycja przestrzeni [Katarzyna Kobro and the Composition of Space]*, PWN, Warszawa 1984.

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Academic teacher, researcher and architect, designer. Graduated from Poznan University of Technology (Faculty of Civil Engineering). Expert in the field of greenery design, landscape architecture, design and planning of rural areas. Conducted research and experience represent a superposition of a few aspects of creative work: fascination of logic, order, modules, mathematics, geometry and fractals and the desire to reveal the essence of light and shadow in the process of creating and modelling of space. Author of over 30 scientific publications, including the monograph *Modular. Fashion and Architecture* (2016).

The workshops in Poland and abroad within the scope of application of light, furnished knowledge in terms of the range of light applications and skilful use of illumination. In her professional practice (architectural studio Archibox), an author and co-author of 90 projects. An author of original project "Fashion architecture" (namely design and execution of outfits inspired by architecture), she's an author of several artistic installations, mappings, exhibitions and workshops.

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