doi.org/10.62683/SINARG2025.133

Research paper

STUDY OF THE TRANSFORMABILITY OFARCHITECTURAL FORM UNDER THE INFLUENCE OF LIGHT AND SHADOW

Jasmina Tamburić[1], Olivera Nikolić[2]

Abstract

The paper presents a study on the transformability of architectural form under the influence of light and shadow as key elements of visual perception, experience, art, and architecture. Through the analysis of examples where these factors are the primary determinants of the appearance of architectural form, the study demonstrates the principle of shaping ambiance and evoking specific emotions. The study of the transformability of form perception is illustrated through a series of photographs of the same architectural structures (or their segments) taken at different times of the day. These photographs served as the primary means of expression in the research on the influence of light and shadow on architectural form. Visual perception, as a complex process of experiencing shape and space, although primarily linked to the sense of sight, does not function in isolation from other senses, previously acquired knowledge, experiences, and emotions. It consists of a set of impressions and understandings of the observed object, which change depending on the movement of the observer. Among the numerous factors that influence the visual perception of architectural form, light and shadow stand out as dominant, playing a crucial role in its transformability and experiential quality.

Key words: *Visual perception, Transformability, Architectural form, Light, Shadow, Photography*

[1] Assistant professor, Faculty of Civil engeneering and architecture University of Niš,Serbia, jasmina.tamburic@gaf.ni.ac.rs, 0000-0002-5812-620X
[2] Assistant with PhD, Faculty of Civil engeneering and architecture University of Niš,Serbia, olivera.nikolic@gaf.ni.ac.rs, 0000-0002-5229-1722

1. INTRODUCTION

This paper presents a method for examining the visual characteristics of architectural form and its transformation under the influence of light and shadow. The study of the transformability of architectural form refers to the emergence of newly perceived shapes created by the interaction of light with form. Such dynamic change occurring in the natural environment on static physical forms is constant and represents one of the most important features of spatial form. The perception of form in humans is, to a large extent, an automatic cognitive process, explored within a specific branch of perceptual psychology. For the purpose of this research, the human eye as the center of visual perception is represented through the camera lens and photography, which serve as visual documentation in which the formal transformations of spatial form are identified. This research builds upon established theoretical approaches in visual perception, such as those presented by Stanisavljević [1], Arnheim [2,3], Norberg-Schulz [4,5], and Pallasmaa [6], providing a perceptual framework for understanding the dynamic interaction between light, shadow, and form based on visual perception by Ognjanović [7].The photographs used in this study originate from the author's archive [8,9], as well as from student projects developed within the course *Visual Research* in 2024 at the Faculty of Civil Engineering and Architecture, University of Niš.

1.1. Method

The method of examining the transformability of architectural form is presented through a series of monochromatic photographs. These photographs depict architectural forms and the changes in their perception caused by the influence of sunlight at different times of day. Monochromatic photographs are particularly suitable for studying form transformability, as they more clearly reveal the geometry of shadows, as well as the features of the form such as lines, volumes, tonal values, and shapes. The study of form transformability through photography was conducted within practical exercises by first-year students as part of the Visual research course.

2. SUBJECTIVE ASSESSMENT OF VISUAL PERCEPTION

Visual perception is an integral part of human cognition; it enables the understanding of the world around us through mental analysis and organization [10]. It occurs largely automatically, but also consciously. The root of the word “perception” comes from the Latin *perceptio*, meaning “reception, observation and understanding”. Visual perception refers to the process by which the human brain interprets information primarily gathered through the sense of sight. However, the interpretation of visual information is not merely a physiological function of the eye. The scientific study of perception challenges the idea that the world we encounter in everyday life is solely physical rather, it is largely experiential. Our contact with the physical world is indirect, and what we experience in daily life is a representation constructed by our senses and central nervous system.

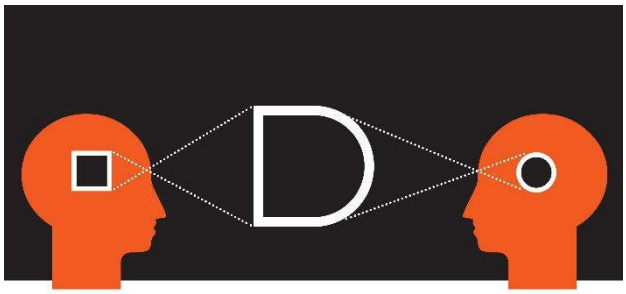

Figure 1. Graphical representation of visual perception

Visual perception does not function in isolation from other human senses, nor from previously acquired knowledge, experiences, and emotions. Although primarily related to vision, all other senses actively contribute and play a significant role in enriching and complementing it. Information from the external environment is received through our primary senses, which operate in a systemic manner, enabling the brain to build a comprehensive image of the world. The integration of all sensory information provides a more complete and precise representation of the visual world.The perspective from which we observe the visual world is located in our eye, which can occupy only one position at a time. As we move, our eye carries the visual world with it. This world is both real and imaginary—a physical world of shapes and spatial relationships that create a highly complex system of perception. Visual perception is an individual and unique understanding of the visual world, arising from the subjective experience of the senses.The initial stage of visual perception begins with sensory input processed by the visual system. The eye detects light, colors, shapes, and motion. The information gathered by the eyes is processed by the brain to create an image of the context or environment. The visual system collects data, identifies objects, and determines their spatial relationships.

Visual experience is a subjective process that involves a combination of physiological observation (through the eye) and cognitive processing of what is seen (through the brain). It represents the way in which the human mind and senses perceive and interpret visual information from the environment. Cognitive processing, in fact, determines how we experience the visual world.

3. OBJECT OF VISUAL PERCEPTION

Form, in the context of a solid spatial structure, possesses perceptual, sensory, and dynamic properties [11]. This research focuses on the perceptual and dynamic attributes of spatial form. The perceptual properties include its size, shape, color, and texture [12], while the dynamic ones pertain to its change or visual transformation. Visual perception shapes the perceptual experience, and spatial form is its primary object.

Spatial form is not merely a static object, but a dynamic visual entity that continuously changes depending on lighting conditions. Light and shadow act as key factors in its visual articulation, modeling surfaces, revealing volume, and emphasizing structure. Through changes in intensity, direction, and quality of light, the same form can acquire different visual characters, thus becoming transformable in a perceptual sense. In this way, form is not observed solely as a geometric whole, but as a perceptual phenomenon that emerges through the interaction between lighting conditions and the observer’s sensory experience.

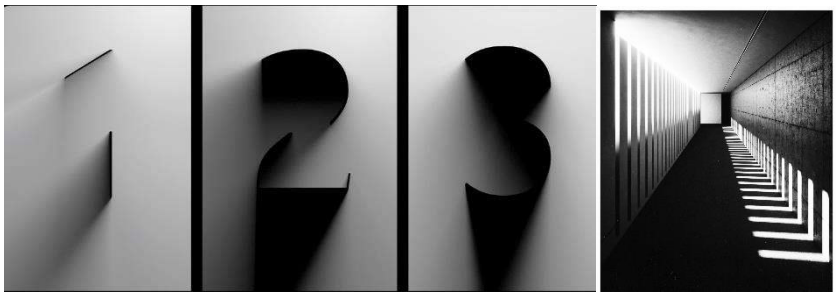

Figure 2. Forms, light and shadows [13]

4. LIGHT AND SHADOW

Light and shadow are integral elements of form and space, contributing to their dynamic qualities in terms of appearance and relativity. They are key components of visual perception—on one hand, defining shape, texture, and color, and on the other, conveying depth and atmosphere within a space. Form and space can only be perceived when illuminated, even by a minimal light source. Visual perception of space and form depends on the intensity, direction, and color of illumination.

There are natural and artificial sources of light. Sunlight is white and composed of six clearly defined colors and all transitional shades (yellow, red, blue, orange, violet, and green—the spectrum of the rainbow). The quality of white sunlight shifts depending on various natural influences, thereby creating the color of the atmosphere. As the seasons change, the angle of sunlight and the shades of electromagnetic radiation change as well, producing altered perceptions of the same forms. Sunrises and sunsets change the color of the atmosphere because light travels a longer path, making red and orange wavelengths more visible. Thus, the same space or object may be experienced differently at various times of day or during different seasons.

Light is not only a physical phenomenon that allows us to perceive color, shape, and texture; it also has the capacity to transform structure into a dynamic entity. Whether from natural or artificial sources, light is essential for defining space, evoking emotion, and enhancing the overall aesthetic experience. For example, soft, diffuse sunlight can create a calm ambiance, while a focused beam of light can draw attention to a specific architectural detail or artwork. Deliberate manipulation of light and shadow can profoundly alter the way space is perceived. Light and form are primary elements of architectural composition, and both are prone to dynamic transformation depending on the time of day, the season, or the intensity of natural light.

Artificial lighting plays a particularly important role in shaping and redefining spatial perception. Unlike natural light, which depends on external conditions, artificial light allows for constant and intentional control—it can be precisely directed and modulated in line with the author's vision. Its intensity, direction, color temperature, and degree of diffusion directly influence how a form is visually perceived. Light effects shape the relationships between surfaces, emphasize textures, structures, and material qualities, while shadows become active components of visual dynamics. In this way, light projects a new geometry by forming shadows as spatial drawings, creating a sense of ongoing visual transformation. Artificial light allows for multiple interpretations of the same form. It can be categorized by character—diffuse (soft) or direct (hard)—as well as by direction, the shape of the source, and the type of light fixture used.

A shadow is a phenomenon that occurs when an opaque object obstructs the path of light. The characteristics of light directly affect the appearance of the shadow. A shadow has its own shape, dynamics, and visual features. Its form always depends on the light source, the position and shape of the object casting the shadow, and the surface onto which the shadow is projected. A small or point light source will produce sharp and well-defined shadows, while diffuse light creates lower contrast and softer edges. The closer the light source is to the object, the larger and more widespread the shadow will be; conversely, if the source is farther away, the shadow becomes smaller and more precise. Besides distance and angle, shadows are shaped by surface textures and light reflection. When multiple light sources are present, overlapping shadows may occur. Shadows can also be categorized based on the degree to which light penetrates the object.In architecture, shadows play a crucial role in shaping space and atmosphere and in evoking different emotional responses. They emphasize form and volume. Particularly important are the dynamic qualities of shadows—their ability to create rhythm or harmony within space.

5. STUDY OF FORM THROUGH PHOTOGRAPHY

The photographic study of form occupies a key role, serving as a bridge between visual perception, analysis, and visualization. It is presented through black-and-white photography, as this medium is more suitable for the exploration of form. Using achromatic black, gray, and white tonal values, the visual qualities of form, such as shape, contrast, and proportional relationships among structural elements, are more clearly revealed under the influence of light and shadow.Its use functions as an analytical tool, enabling a deeper investigation and understanding of formal and other dynamic relationships. Form studies through photography can be conducted under controlled studio conditions, where relationships between elements are examined using artificial lighting and a neutral background. Through careful selection of framing, angle, perspective, lighting conditions, and the relationship between foreground and background, attention is directed toward key formal characteristics [14].The position and variation of the light source, its intensity, and the shape of the light beam further remodel the form, while shadows reveal its structure and dynamics. In this sense, light becomes not only a means of visibility, but also a carrier of meaning.

The illustrations present a series of examples of formal transformations of a single solid form, shown from a frontal view against a neutral background. The resulting photographs were taken under strictly controlled studio conditions, using artificial lighting. In all examples, the position of the camera, the object of perception (the subject) and the background remained identical. The only variable was the number, position, and intensity of the light sources.

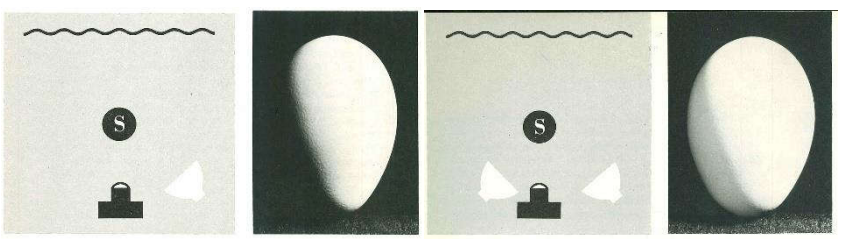

Figure 3. a) Example with one light source
b) Example with two light sources of different intensity

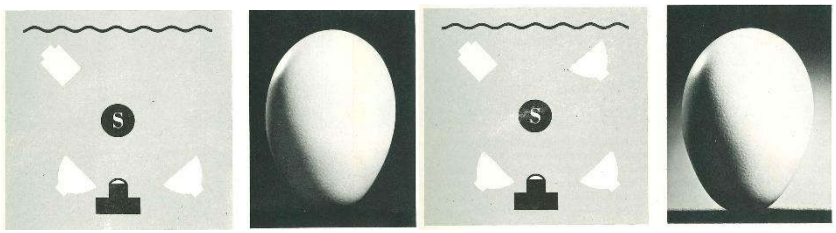

Figure 4. a) Example with three light sources of different intensities and positions
b) Example with four light sources of different intensities and positions

The presented examples illustrate the formal transformations of shape caused by variations in the number and intensity of light sources. The light sources differ in terms of diffusion and direction and are oriented toward the subject of perception. In the final example, one light source is directed toward the background, resulting in a perception of spatial context, while in the others, the focus remains exclusively on the subject. A single light source creates a simpler visual impression, in which the fully shaded portion merely hints at the subject's form. Introducing a second light source reveals the form through a transparent shadow cast by the stronger light. With the addition of a third light source aimed at the subject, a new shadow emerges and its intensity increases. *(Figure 3,4.)*

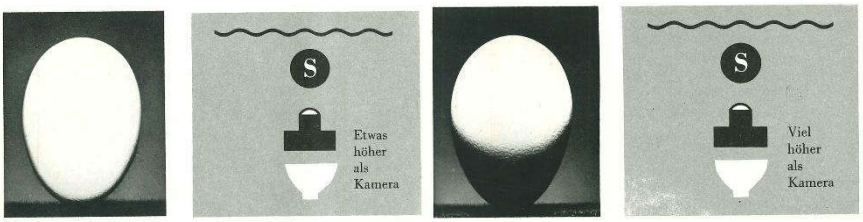

Figure 5. a) Example with a light source larger than the camera
b) *Example with a light source positioned above the camera*

When the light source is larger than the camera lens and located behind the point of perception, the form is displayed as a shape defined by a prominent edge shadow, also illuminating the background. When the light source is moved vertically, the shadow changes shape relative to the extent of the movement. This example demonstrates greater contrast in terms of light intensity and source positioning. *(Figure5.)*

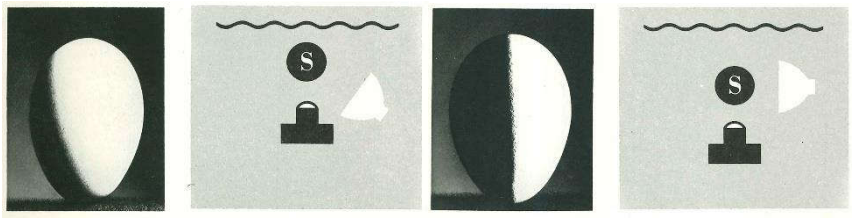

Figure 6. Examples of a direct light source and its positional change

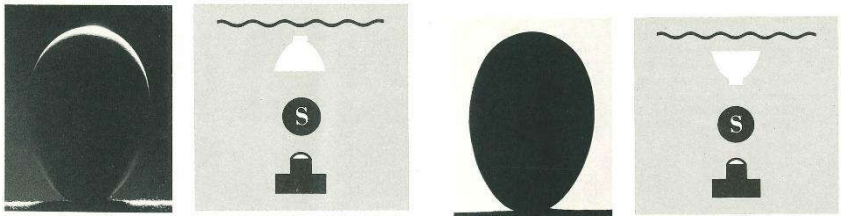

Figure 7. a) Example with the light source positioned behind the subject and directed toward the camera, b)*Light source positioned behind the subject and directed toward the background*

As the light source is brought closer to the subject, sharp shadows are formed that match the contours of the perceived form. If the same high-intensity light is directed laterally toward the subject, it creates a visual geometric plane that evenly divides the subject between light and complete shadow *(Figure 6,7).*

The study of form outside of controlled studio conditions can be conducted in unpredictable and spontaneous natural environments. In such cases, observation and analysis include the interaction between the form and its immediate surroundings, or the form as an independent entity. A reduced number of details in the photograph results in fewer visual cues, which in turn directs focus toward the visual analysis of the studied subject. In this visual investigation, the photographs were produced by students as part of a semester assignment for the course of the same name. The task required them to identify suitable positions and frames of selected architectural structures within an urban context. All observations were made from the same position, angle, and framing of selected details, but at different times of the day. Since the angle of natural sunlight shifts throughout the day, the study required documentation at various times, resulting in four photographs per subject. In this way, the transformation of the visual characteristics of architectural form under the influence of light and shadow quality was documented and interpreted.

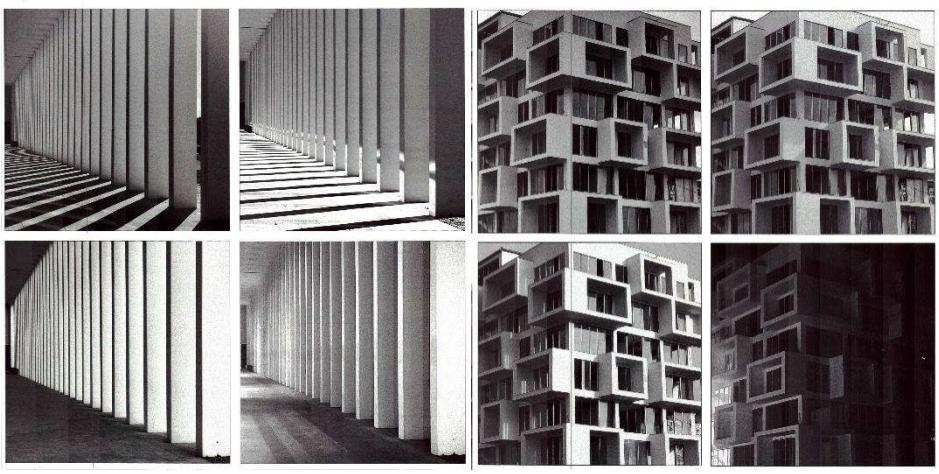

Figure 8. Student works from Visual Research course 2024- Faculty of Civil Engineering and Architecture, University of Niš a) Aleksandra Peulić b) Milica Đorđević

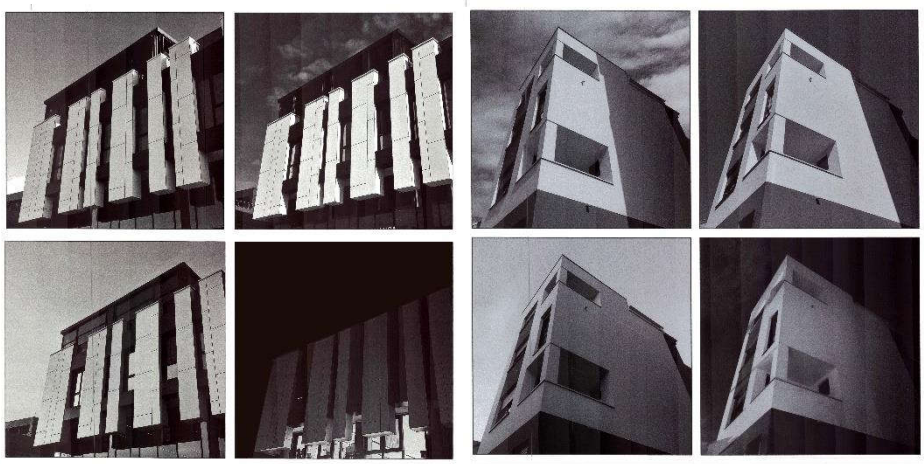

Figure 9. Student works from Visual Research course 2024- Faculty of Civil Engineering and Architecture, University of Niš a) Sanja Ranković b) Ivona Đelić

Elaboration

The presented student works demonstrate how variations in natural lighting throughout the day significantly affect the visual perception of architectural elements. The shadows become sharper or softer, highlighting different parts of the form and shifting the viewer's focus. For instance, in Figure 8b, the light from the late afternoon sun accentuates the relief and depth of the façade, while the morning light in Figure 8a results in a more uniform and flattened appearance. These shifts in perception confirm that light and shadow not only reveal geometry but also redefine the emotional and spatial experience of the observed object. Such insights provide valuable recommendations for architectural lighting design—emphasizing the need for dynamic light studies in early design phases to enhance form expression and spatial atmosphere.

6. CONCLUSION

The study has shown that light and shadow, as fundamental elements of visual perception, play a crucial role in transforming the experience of architectural form. Their ability to model space, shape shadows, and emphasize structural characteristics makes them not only visual phenomena but also instruments of expression and meaning. Analysis conducted through controlled photographic experiments and student projects in real urban environments confirmed that the visual identity of form is not static but dynamically shifts depending on the light source—its direction, intensity, and number. Photography, as a methodological tool, proved to be an effective mediator between perception and visual analysis, enabling precise articulation of form transformability. These insights highlight the importance of understanding lighting conditions in architectural design processes, especially in the context of education, where awareness of visual sensitivity and the perceptual complexity ofspace is cultivated.

ACKNOWLEDGEMENTS

This research was supported by the ministry of science, technological development and innovation of the Republic of Serbia, under the agreement on financing the scientific research work of teaching staff at the faculty of civil engineering and architecture, University of Niš - registration number: 451-03-137/2025-03/200095 dated 04/02/2025.

REFERENCES

[1] Dušan Stanisavljević: **Vizuelna istraživanja**. *Arhitektonski fakultet u Beogradu*, Beograd, 2016.
[2] Arnheim, Rudolf: **The Dynamics of Architectural Form**, *University of California Press*, 1977.
[3] Arnheim, Rudolf: **Art and Visual Perception: A Psychology of the Creative Eye**, *University of California Press*, 1974.
[4] Norberg-Schulz, Christian: **Intentions in Architecture**, *MIT Press*, 1965.
[5] Norberg-Schulz, Christian: **Existence, Space and Architecture**, *Praeger Publishers*, 1971.
[6] Pallasmaa, Juhani: **The Eyes of the Skin: Architecture and the Senses**, *Wiley*, 2005.
[7] Predrag Ognjenović:**Psihologija opažanja**, *Naučna knjiga*, Beograd, 1992.
[8] Oliver Tošković , Vladimir Kovač, Danira Savilj:**Lost in projection – Implicit features experience of 3D architectural forms and their projections.** *Acta psychological,* Vol. 213, 103239, February 2021, https://doi.org/10.1016/j.actpsy.2020.103239
[9] Richard Aveden et al: **Kurs der Famous Photoraphers school Band I-II,***Guiding Faculty*, Munchen, 1971
[10] https://elementarium.cpn.rs/u-centru/opazanje-prostora/?script=lat*(10.4.2025.)*
[11] Danica Stanković, Milan Tanić:**Forma u arhitekturi**, *Građevinsko- arhitektonski fakultet u Nišu,* Niš 2019.
[12] Kosta Bogdanović, Bojana Burić:**Teorija forme**, *Zavod za udžbenike*, Beograd 1991.
[13] https://www.danielfrumhoff.com/projects/architectural-type-studies*(13.4.2025.)*
[14] Dubravka Lazić Vladimir Tatarević: **Fotografija**, *Zavod za udžbenike*, Beograd, 2014.