Examination Of Artificial Lighting Systems In Contemporary Open Offices Accordingly Gestalt Principles

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***Abstract*—** This research is a comprehensive investigation into the aesthetic criteria created by Gestalt design principles on the scale of lighting systems. Research concentrates on interior artificial lighting designs of contemporary office buildings and the potential of artificial lighting systems to create aesthetic criteria in office interiors. The research focuses on contemporary office buildings and examines lighting designs in open-plan and innovative office interiors. In this respect, the interiors of contemporary office buildings, including contemporary, well-equipped and open-plan office interiors were selected for the analysis section. The main purpose of the analysis is to reveal the aesthetic contribution of Gestalt design principles, such as; figure-ground, proximity, similarity, closure, symmetry/asymmetry, good continuity, etc., which create an effective aesthetic visual perception in different design disciplines in the design of artificial lighting schemes in office interiors. Consequently, it is expected to shed a light on a methodology for creating successful artifical lighting designs using Gestalt design principles in establishing aesthetic criteria for interior artificial lighting designs.

Keywords— gestalt principles, office spaces, artificial lighting, aesthetics, lighting schemes**.**

I. *INTRODUCTION: GESTALT THEORY AS AN AESTHETICAL POINT OF VIEW*

Gestalt principles are known as one of the most effective methods for creating visual perception and aesthetic groupings with composition. According to Gestalt theory, spaces can be both negative and positive and visually can be created through the aesthetic and harmonious relationship between figure and ground, a background, and the shapes within it. While one element does not create any perception, four or five elements combined using Gestalt principles such as; proximity, similarity, symmetry, and closure, can create visual aesthetics and perception. This research focuses on artificial lighting systems within the frame of Gestalt principles and represent a method for interior artificial lighting design by measuring Gestalt principles in the artificial lighting of office buildings.

Gestalt design principles are frequently used design methods for aesthetically grouping furniture and furnishing elements in spaces and create aesthetic visual perception. In an open office, the aesthetic perception is created in the organization of the desks and workstation groups within the space by using the figure-ground relationship (placing furniture on the parquet floor), using the proximity principle in grouping the workstations, aesthetically dispersing them throughout the space with the principle of good continuity, and grouping them with symmetrical compositions.

Lighting devices, which are indispensible elements of lighting, emit light in various forms such as indirect, direct, and diffused anda re located in the context of the functions and architectural designs of the spaces; i. on the ceiling, ii. on the walls, iii. hanging from the ceiling within the space, iv. extending from the walls into the space, v. embedded or freestanding elements in the floors. Therefore, while these elements are used for lighting purposes, on the other hand, like other furnishing elements of architecture, they are not independent of them in terms of visual form, style, materials used , color-texture characteristics,etc.[1]

In relation to this diversity of lighting equipments, the same methodology comprehends the lighting design. Gestalt principles add significant aesthetic value to the organization of lighting (figures) on a ceiling plan (background). Similarly, the principles of good continuity used in the spatial organization of floor lamps and the directional design of recessed lighting, as well as the proximity and enclosure created by pendants placed at regular intervals, allow for the establishment of aesthetic criteria in interior artificial lighting systems. Accordingly, this study aims to analyze artificial lighting systems in office interiors using gestalt principles, revealing methods for creating aesthetic compositions within the context of the figure-ground relationship in the arrangement of fixtures in interior spaces.

A. Aims and objectives: This study mainly researches interior artificial lighting schemes in relation with gestalt theory, and aims to explore gestalt principles contribution during the design of artificial lighting compositions of interiors.

B. Literature Review: The theorethical part mainly covers academic sources on gestalt perception theory, design principles, artificial lighting systems and their organizations in interior spaces.

C.Methodology: Research methodology mainly based on two sections; theories and practices. After conducting a comprehensive literature review for theorethical part, seven office interiors have been analysed accordingly to gestalt design principles focusing on their lighting schemes.

II. GESTALT PERCEPTION THEORY

Gestalt theory first emerged in the early 20th century and strongly advocated a holistic or non-additive approach to perceptual object analysis. It is based on the perception of objects as an organized and structured whole rather than the sum of their parts and argues that "the whole is different from the sum of its parts" (Koffka, 1935). In the example of the bicycle in Figure 1 indicates that the bicycle does not resemble its constituent parts and the whole is totally different from its parts.[2][5]. (Figure 1)

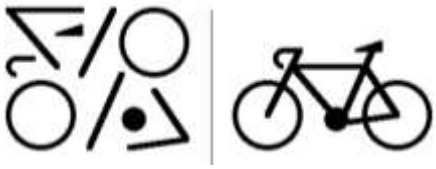


Figure 1. From part to whole (bicycle) (Source: Ganslandt & Hofmann, 1992)

In addition, as highlighted by Mennan (2015); ‘‘The theoretical and historical reinterpretation of the Berlin School claims in the context of complexity starts from the questioning of the fundamental assumption of Gestalt theory; namely, the claim that the simplifying and unifying tendency of the perceiving mind reduces phenomenological complexity to a simple and orderly hidden in visual reconstruction and unification, formulated in Wertheimer’s Laws of Organization in Perceptual Forms(1923/1938)’’[2]. Visual perception is the strongest link that connects us with the environment, during our daily activities. Visual perception can happen by light, by its organization in space, and its intensity and properties can create diversity during our perception of light. Using light and making a lighting design to an interior means designing a visual interior.A good lighting design can help to orient ourselves in an interior environment safely or ensure to work more efficiently and can create aesthetics in a space by its color, intensity, form, and arrangement. On the other hand, physical properties of a lighting arrangement can

be calculated by computer-based programs. Therefore, its effect in space can be calculated and visualized before installation.

Perception can also be shown to depend on prior experience. In addition, configurations and arrangements used before and known already create an easy visual perception and quickly realized by people. Therefore, prior experiences of visual perception have become permanent and a key source for new designs. For example, generally in open offices, for the general ambient lighting design, light sources or fixtures can be placed on each workstation group, so the lighting design of the ceiling will be in harmony with the furniture arrangement of the flooring. In this way, a very strong visual perception will be created by the reflection of the floor to the ceiling. The workstations on the floor will match with the lighting fixtures on the ceiling the bottom will reflect to the top. By this way, gestalt design principles; figure-ground, similarity, proximity, closure and good continuity will be ensured in a spatial way; spatial visual perception.

A central theme in perception is how the properties of objects remain constant despite changes in retinal images-size, shape, reflectance, and color. These considerations do not include how the object itself is perceived. To attribute properties to an object, the object itself must be recognized, and its environment must be distinguished. More generally, the main concern of gestalt figure-ground theory deals with how the perceptual process identifies structures that capture attention and distinguish them from their environment? In a drawing, most people see a white vase on a gray background. On closer inspection, two gray heads facing each other on a white background become apparent. Once the hidden faces are discovered, there is no difficulty in perceiving either the vase or the faces, but it is impossible to see both simultaneously.[3](Figure 2)

In both cases, we perceive a figure, either a vase or two faces against a contrasting background. The distinction between gestalt (form) and environment, motif and background, does not operate harmoniously. Furthermore, the fact that the vase is the preferred interpretation of the two demonstrates that this interpretive process is governed by specific rules; that is, laws can be formulated by which specific arrangements are combined to form figures, objects of perception. These rules are not only valuable in defining the perceptual process but also have practical relevance for the lighting designer. Every lighting design consists of an arrangement of luminaires on the ceiling, walls, or in space. This arrangement is not perceived as such but is organized into forms or groups according to gestalt laws.



Figure 2. Depending on how you view this drawing, you will see a vase or two heads facing each other. (Source: Ganslandt & Hofmann, 1992)

The lighting effects created by architectural environments and fixtures create other patterns that are incorporated into our overall perception of the situation. These structures may be visually reorganized, and we may perceive the patterns in different shapes and forms than intended. Another negative effect is that, for example, in a chessboard setting, the Gestalt and background may not be clearly defined. The result is a constantly shifting focus. Therefore, it is necessary to consider Gestalt laws when developing lighting design concepts.[3]

A. Perceptual Psychology and Law of Gestalt

Presenting a camera can only resemble an eye model by the way it transforms the perceived image from the outside world to the cortex. For to understand what visual perception is about, first, it must be aimed to create visual experiences related to interpretations of knowledge, instead of transforming them. As a common discourse, well known shapes can be recognized much more easily than less known shapes. Once making the visual interpretation of complex shapes, they will stay and will be used as references for future perceptions.[3](Figure 3 a-b-c)



a ***b*** ***c***

Figure 3. a) Recognizing a general shape by exploring basic details, b) Matching a colour to the respective pattern perceived, the colour of the central grey point adjusts itself to the back or white colour of the respective perceived pattern of five, c) Constancy with regard to perception of size, due to the perspective interpretation of this illustration the luminaries are all perceived as being the same size in spite of the variations in size of the retina images.

The general theme of perception theory until now was the question of: 'how features of objects can be perceived constantly while changing images of the environment through sizes, forms, colors?'. This was not about how an object is perceived. To attain some properties to an object, it must be distinguished from its environment. Therefore, the process of recognizing an object is as hard as perceiving it in the complex multi images on the retina. Within a more general frame, how can perceptual processes distinguish buildings, objects, etc. from their environments and define them? As previously prensented by figure 2, most people perceive a white vase on a gray background. However, when looked closer, two gray heads looking at each other are perceived on a white background. When both images are recognized, they can be easily perceived but always separate.[3]

In both cases there is a perceived shape; a vase or two heads. Harmony is lack between form and environment and/or object and background. In the sample, background is just what is perceived behind the form and covers all the drawing. Instead of color and environmental mission, no extra feature has been attained to the background. On the other hand, between two interpretations, when a vase becomes selected, demonstrates that perception is based on some specific rules, which can be used while organizing and grouping objects to create final schemes. These rules are not only beneficial for defining the perception process, they also indicate practical ideas for a lighting designer. Each lighting installation is an arrangement of luminaires on the ceiling or wall in a specific space. These installations can only be perceived when arranged properly by the laws of gestalt. In addition, the luminaires' organization, light effects also act as secondary objects added to our perception.[3]

B. Perceptual Psychology

To interpret closed forms as figures is one important law of Gestalt perception. However, closed forms don't accommodate a continuous contour, they can still be perceived as a whole. Another strong law of Gestalt perception is that elements arranged close together are grouped and form a figure according to the law of proximity. [3] (Figures 4)

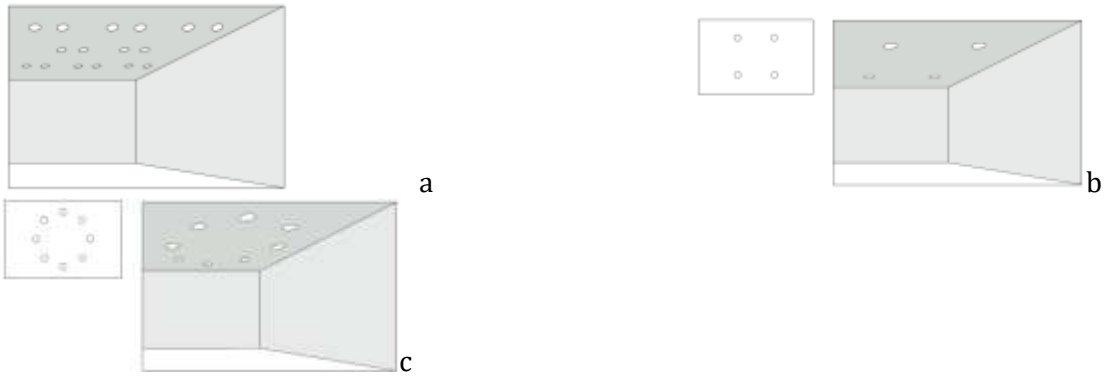


Figure 4. a) Downlights are arranged in two rows according to the law of pure form and figure-ground, b) When two modular luminaires are added, the arrangement is rearranged according to the law of symmetry, creating two groups of five, c) As illustrated above, visual perception begins with the formal approach. We see the circle form first and then perceive the light in the circle form. Therefore, the form of the light becomes a circle. (Source: Ganslandt & Hofmann, 1992)

These examples demonstrate that we first see a circle, then a pattern of lights. The circles are arranged so tightly that the imaginary connecting lines between them are not straight but form a circle; the resulting shape is not a polygon, but a perfect circle.

In addition to proximity, closed shape is another gestalt principle that creates a visual perception through pure shapes that are based on simple and logical structures that become more visible when compared to more complex structures faded in the background. A closed shape is always seen as being inside the connecting line; therefore, the forming effect operates in only one direction. The inside side is usually the same as the concave side of the line surrounding the shape. This logical structuring of certain shapes can also create symmetry. Equal-width shapes have a similar effect. This is not strictly speaking an example of symmetry. However, a principle of order and organization is evident and allows us to perceive a shape [3].

The effects of lighting elements in architecture, such as creating a dimension effect, emphasizing the spatial effect, adding meaning and visual richness to the space, and appealing to emotions, should not be overlooked [1].

C. Gestalt Design Principles

Gestalt theory, also known as Gestaltism or constructivism, is a school of psychology that emphasizes a holistic approach to perception. It proposes that the human brain perceives objects and experiences as unified wholes rather than the sum of their parts. The whole is greater than the sum of its parts. This fundamental principle suggests that the meaning and understanding of something stem not from the individual parts, but from the overall structure. Our brain seeks order and fills in missing information to create a complete picture [3] . Gestalt principles explain how sensory information is organized and interpreted; there are five principles, as follows:

-The law of proximity: Objects close to each other are perceived as belonging together, even if they have no shared qualities. The principle of proximity emphasizes the importance of spatial relationships in guiding our perception and organizing visual information.

-The law of similarity: According to this principle, elements that share similar qualities, such as shape, color, or size, are perceived as belonging together. This innate tendency to group similar elements promotes coherence and harmony in visual compositions.

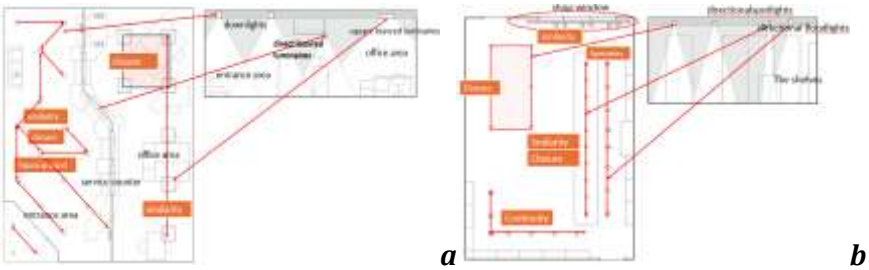
-The law of closure: When we encounter incomplete stimuli, our minds fill in the missing gaps to perceive complete and coherent forms. This principle highlights our innate

tendency to seek closure and continuity, allowing us to perceive wholes rather than fragmented parts.

-The principle of continuity (good continuity**):** The principle of continuity ensures that elements arranged in a continuous and uninterrupted manner are perceived as belonging to the same group. This fluid and uninterrupted flow increases the readability and fluidity of visual compositions.

-The law of figure-ground relationship: One of the fundamental principles of Gestalt theory is the distinction between figure and ground. Our minds automatically perceive objects as either the central figure or the surrounding background, facilitating clarity and comprehension in visual perception. [5]

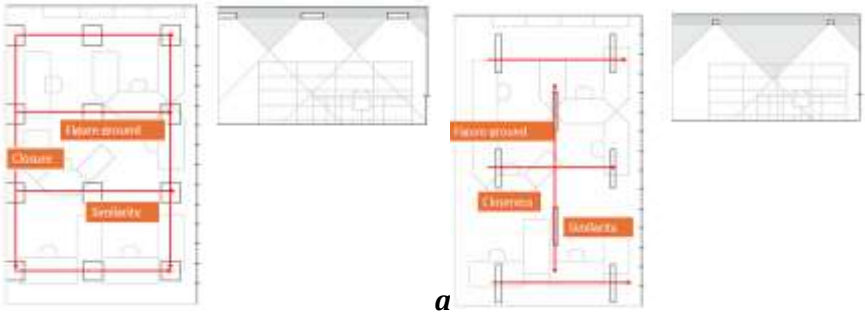
When the office and store interior artificial lighting plans are examined, Gestalt design principles are dominantly seen in the space arrangement and lighting design schemes on the ceiling. In the office space left, the placement of downlights in the entrance and waiting area, in line with the Gestalt principles of similarity, proximity, and continuity, not only defines the space but also creates a uniform and homogeneous lighting design. [3] (Fig. 5 a-b)



a ***b***

Fig. 5. a) Office entrance area artificial lighting plan and section, b) Store interior artificial lighting and section.[3]

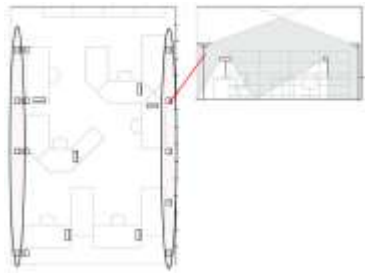
In the office plan and section illustration, square-shaped louvered fixtures create a square-shaped layout and enclosure. Figure 6 illustrates, shelves are illuminated with spotlights arranged according to the Gestalt principles of symmetry, similarity, proximity, and continuity. In the interior, fixtures create an enclosed effect, creating a strong spatial emphasis. Direct spotlights are also positioned in the display case, following the principles of similarity, proximity, and continuity. (Fig. 6 a-b)



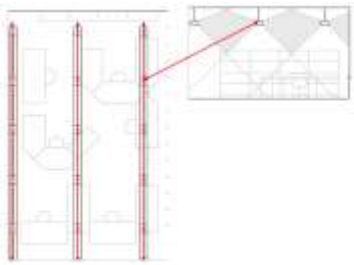
a ***b***

Fig. 6. a) Regular placement of recessed louvered luminaires for ambient lighting in an open office space, b) Staggered arrangement of recessed louvered luminaires provides homogeneous ambient lighting: the linear prismatic lens placed in the middle of the reflector creates a batwing shaped light distribution, eliminating reflected glare.[3]

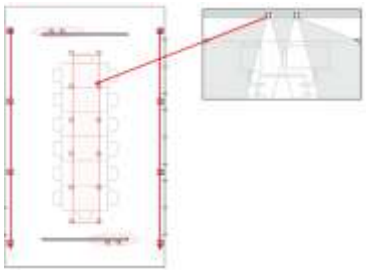
Gestalt principle of space (figure-ground) homogenizes the figure-ground relationship, just like a chessboard, and the lighting fixtures integrate with the ceiling, creating a homogeneous space. In this case, the office arrangement below can be changed without being affected by the lighting above, making it flexible. (Fig. 7 a-b)
Figures 7 a-b show the same office interior lighting, but this time, floor lamps provide ambient illumination, while desk lamps positioned at each workstation provide task illumination. The floor lamps are arranged symmetrically along the walls, following the Gestalt principles of similarity, proximity and continuity. Table lamps for task lighting are also placed above each desk, creating a figure-ground relationship. In the meeting room an aesthetic visual lighting design was achieved by using the Gestalt principles of symmetry, similarity, proximity, continuity and closure, which are compatible with the form of the space. (Fig. 7 a-b-c)



a



b



c

Fig. 7. a) Diffused, glare-free ambient lighting produced by freestanding ceiling fixtures. Additionally, each workstation has its own task light. b) Illumination is provided by a suspended light structure that supports both direct-indirect fixtures and downlights. c) The ceiling fixtures provide indirect light for general illumination of the room, while two rows of recessed spotlights provide direct light to the desk for task lighting.[3]

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II. *ANALYSIS OF ARTIFICIAL LIGHTING SCHEMES IN OFFICE SPACES*

In this section, Gestalt design principle analysis have been conducted using interior visuals of the artificial lighting systems of contemporary-style, open-plan office spaces selected from both Turkey and abroad. During the analysis, space organization for an office building/space criteria constituted the main classification of lighting design concepts, such as main work areas as open spaces, workstations, circulation routes, halls, receptions & lounges, resting spaces as cafes and common sitting areas, assembly rooms and meeting rooms.
In the study, the lighting designs and arrangements of seven office buildings were conducted by space-based lighting design analyses, concentrating on the visual perception of different functional space lighting designs in relation to gestalt principles such as; proximity, similarity, closure, figure-ground relationship, good continuity.

3.1. Oval Office, Hamburg, Germany

Tchoban Voss Architecture, in 2003, designed a five-story, 26,000 m^2 office building. An examination of the interior artificial lighting systems revealed that the placement of spotlights on the suspended ceilings created aesthetic designs using the gestalt principles of similarity, proximity, closure, and symmetry. [4] (Table 1)

TABLE 1 GESTALT ANALYSİS OF İNDOOR ARTİFİCİAL LİGHTİNG SYSTEMS.

 Lobby&Reception desk	 Corridor	 Meeting room	 Hall
In the circular pendant fixture and the spotlights on the ceiling: proximity, similarity, good continuity, figure-ground.	Proximity, similarity, good continuity, figure-ground relationships.	Pendants create proximity, similarity, good continuity and figure-ground principles.	Spotlight on suspended ceilings creates proximity, similarity, area and closure principles.

3.2. Barclays Headquarters Building, San Francisco, USA

Part of a four-building complex designed by Studios Architecture in 2008, the lighting design schemes in the main spaces, conference, and break areas of the building were examined, and it was observed that gestalt principles were used extensively. [4] (Table 2)

TABLE 2 GESTALT ANALYSIS OF INDOOR ARTIFICIAL LIGHTING SYSTEMS.

 Lobby&entrance hall	 Work area	 Circulation routes	 Café&resting spaces
Similarity, good continuation, figure-ground.	Proximity, similarity, good continuation, figure-ground.	Similarity, good continuation, closure, figure ground.	Similarity, good continuation, closure, figure-ground.

3.3. Solid-Flow Office in Berlin Germany

The aesthetic effect of gestalt principles was revealed by examining the artificial lighting schemes in office interiors designed by Martini Meyer in 2005. [4] (Table 3)

TABLE 3 GESTALT ANALYSIS OF INDOOR ARTIFICIAL LIGHTING SYSTEMS.

 Work-spaces	 Resting spaces	 Reception &lounge	 Circulation routes
Similarity, closure, figure-ground, area.	Proximity, similarity, closure, figure-ground, area.	Similarity, closure, figure-ground, area.	Similarity, closure, figure-ground, area.

3.4. Office in Munich, Germany

In the office designed by Landau & Kindelbacher Architects in 2007, the influence of gestalt principles was strongly evident in the artificial lighting design of the interior spaces. The influence of continuity, similarity, symmetry, proximity, and figure-ground principles was particularly evident in the placement of the ceiling fixtures in the meeting room. [4] (Table 4)

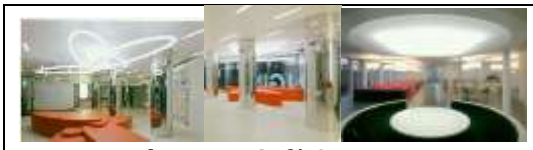
TABLE 4 GESTALT ANALYSIS OF INDOOR ARTIFICIAL LIGHTING SYSTEMS

		
Meeting room: Proximity, similarity, closure, figure-ground, area, symmetry.	Meeting room: Proximity, similarity, closure, figure-ground, area, symmetry	Corridors and Lounge area: Proximity, similarity, figure-ground, area, symmetry.

3.5. Engine Firm Londra, England

The aesthetic approach to the interior lighting design in the 485-square-meter office designed by Jump Studios is striking. The integration of the ceiling lights, particularly in the meeting space and café, with the furniture design beneath, is particularly effective in terms of form-ground relationships. Furthermore, the gestalt principles of similarity, proximity, and closure were used in the design of the fixture layouts for the general ambient lighting in the open office area, creating a visual aesthetic perception.[4] (Table 5)

TABLE 5 GESTALT ANALYSIS OF INDOOR ARTIFICIAL LIGHTING SYSTEMS.

 Waiting lounge , Café & resting space	 Waiting area in open office.	 Resting socializing space.

Similarity, closure, figure-ground, area, asymmetry.	Proximity, similarity, closure, figure-ground, area, asymmetry.	Proximity, similarity, figure-ground, area, asymmetry.

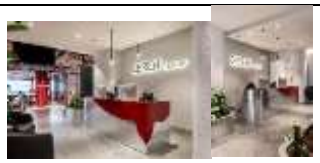
3.6. Antalya Teknokent Building:
Rem Architects,2020,Antalya (Table 6)

TABLE 6 GESTALT ANALYSES OF INTERIOR LIGHTING SCHEMES.

 Open office	 Open office	 Circulation routes
Proximity, similarity, closure, area, symmetry. (URL-1)	Proximity, similarity, closure, area, symmetry.	Proximity, similarity, figure-ground.

3.7. Zeren Group Office
Yup Architectural Design Studio, Istanbul,2024 yılı,310 m2. (Table 7)

TABLE 7 GESTALT ANALYSIS OF INDOOR ARTIFICIAL LIGHTING SYSTEMS.

 Lobby and waiting lounge	 Open office work areas
 Corridor, hall (URL-2)	 Workstations Proximity, similarity, closure, area, symmetry, gestalt principles.

IV.CONCLUSIONS

As a result, the research which focuses on aesthetic contribution of Gestalt theory and design principles to the creation of artificial lighting schemes in office interiors, demonstrated that gestalt principles have a strong aesthetical contribution during the creation of artificial lighting design schemes of office interiors. In office interiors, today, light is used as a source for visual orientation, space creator, sub-space identifier, in a very flexible way. With the loss of walls and vertical partitions, in the contemporary style of open offices, the main aim is to achieve individual work, rest and circulation areas without any solid, hard partitions for flexibility, adaptation and multi-functional purposes. Today, especially in office interiors, material choices, colors and light have become the main space identifiers of sub-spaces in one big open space. Therefore, however, the usage of color and material as a space identifier is very flexible, usage of light can be more adaptive, multi-functional and user-friendly by the developing led technologies, smart dimming systems and lighting fixtures design diversity. By this way,

in the study 'light' and 'artificial lighting design schemes' is taken as a space identifier for open offices and analyzed under gestalt visual perception design principles, as light is a strong visual perception creator.

Therefore, in the study after the theoretical part, seven office interior spaces have been analyzed accordingly artificial lighting design schemes, using gestalt visual perception principles; proximity, similarity, good continuity, figure-ground, closure, and demonstrated that gestalt principles have a strong contribution to the lighting design by arrangement of lighting fixtures. It's commonly found that proximity and similarity is the most used gestalt principles, and they are commonly used during ambient lighting layers, on the other hand, closure and good continuity are commonly found at task lighting layers of office interiors. In some samples, figure-ground relationship and closure gestalt principles have been realized at rest spaces, waiting lounges and cafeterias where lights on the ceiling formal design appears the same as the furniture and floor design. Symmetry, closure, good continuity gestalt principles commonly have been found at meeting rooms.

To sum up, results have revealed that Gestalt design principles have a significant impact on the design of artificial lighting schemes, creating an aesthetic visual perception in the positioning and composition of lighting fixtures in open office interiors today.

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