

Informal interior architecture: The Inspiration of Light and Shadow and Biomimetic Methods in Informal Interior Architecture

Tofaily Nohad (PhD)

Faculty of fine Arts and Architecture, Lebanese University, Lebanon

Received 20 Jan 2022, Accepted 15 March 2022, Available online 21 March 2022, Vol.10 (March/April 2022 issue)

Abstract

The importance of this research is to study the light and shadow to be implemented by the architect's interior designs through biomimetic methods in order to make it unique. This is used to captivate or grab the attention of the receiver to the interior spaces and its expressions in architecture, which shows the importance of this architectural phenomena from various aspects: stylistic, technical and analytical. It is considered that light and shadow make an architectural project unique due to its effective light by reshaping the elements of light and shadow, representing a dynamic creative magic wishing the interior architecture scene. The research also presents a novel biomimetic design method for transferring design solutions from nature to technology, as it focuses on structure-function patterns in nature and advanced modelling tools. Where it focuses on biomimetic characteristics, stages and main challenges.

Keywords: Informal, Interior Design, Shadow, Light, Biomimetic Methods, Interior Architecture Space.

1. Introduction

Informal interior design

Informal interior design was called "The Informal Design movement". It is known as the new comprehensive or understanding of new and unique design (Schepers, 2000). This kind of design was with no doubt a much independent and free design when it comes to dealing with laws of production and restraints (Betts, 2004). Thus, this independency and freedom with its design is what make it different than the traditional and classical industrial design. In 1985, The Pentagon group was not designing technical products but they were putting ideas into practice with their objects (Betts, 2004). The Pentagon Group's work and projects took their design into process by integrating and incorporating non-material ideas into their concepts, which were reflected in their projects, for instance: "Café Casino" and the "Café in a container". New design means Italy, since the west German and for decades have been influenced and committed to the heritage of Bauhaus (Schepers, 2000).

History of informal interior design

The aim of "coming up or creating new visual worlds" came in the 20th century from the "Alchimia group that is related to the foundation of Milan in 1997.

This was considered the turning point in the post-war history of the "Italian bel Design", which absurdly made the design language more colorful, collage-like and provocative in its treatment of the objects at home (Laubersheimer, 2003).

Milan's furniture fair is where the first collections of the group were introduced and took an ironic sale like the "Bauhaus". However, such things were added to the series of Alessandro Mendini's (such as little flags and cardboard clouds which are known as the hitherto sacrosanct classics. As well as, another collection that are related to the designer Ettore Sottsass were led by the Memphis group in Milan in the year of 1981 (Laubersheimer, 2003). However, this group's collection was a bit bizarre and as provocative as these of the Alchimia group. After that, the movement spread to the north of the Alps which had similar developments in the beginning of the 80's (Betts, 2004). On the other hand, German designers did not give up on creating their own vocabulary, but they still took into consideration to put in the work the Italian's concept of colors and conceptual designs (Betts, 2004). Later on, the materials that weren't used in the furniture were used again and the colorful concept was replaced what was called "The Brusque".

Alessandro Mendini Alessandro Mendini was an Italian designer and architect. He is known for the development of Italian, Postmodern, and Radical design. As he also worked, aside from his artistic career, for Casabella, Modo and Domus magazines.

*Corresponding author's ORCID ID: 0000-0002-3482-0272
DOI: <https://doi.org/10.14741/ijmcr/v.10.2.4>

Ettore sottsass Ettore Sottsass was a 20th century Italian architect, noted for also designing furniture, jewelry, glass, lighting, home and office wares, as well as numerous buildings and interiors known as bold colors.

1.1 The research importance

The research shows a great importance of applying light and shadows by the architect in order to achieve uniqueness to impose on the recipient. Also, it points out the importance of discussing this phenomenon from its different aspects; stylistic, constructive and technical, and the potentials of the light and shadow to exceed the functional side to tell a story and to give a meaning and form a metaphor through the blending of shadows. As it shows the importance of using biomimetic methods and its inspiration by the light and shadow.

1.2 The research question

How inspiring is the Light and Shadow in the informal interior architecture? How useful is Biomimetic Methods in Informal Interior Architecture

1.3 The research objectives

The research aims to emphasize the potential of light and shadows and their psychological influence, through the building of a conceptual framework that clarifies the methods of investing in the architecture.

1.4 The research hypotheses

The impacts of reformulating the elements of light and shadow in coming up with creative images that achieve humanity and architectural values that are lost and its positive impacts on the recipient.

Biomimicry: Nature inspired Interior Design

Biomimicry is known as the study of nature that involves designs inspired by nature. they are considered inspiring designs to solve human problems. For instance, hook and loop (Velcro) designed after bur hooks (Yurtkuran, Kirli, & Taneli, 2013). Also, there is Leonardo da Vinci's interest in flight, through the study of bird wings is another example of how design is inspired by nature. In order for the design to be considered or defined as biomimetic, it has to be based on science or what is so called natural science, including biology. (El-Zeiny, 2012). So, this approach of biomimetic design can be considered as the process adaptation of natural organisms which can solve design issued and guides interior architecture design in one-way or another. Hence, biomimetic designs are an innovation or creativity process of ideas that are inspired by nature.

However, this biomimetic approach design happens in two different directions, the first one is through identifying the issue in the design and take a look of how other

organisms and ecosystems managed to solved it, and the second direction is done through the translation of a specific trait in an organism to a design that is responsive to human issues (Taneli, 2013).



Figure 1: Velcro's hook and loop

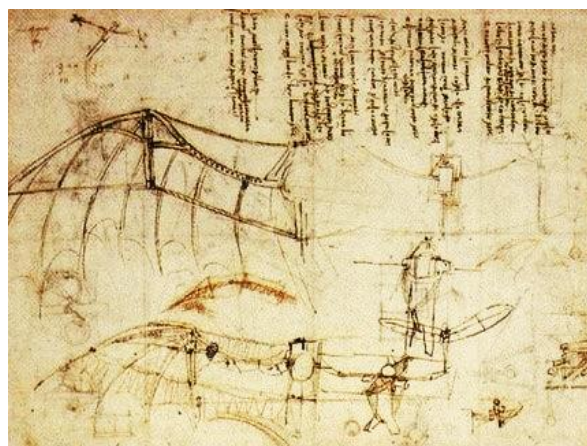


Figure 2: The Leonardo da Vinci's study of bird wings inspired by flights

Characteristics of Biomimetic Methods

It is agreed Worldwide that plants, microorganisms and animals are engineers and they are experienced (Benyus,2018). Since it was perfectly displayed that the majority of the societies' issues were fixed by nature. The whole living things in nature are the ones who knows what lasts on earth and what's the most suitable thing to do (Benyus,2018). On the other hand, some researches about the biomimicry approach found that what is in the world around us is the secret of survival and what did not function is now a fossil after 3.8 billion years of development (Benyus,2018). Putting what nature teaches us into practice is what is known by technological oriented approach or biomimicry (Benyus,2018). Moreover, the biomimicry is known for its few characteristics which are: it is a new way of putting value for nature and observing it so biomimicry is a mentor. It judges the human innovations' rightness by using ecological standards. Thus, it is a measure. And lastly it imitates the models that are

found in nature and gets inspired from them for their designs after studying them. Thus, it is a model (Benyus,2018).

Stages of Biomimetic Methods

There are 6 essential stages to be taken when a designer is seeking solution for a challenge he is facing in his design (Laubersheimer,2003). However, some designers catch themselves moving backward and forward to the same stage which is not crucial but it could benefit them from repeating the same stage. Thus, it helps them reveal new knowledge that can inform them about the challenges assumptions that were made before (Laubersheimer,2003). The first stage is called "Define" it's when the designer knows what impact should his design have on the world, knowing all the criteria that will make him successful. The second stage is known as biologizing, in this stage the designer has to analyze contexts and functions to find a solution for his design issue (Laubersheimer,2003). This happens by asking nature for advice and reframing the design in biological terms. The third stage is discovering, where the designer finds strategies to support survival and success and then the designer starts looking for natural models that has similar function and context of his design solution. The fourth stage is called "Abstract", which is restating the design in a non-biological way in order to study the important features that make biological strategies successful. The fifth stage is emulating and it's the stage of searching for patterns and correlation between the strategies in order to create a design that is based on these elements. And lastly is the "Evaluate" stage, which is the finishing by considering business model feasibility, assessing the design concept and refining an going back to the previous stage to come up with a suitable solution (Laubersheimer,2003).

The Main Challenges of the Biomimetic Methods

The main challenges of the biomimetic methods can be divided into four phases: prospecting, relevance, information accessibility, and implementation. "Prospecting" is the first phase of the designer facing a challenge, this one happens when the designer follows a specific design process after discovering their design issue, so in order for designers to solve their problem, they start to think and look outside the box in order to get inspired and succeed in facing their problem (Corbusier,2012). This case happens only when the designer has the foresight to look to nature or stumble upon it. Thus, nature considers this an opportunity to inspire (Corbusier,2012). The second main challenge is called the "Relevance", this one is often related to biologists who identify human analogy that could make them get inspired. So, in order to start looking into the nature analogy, designers must be able to divide the problem into parts like maintaining temperature and storin nutrients. Hence, in order for designers or teams to

apply a biological concept, they should have a subject expertise to recognize this opportunity of this concept's application (Corbusier,2012). The third phase that designers might go through is the "Information Accessibility", this requires the designer to have a good comprehension or understanding to the biological principles that gives them the inspiration for a creating a solution. This will able designers to create bio-inspired designs. For instance, the designer must understand the production of proteins by the blue mussels that helps them stick to the slippery stones in the ocean, here the design should ask how did the production of proteins happen and how does it work. However, some designers don't have the accessibility to this understanding level for their variety in their knowledge systems, foundational knowledge and technical language. Moreover, some try to find a biology expert to help them translate the biological qualities into design concepts. And lastly, the "Implementation" phase, in this phase prototyping, manufacturing and launching a business will be needed especially that designer would have been found their solution's inspiration. Moreover, more resources would be available if the designer was working in order to assist this implementation process, however if the designer was working independently, the challenges would be harder to overcome or solve(vinci,2000).

The perspective view of light and shadow in interior architecture

A house is the only habitat when it is full of light and air (Corbusier,2012). The light is a part of the interior space with the integration of colors, themes, furniture and materials. Also, the space and the environment would look and feel unique with the correct usage of the light that can be natural or artificial (Corbusier,2012). However, the light's effect can be seen in a shadow form. Thus, the design and the environment all depends on the way of using the light (Corbusier,2012). On the other hand, designs can be cost-effective after the interiors get boring after a certain time so a cheaper way of changing the interior design would be designed depending on the light and shadow, since different effects could reflect if the space has light (Vinci,2000). Adding to that, every season has its own light which changes, creating shadow changes to make it more charm (Vinci,2000).

What can have more various interior shadow effects in the exteriors are the skylight and facades. Also, there are three types of shadows that have various results (Vinci,2000), the attached shadow, the cast shadow and shading (Vinci,2000). The attached shadow, such as a cantilever roof causing a shadow on the façade. The shading belongs to bright and dark contrasts, which are inherent to the form and depend only on the source of light, such as a ball shaped pavilion, The third, cast shadow, could be the result of a high house generating shadow on the street due to the projection of the building outline (Vinci,2000). These types of shadows

are known for adding beauty and freshness to the exteriors as well as to the interiors (Vinci,2000). However, it is more exciting when screen and Jalis create the shadow. The latter has the power of improving the quality of the space, creating an interesting and an aesthetically captivating space. Thus, the use of shadow is an important key of interior design (Vinci,2000). Light matters, a monthly column on light and space (Schielke,2003). The relevance of shadow that was eliminated by the impression of light was due to the increase of LED installations and transparent buildings. However, light is a central element and it is described as a "giver of all presences". The shadow belongs and is related to light so all the organisms & natures from mountains to streams to rivers, animals and human are all made of light that creates a mass called casts a shadow (Kahn,2000). Thus, light is the maker of material, and material's purpose is to cast a shadow 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 (Kahn,2000).

Thomas Schielke Based in Germany, he is fascinated by architectural lighting, has published numerous articles and co-authored the book "Light Perspectives".

Moreover, what was considered a natural part of light was the dark shadow (Kahn,2000). Some designers like Kahn never tried the formal effect with a pure dark space. For example, there should some mysterious opening to know how dark it really is in a dark space. In buildings, there should be harmony in spaces since the level of darkness in a space is elucidated by the glimpse of light. Thus, the structure and the character of the space's natural light is what defines it. As a result, the light as a source is often hidden behind louvers or secondary walls, thus concentrating attention on the effect of the light and not on its origin. On the other hand, darkness evokes deep mystery as well as it evokes the potential dangers and the blindness in it. These tools that are evoked by darkness can be created by designers in order to evoke drama and silence using light and shadow, this is called "sanctuary of art" or "treasury of shadows". For instance, a place that triggers the mind with the dark silence is the portico where the precise defined moulds are created with dark shadow lines and holes, creating a unique texture on its walls, and the shade that is found there reflects the arrangements of volumes (Kahn,2000), adding to that the white and grey concrete walls that creates a 3D canvas for the shadows that are created by light (Kahn,2000). Some designers like Kahn did not believe in artificial shade so he created his buildings in some countries like India and Pakistan to protect the sanctity of shadows and not to protect the people from the sun. Thus, he occupied many buildings in these countries that are extremely exposed to the sun. As mentioned, Kahn did not believe in artificial shade so he did not believe in "Brise-soleils" of Ingerborg Flagge. Unlike Flagge, Kahn used windows and doors in his double walls to direct the light into the

interior. As Kahn describes the large open windows and doors of the Indian Institute of Management: *"The outside belongs to the sun and on the inside people live and work. In order to avoid protection from the sun I invented the idea of a deep intrados that protects the cool shadow."* **Ingerborg Flagge** he former director of the German Architecture Museum who curated the exhibition *"The secret of the shadow"*.

The inspiration of light and shadow in Biomimetic methods

Few extensions are found in buildings in order to apply various degrees of biomimicry. However, it is clear from various investigations that different bio-procedures and their application in design have been attempted to tackling different building issues and those creative engineering arrangements are tracked down climate agreeable, energy effective and tastefully extraordinary (Kahn,2003). What can obviously enhance the climate's nature is the knowledge of biomimicry for daylighting with the structure inside while providing some chances to save energy. For example, some institutes keep itself cool by controlling the amount of sunlight that gets in the building, this control happens by using automated lenses on the building's façade which helps flood the room with natural light (e.g., L'institute Du Monte Arabe). Another example of applying organism level of biomimicry is the use of concrete, steel and glass to construct the building which is inspired from Bee Hive. In such buildings, different hexagon sizes are used to design the windows where conventional energy is possible (e.g., Sinosteel International Plaza) (Kahn,2003). Moreover, some institutes achieved the level of organism biomimicry by designing it as a living skin, such as the Habitat 2020 where its exterior is designed as a living skin. this creates a connection between the exteriors and the interiors that looks like the stomata on a leaf surface which is known for the automatic position of letting in the sunlight. Hence, these biomimetic methods have saved and solved many energies like the electricity that uses artificial lighting but instead all was dependent on the natural light (Kahn,2003).

Sustainable Development "Sustainable development is expanding the achievement of today's human goals while allowing future generations to meet their needs."

Although sustainable development can be explained in several ways, essentially it edges towards the evolution that creates a balance among distinct and rivaling needs as opposed to the different types of environmental, social, and economic obstacles that society faces (Gad,2012). Development is often derived from a specific need, regardless of its broad consequences in the future. Wide-ranging financial crises due to careless investments and issues in the global climate caused by relying on fossil fuel sources highlight the potential

impairments done by this certain approach. Constant and critical impacts will take place as long as unsustainable development is being pursued, hence why immediate action should be taken (Kahn,2003). Sustainable development is the idea of balancing between achieving human development goals and compromising the capability of natural systems that supply the economy and society with natural assets and ecosystem utilities. The main goal is to build a civilization where the living conditions continue to be met while also keeping the natural system stable. Sustainable development is the concept of fulfilling the necessities of today without affecting future generations (Kahn,2003).

Essential elements of mimicry

The three Essential Elements of Biomimicry form the base of the biomimicry meme; they are interlinked but distinct aspects in this profession (Winston,2004). Biomimicry is created by merging the fundamentals of bio-inspired design. One of the first biomimicry elements is ethos. Our principles, aims, and underlying philosophy for why we pursue biomimicry are all embodied in the ethos aspect (Graf,2000). Ethos reflects our regard for, responsibility for, and gratitude for our fellow beings and our home. Moreover, (re)connect is another element that highlights how, while appearing to be "different," people and nature are closely bound. Nature is who we are. (Re)connecting is an attitude and a practice that examines and deepens the interaction between human beings and the natural world (Vernon,2001). The third element is called the emulate element. It uses nature's principles, patterns, strategies, and functions to apprise design. Emulation is about being proactive in accomplishing the objectives of humans fitting in with nature in a sensible manner (Graf,2000). As expressed, achieving biomimicry's elements can help increase the effectiveness of products' patterns and forms to achieve their desired functions by studying the structures of nature's strategies and how they are built. Biomimicry encourages designers to look beyond form and toward nature's inherent sustainability strategies, resulting in designs that are efficient, adaptable, and multi-functional (Graf,2000).

The principles of Biomimicry

Principle 1: Nature Runs on Sunlight

Sunlight is the main energy source that nature uses where its ultraviolet radiation known as UV light and the heat it provides are used by the organisms in nature. Climate change is caused by humans on earth due their use and burn of fossil fuels that creates CO₂. Thus, designers in this case use mimic nature and rely on renewable power and sources. Moreover, a popular chemical reaction called "photosynthesis" is a reaction that happens in nature especially in plants which uses water, carbon dioxide and light which provides them food in order to survive. Also,

small structures called "chloroplasts" are found in plant cells and these mini structures contain chlorophyll, where in this case photosynthesis takes place. This wide phenomenon has two stages (Light reaction: converts the energy of sunlight into chemical energy (ATP – adenosine triphosphate and NADPH – nicotinamide adenine dinucleotide phosphate and Dark reaction: chemical energy is converted to produce sugars from carbon dioxide). Hence, the equation here is $6\text{CO}_2 + 12\text{H}_2\text{O} + \text{sunlight} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$). On the other hand. Some bacteria that are found uses simple chemical compounds for their energy and not the sunlight such as: hydrogen or Sulphur compounds. Thus, this is called chemosynthesis which is not very similar to photosynthesis. Chemolithotrophs is one of these bacteria that takes place in chemosynthesis and uses an inorganic electron donor for breathing. Ponds and mineralized area are the places where bacteria dwells, these places are where the sun does not really shine such as deep-sea smokers. The carbon dioxide is used in order to build the autotrophs' organic matter. Thus, Heterotrophic organisms derive their energy from organic materials produced by autotrophic organisms.

Principle 2: Nature Fits Form to Function

A tree is rooted within the ground to draw water and supplements from the soil; it also spreads its branches as wide as possible to extend the area on its leaves to retain more daylight that creates vitality and growth. Seeds are light and thin, some even come with a furnished umbrella that helps them float in the air. Everything in nature is designed according to the function it serves, which is how buildings, transportation systems, and schools should be built. In mammals, grazing has prompted the most remarkable dental specializations. Grass and meadows first appeared on Earth about 20 million years ago. Grass is a poor source of nourishment as it produces little energy in relation to its mass, so grazers must process massive amounts of material. Many of those calories come from inorganic cellulose, which mammals can only break down with the help of symbiotic microbes in their stomachs or intestines. It contains additives such as silicon dioxide and lengthwise strands that require cross-wise biting rather than instantaneous shredding. Long-lived grazing animals, on the other hand, have peculiar teeth, which are often piled side by side. This unusual structure means that, while teeth may wear down, they do so uniformly. The tougher substances (especially enamel) will continue to extend while the softer textures (cementum and dentine) subside.

Case study

Many scientists believe that Mother Nature is the most knowledgeable which is why researchers are looking at nature for inspiration and new solutions to human issues

(Schleeter, 2014). Scientists discovered an unusual pattern of jagged scales in fireflies that increased the glow of lanterns and used that information to construct an LED overlay that replicated the natural structure (Bay, 2013). The overlay, which boosted LED light extraction by up to 55% while using less energy, may be simply adapted to existing diode designs to assist humans light up the night while using less energy (Vigneron, 2012). Fireflies generate light through a chemical reaction that occurs in specialized cells called photocytes, and this light is emitted through the cuticle, a part of the insect's exoskeleton (Bay, 2013). Because light travels more slowly through the cuticle than through air, a portion of the light is reflected back into the lantern, dimming the glow (Suhonen, 2012). However, the unique surface geometry of some firefly cuticles can help minimize internal reflections, allowing lighter to escape and reach potential firefly suitors' eyes (Cloetens, 2014). This inspired many researchers to come up with ways to make LEDs more efficient.

According to new research, a new form of LED light bulb might one day be used to light households and businesses while also lowering energy expenditures (Elyse, 2018). LEDs play a critical role in clean energy, so increasing their efficiency is important (Yin, 2019). The overall efficiency of commercial LEDs is already around 50%, therefore researchers focused on ways to get lighter out of them. Since light can reflect backward and be lost, both fireflies and LEDs encounter similar issues in releasing the light they create (Zhu, 2019). Microstructures- microscopic projections—on the surface of LEDs are one way for permitting more light to escape (Chen, 2019). These projections are symmetrical in most LEDs, with similar slopes on both sides. These microstructures can also be found in fireflies' lanterns, but they have asymmetric sides that tilt at varying angles, giving them a lopsided look (Yao, 2019). Researchers attempted to go deeper into the subject of light extraction efficiency employing asymmetric structures in this work. Scientists discovered that by using asymmetrical pyramids to generate micro-structured surfaces, they could boost light extraction efficiency by roughly 90% (Lee, 2018). In two ways, asymmetrical microstructures improve light extraction. First, because the asymmetric pyramids have a larger surface area, they allow more light to interact with the surface, trapping less light. Second, when light strikes the two separate slopes of the asymmetric pyramids, the reflections are more randomized, giving the light a second chance to escape (Chao, 2019). After demonstrating that the asymmetric surface might theoretically improve light extraction using computer simulations, the researchers went on to demonstrate this empirically (Shang, 2019). The scientists constructed symmetric and asymmetric surfaces using nanoscale 3D printing and evaluated the amount of light emitted. The asymmetric surface behaves as expected; it allows the release of more light. Since LEDs last longer and consume less energy, they are better for the environment

than typical incandescent or fluorescent light bulbs. The market for LED-based lighting is expected to reach \$85 billion by 2024, thanks to the rising demand for renewable energy (Yin, 2019). LED lighting can be 80% more efficient than traditional lightings like fluorescent and incandescent light bulbs (Connell, 2013). Only 5% of LED energy is wasted as heat, while the remaining 95% is converted into light. In comparison, fluorescent lights convert 95 percent of their energy to heat and only 5 percent to light. LED lights also use far less energy than traditional lighting; a typical 84-watt fluorescent can be replaced by a 36-watt LED to produce the same amount of light. Lower energy consumption reduces the demand for power plants and reduces greenhouse gas emissions (Helm, 2020). In addition, LED devices make it possible to deliver the least amount of carbon dioxide in the atmosphere of any lighting source due to their low power consumption. A simple incandescent bulb, for example, emits 4,500 pounds of CO2 per year, whereas LED bulbs emit only 451 pounds of CO2 (Smith, 2018). By reducing greenhouse gas emissions, retrofitting HID fixtures with LED fixtures can have a significant environmental impact. Because LED lighting can last up to 20 years in some cases, the longer life reduces the need for more luminaires and bulbs, lowering greenhouse gas emissions caused by the manufacturing process (Brown, 2019). While commercial and household use of LED lamps are beneficial, full conversion of the industrial sector to LED could have a far greater impact (Williams, 2020).

Efficiency table of different light sourcesb

| Lumens | Standard | Halogen | CFL | LED |
|---------------------|-----------|-----------|------------|-------------|
| 450 | 40W | 29W | 9W | 8W |
| 800 | 60W | 43W | 14W | 13W |
| 1100 | 75W | 53W | 19W | 17W |
| 1600 | 100W | 72W | 23W | 20W |
| Life Span (approx.) | 1 year | 1-3 years | 6-10 years | 15-25 years |
| Saving | No saving | Up to 30% | Up to 75% | Up to 80% |

In conclusion, cities are growing in size and nature is often polluted; light is an "easy" way to create a natural experience and change appearance without requiring significant changes to architecture and design (Lorenzen, 2018). Biomimicry takes it a step further by viewing nature as a source of solutions that are not only pleasant for people but also sustainable, of high quality, and long-lasting, as nature has proven to be able to withstand all kinds of changes, including environmental challenges (Kublik, 2019).

Conclusion

It was found by a bunch of architects that the power of inspiration, which induces a mix of emotions in the soul, stems from natural light. Designers tend to emit this mix in the form of light and shadow. Since the rate of change per day gives a variety of functions and interior shapes, the

receiver's senses are altered. The virtual use of the sunlight is one of the unique features that arise from architectural perception. Due to the importance of this component, its absence or presence determines whether the user of the space is affected negatively or positively. Sunlight helps create a unique and effective building environment as well as an energy supply. Architects have found many ways to make daylight available for design; this raised the assumption that the study of building patterns relying on sunlight is the central goal in the future of architectural design.

The interior, which consists of many traps, must be selected carefully and assimilated with each other in a way to avoid contradiction. The main reference in the formation of construction and interior space are the workers, as their physical and psychological response is what determines whether the color, raw material, interior trim, shape, and size of the slots are meticulously chosen or not. The concern when designing shaded combinations of natural light gives architectural spaces a creative touch that affects the users of these spaces. Additionally, it permits designers to express the meaning and value of philosophical and symbolic fantasies and emotions. The future imagining recipient influences the formulation of shadow and light elements in architectural design as well as prepared flow and effective elements in interior design.

References

- [1]. A.G.S. (2000). Architectural Graphic Standards. John Wiley & Sons, Inc. New York
- [2]. NARM, (2009). Natural daylight design through roof lighting, UK: National Association of Skylight Manufacturers.
- [3]. Yurtkuran, S., Kırılı, G., & Taneli, Y. (2013). Learning from nature: Biomimetic design in architectural education.
- [4]. Zari, M. P. (2007, November). Biomimetic approaches to architectural design for increased sustainability.
- [5]. Hathcock, 2017. Biomimicry: Nature inspired Interior Design.
- [6]. Rudnitskaya, 2019. Biomimetic sensors arrays.
- [7]. Pawlyn, M. (2011). Biomimicry in architecture. London: Riba Publishing.
- [8]. Pearce, A. and Ahn, Y. (2012). Sustainable buildings and infrastructure. Routledge. London.
- [9]. Benyus, J. M. (2002). Biomimicry: Innovation Inspired by Nature. New York: Perennial.
- [10]. Al-Jawhary, A., 2010. Biomimicry in Environmental Architecture Exploring the Concept and Methods of the Bio-Inspired Environmental Architectural Design.
- [11]. Yao, 2013. The elements of biomimicry and its inspiration in interior architecture.
- [12]. HMG, (2003). Skylight Photometric Testing. A report and photometric files for 16 common skylight and well combinations
- [13]. Domballe, J. (2020, November 02). The current situation in the port of Beirut, Lebanon.
- [14]. Ohioma, P. (2012). Collections and Collaboration: Art and Museum in Africa.