The Dynamics Of Colors And Their Influence On Architecture

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Abstract:

Color is an essential element in architecture not only aesthetically, but also has a great psychological-sensory importance, so colors are responsible for a variety of psychological factors that the mind translates into feelings that vary depending on the color of the surface, it performs a function not less important than the set of compositions and other elements of construction, so identifying colors for any project is a great responsibility, it is people who will interact with the end result in a positive or negative way, not only for its architectural composition but also for its colors. When it comes to choosing colors and lighting in architecture, it is important to take into account the feeling it will make in the people who will live in it, where we unconsciously tend to allocate colors that may lead to negative effects on our bodies, personality, behavior, and mood. Color can also show a certain size, or visually simulate certain aspects of the vacuum that increase, decrease, or change the value of the space or architectural composition of the mass, so it should be used wisely so as not to give negative results to the building and users.

Describing the relationship between the different colors and features governing it, or even many of the studies on these theories, is as complex as it is widespread, and the color is associated with psychology, symbolism and even mysticism; where colors take on different meanings depending on the artistic, historical or cultural period; among many other characteristics. This article does not aim to address the artistic aspects of color but seeks to reflect on the relationship between color and architecture where this paper aims to study how colors affect human beings in general and its importance and impact on architecture in particular and its relationship to various activities and uses inside and outside the architectural and urban space.

Key words:

(CIA) Color in architecture, (CD) Color dynamic, (CL) Color and light, (VEC) Visual effect of color, (PEC) psychological effect of color;

ملخص البحث:

اللون عنصر أساسي في العمارة ليس فقط من الناحية الجمالية فحسب، بل له أيضًا أهمية نفسية - حسية كبيرة، فالألوان مسؤولة عن مجموعة متنوعة من العوامل النفسية التي يترجمها العقل الى مشاعر و احاسيس تختلف تبعا للون السطح، فهي تؤدي وظيفة لا تقل أهمية عن مجموعة التكوينات وعناصر البناء الأخرى، لذا يعد تحديد الألوان لأى مشروع مسؤولية كبيرة، فالناس هم الذين سيتفاعلون مع النتيجة النهائية بطريقة إيجابية أو سلبية ، ليس فقط لتكوينه المعماري ولكن أيضًا لألوانه، فعندما يتعلق الأمر باختيار الألوان والإضاءة في العمارة، من المهم أن نأخذ في الاعتبار الإحساس الذي سيحدثه في الأشخاص الذين سيعيشون فيه حيث نميل دون وعي إلى تخصيص ألوان قد تؤدي الى أثار سلبية على أجسامنا وشخصيتنا

وسلوكنا ومزاجنا.، كما يمكن أن يُظهر اللون حجمًا معينًا، أو يحاكي بصريًا جوانب معينة من الفراغ تزيد او تقل أو تغير من قيمة الفراغ أو التكوين المعماري للكتلة، لذا يجب استخدامه بحكمة حتى لا يعطى نتائج سلبية على المبنى و المستخدمين. إن وصف العلاقة بين الألوان والميزات المختلفة التي تحكمها، أو حتى العديد من الدراسات حول هذه النظريات، معقد بقدر ما هو منتشر على نطاق واسع ، ويرتبط اللون بعلم النفس والرمزية وحتى التصوف ؛ حيث تأخذ الألوان معاني مختلفة اعتمادًا على الفترة الفنية أو التاريخية أو الثقافية ؛ من بين العديد من الخصائص الأخرى. لا تهدف هذه المقالة إلى معالجة الجوانب الفنية للون ولكنها تسعى إلى التفكير في العلاقة بين اللون والعمارة لذلك تهدف هذه الورقة الى دراسة كيفية تأثير الألوان على الإنسان بشكل عام و أهميته وتأثيره في العمارة بشكل خاص وعلاقتها بالأنشطة و الاستخدامات المختلفة داخل و خارج الفراغ المعماري و العمراني.

الكلمات المفتاحية:
ماهية اللون، اللون في العمارة، ديناميكية اللون، اللون والضوء، التأثير البصري للون، التأثير النفسي للون

1. Introduction

Colors play an important role in our lives that some may not realize because they reflect on us different feelings without us realizing, either negatively or positively, whether psychologically or physiologically. Colors and their perception are responsible for a series of stimuli in our psycho-spatial relationship despite its diversity and presence around us. It is in all environments and places, and have we ever wondered about its role and impact in architecture? In addition to the structural elements that make up the building, the application of color to surfaces also affects the user's experience of a space, as color can show a certain volume or structural detail, or visually simulate certain aspects of a space, and it can also provide a range of feelings or visual effects, that act as sensory stimuli. (Pedrosa,2009)

1.1. Research hypothesis:

Knowing the impact of color used in our designs consciously of what we want to formulate and convey feelings and emotions to users increases the success of the building in performing its functions without negative psychologically and healthily affecting them.

1.2. Research problem:

Sometimes we tend unconsciously or consciously to allocate colors that lead to negative effects on our bodies, personality, behavior and mood, as a result of color and optical distortion, occurring in the chaos of colors that we see around us in many visual elements, where color greatly affects human life psychologically, physically and socially as well as our identity and the way we see life.

1.3. Research objective:

This paper aims to study how colors affect humans in general and their importance in architecture in particular and its relationship to various activities and uses inside and outside the architectural and urban space and its proper use increases the value and interaction of people with the building.

1.4. The research importance:

Identifying colors for any project is a great responsibility, not less important than other elements of construction, as it is responsible for many health and psychological factors such as joy, sadness, fear, depression and other heart disease and blood pressure, so it must be dealt with

wisely, consciously and knowingly.

1.5. Research Methodology:

The research used the descriptive analytical approach to reach results that increase the cognitive value of how colors affect architecture.

1.6. Research Axes:

The research dealt with four main axes to reach the goal of the study:

- The first axis: What is color?
- The second axis: The psychology of colors
- The third axis: The effect of color on some important applications in architecture
- The fourth axis: Color and light in architecture.

2. A preface to understanding what colors are:

2.1. Color definition:

Color is the characteristic of an object, whether it is red, green, or otherwise, and it is the "visual perceptual characteristic by which things are compared to separate it from others, and this is what we see when the colors modify the light physically so that the eye sees it and translates it by the brain, which is called the process of response or sense of color. Color is a physiological effect produced in the retina, by conical cells that perform a three-color analysis of the viewer, whether caused by colored chromosomal matter or colored light, and color is associated in our language, through the terms "this red thing", it is a misleading association because it cannot be denied that color is a feeling that exists only in the brain, and the following explanations show us how we perceive colors. (Berns,2000)

- **Light and its relationship to color:** Light rays in the strict sense are not colored, but there is only energy in the rays that stimulate the feeling of color, as Isaac Newton stated, that light is the source of the color sensation, and in 1801 Thomas Young proposed his tricolor theory based on the observation that any color can be matched by mixing three lights. (Helmholtz,1970)
- **Historical concept of the color:** The color sensation is influenced by a long-term historical concept according to the nature and culture of the viewer, as well as the short-term concept of adjacent colors.
- **Science of color:** Color can be understood through many branches of science, including the ability to perceive the color with the human eye, the origin of colors in materials, color theory in art and physics, the ability to change the human psyche, because each color is associated with certain concepts and connotations, and through "color tests" the emotional and intellectual conditions of man can be indicated. (Radwan,2015)

2.2. Color and how it affects humans:

Colors cause perceptions that we must understand, as white sunlight decomposes in colors: Red, orange, yellow, green, blue and purple, and these colors are divided into basic colors (yellow, red and blue) and secondary colors (orange, green and violet) that arise as a combination of basic and intermediate colors resulting from mixing a basic color and a secondary color, as illustrated by Munsell color system. Fig.1 and each color has a three-way effect on the person: (Architect,2016)

- **Impress**, draw attention.

- **Reaction or emotion,** so that each color is able to express.
- **Structure,** because each color has its own meaning and acquires symbolic value.

Colors were also classified as cold and warm colors such as (blue, green and purple) and were named cold because they are associated with space and the depth of sea and night water, while warm such as (red, orange and yellow) and warm or hot colors are named because they tend to light and fire colors the source of heat, and each of these colors has a different effect on humans. (Berns,2000)

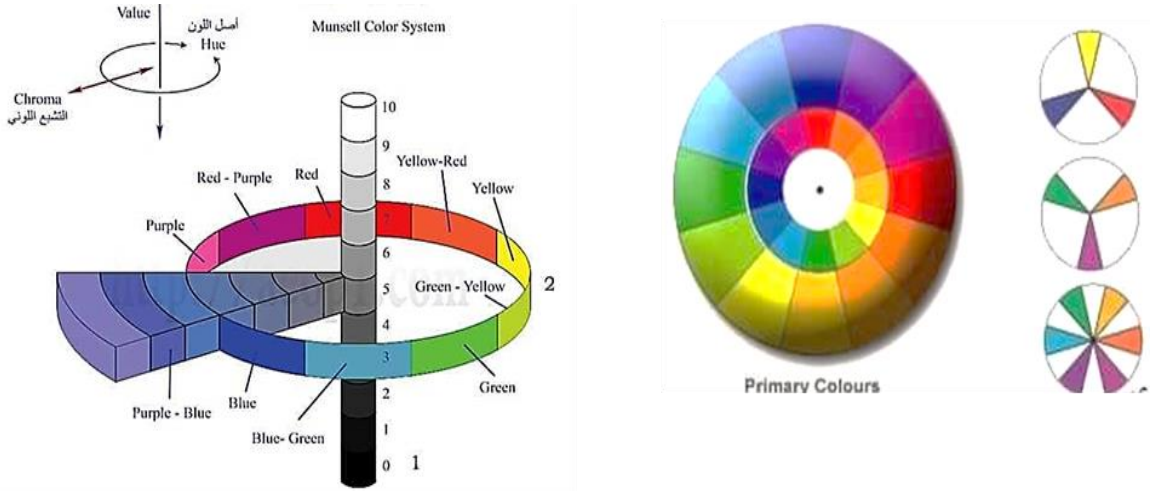


Fig.1 Munsell color system (Derivative,2009)

2.2.1 The effect of warm colors on humans:

- Warm colors are bright, vibrant, energy and elegant for a sense of comfort and warmness of the place, and also act as alarm clocks.
- Warm, light colors suggest art, femininity, childhood, generosity, joy and excitement.
- Warm dark colors also indicate vitality, strength, wealth, and stability. Fig.2

2.2.2 The effect of cold colors on humans:

- Cold colors are calm and soothing, peaceful colors that give a sense of calm and relaxation in the place and in some cases, it is something gloomy.
- Light and cold colors express freshness, tenderness, comfort, unity, hope, peace.
- Dark cold colors express mystery, depression, and covering. (Pedrosa,2009)

2.2.3 Complementary and symmetrical colors:

- **Complementary colors:**

They are the corresponding colors in the color wheel, and these colors are at the top of the contrast between each other making each color appear very clearly in front of the other, so they can be used to create vitality and audacity in place. Fig.3

- **Analogous or symmetrical colors:**

They are harmonious and juxtaposed on the color wheel, a collection of colors from one adjacent family, giving harmony and comfort in place. Fig.4 (Saber,2012)

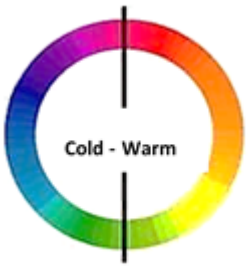


Fig.2 Cold and warm colors. (Gauguin, 2018).

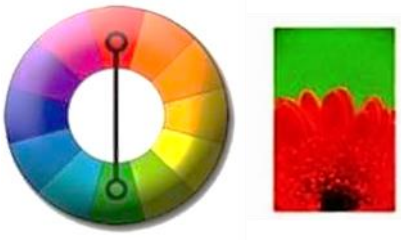


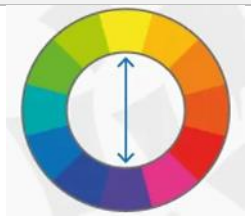
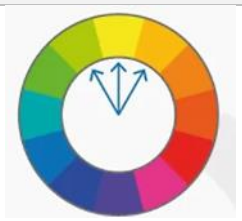
Fig.3 Complementary colors – opposite. (Gauguin, 2018).

Fig.4 Analogous or symmetrical colors. (Gauguin, 2018).

2.2.4 Rules and methods of building a color pattern by the color circle:

To design a specific color pattern, we must first know the design goal to be reached or reflected on the viewer or user, where the design pattern chosen will result in feelings and emotions either positive or negative, so identify the design goal clearly and consciously for the function of space, mass or interior design of brushes or other tools of architectural and urban space.

Where the rules and methods of building color patterns are limited to six basic rules that can be used and applied according to the design requirements that the designer sees and how appropriate they are to the design goal, as table (1) shows those rules that can be used when choosing a theme. (Gauguin, 2018).

Rules and methods for building a color theme using the color wheel		
	The first rule: Complementary color	Illustration Figure
First rule	The complementary colors are every two opposite colors in the color circle, meaning that it consists of two colors and this format gives a high contrast because we use a warm color with the opposite cold color, and for the best result, one of the two colors is dominant in terms of space and then the complementary color is added to it to give brightness and contrast.	
	The second rule: Analogous color	
Second rule	Consists of three adjacent colors in the color wheel, as this color theme gives greater harmony when it is less vibrant, comfortable for the eye, it is recommended to choose one dominant color with a larger area and the other two colors in lower proportions to enhance the theme, and it is preferable in this scheme to avoid mixing warm colors with cold ones.	
	The third rule: Split- complementary colors	

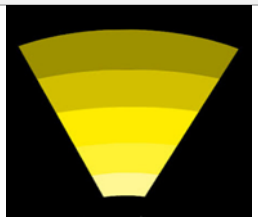
Third rule	Consists of three colors, two of them adjacent to the complementary color of the third. If you want to choose three colors for your design, this is the appropriate format, as it maintains a degree of contrast next to harmony, and it is recommended to choose one dominant color and the other two colors enhance it.	
	The fourth rule: Triad complementary	
Fourth rule	Triad Complementary scheme: This format uses three colors with equal distances between them. These colors are determined using an equilateral triangle at the vertex of the triangle from the center of the color circle. This format gives more balance between colors and less contrast.	
	The Fifth rule: Quadrilateral color	
Fifth rule	This style depends on four colors so that each two colors are complementary, this theme needs to be bold in use, taking into account the proportions and the degree of color to get a good result. It is also recommended to choose one dominant color to maintain the balance required for the design.	
	The sixth rule: Monochromatic color	
Sixth rule	This style depends on the use of multiple degrees of the same color, by adding the white color to lighten the color, or the black color to darken, as it gives smoothness and consistency among the one element.	
		

Table (1) By the researcher with help of (Gauguin, 2018).

2.3. Color dynamics:

We rarely use colors alone, and the problem here is the relationship of colors to each other, which is one of the basic factors that gives me the desired feeling, and to know what the appearance of color will be, you must know what it is, and its value for others, and this is what the term "color dynamics" means that there is a relativity between all the color brilliances found in any composition, and their variations affect perception, and this effect is strong whenever the change is significant in the visual nature of any color. Psychologists call this effect “The following contrast”. (Saber,2012)

2.3.1 How "contrast" affects color brilliance, which increases its dynamics:

Color interferes with the characteristics and perception of shape geometry, when two different colors come into contact in full contrast, the contrast here will increase the degree of variation, and this change is greater as long as the contrast is greater in both degrees of brilliance, and the area of the contact part means that any two colors are equal in the value of gradient, color, and lighting power do not have a significant impact on each other, one or a set of these metrics causes a visible change in impact, This also suggests that the more the transaction between one color and another, the stronger this change, and reaches its limit when one color is surrounded by another color, and when you realize this fact, we become already fully aware of the transverse when using colors. Here's how contrast affects the dimensions and shapes shown: Fig.5,6 (Architect,2016)

- A light color on a dark background looks lighter than it actually is, and a dark color on a light background looks darker.
- If the color is denser it seems to occupy less space. If the color is less dense it seems to have a larger area.
- Warm colors look wider and cold colors look smaller than they already are.

Fig.5 Warm colors appear more (spacious than cold. (Architect,2016)

Fig.6 Full contrast increases the degree of (difference. (Architect,2016)

2.3.2 Contrast in gradient value:

When there is a contrast coming for two values of different gradation, what appears lighter is the lightest and what appears darker is the darkest, and this effect is evident when we put gray on a white floor, then on a black floor respectively, and we see the same thing as the different values of two adjacent colors, and do not forget that the color of the floor is affected as the color of the shape, and this effect may be more complex because the other color scales will often be presented too. Fig.7:10 (Scott,2007)

Fig.7 The color gradation on two different grounds

Fig.8 Gradient and light force fields. (Scott,2007)

Fig.9 Gradient value for one color

Fig.10 Color gradient with another color

2.3.3 Contrast in color:

The effect becomes more dynamic in the case of different color contrast, the change will be towards any different color, and the principle here is the contrast in temperature, if there is a warm color in a contrast coming with a cold color, the warm color looks warmer, and the cold

color looks cooler, you find that green if placed on a yellow floor, and then on a blue floor inside a circle, you can notice that the green color looks on the yellow floor relatively cold, as you find that the green color if placed on a yellow floor, and then on a blue floor inside a circle, you can notice that the green color looks on the yellow floor is relatively cold, as the blue floor looks warm, the green color in the first case appears more green than it really is, while in the second case it appears more yellower, the amount of effect and change in the color state gives rise to a sense of movement within the color composition.Fig.11:15 (Saber,2012)

Fig. 11:15 Contrasting different colors on two different backgrounds. (Scott,2007)

2.3.4 Contrast in light power:

There are two types of relative changes in the color lighting strength scale. If we take a case where the contrasts between the corresponding colors have different light forces, the color shine shows greater light power than its real strength, and the less shine in its light power appears more neutral than it really is, and this simple encounter is more complex if there is an opportunity to compare complementary colors, and others close to them, and as long as they both feel their complementary color, the degree of clarity of light power increases in both, and this effect may become strong to the point where the contrast is so strong that the eye does not rest, fig. 16:20, (Scott,2007). This is a brief part that shows the strength of the color effect in the design and the extent of the sensory alternatives we receive from color variations.

Fig. 16 The light power of two different colors on two different grounds

Fig.17 The light power of a single color

Fig.18 High light power in a small area

Fig.19 Low light power in a larger area

Fig.20 Complementary color

2.3.5 The color contrast in architecture:

What we have dealt with about what color and its dynamics is a brief picture that every architect must study more extensively because we cannot address all the influences and color characteristics that affect the overall composition and emptiness of the building, which for architects are important physical elements in the design process and architectural idea, especially when they wish to give its composition a larger and more comprehensive picture of the required color dynamics, as well as other elements of the composition. Fig.21

Fig.21 The color contrasts in architecture give strength, beauty and confirmation to the design idea. (Saber,2012)

3. Introduction to color psychology:

"Ardtcham" explained that colors give an impact on human behavior, where many experiences have shown how colors affect our keenness and caution, or our feeling of cold or warm, or joy and sadness, where it greatly affects human life psychologically, physically and socially as it affects our identity and the way we see life. (Fehrman,2004)

3.1. Psychological characteristics of colors:

Before choosing or identifying colors for any project, you must fully understand the feelings that these colors convey to the viewer, because as it has a positive and beneficial effect, it may have a negative impact, so understanding the psychological and moral impact of colors will have a great impact on the final product and the messages it sends to users, and below we explain some psychological characteristics of colors in general: (architect,2016)

- **Red:** It increases the illusion of heat, muscle tension and breathing where it activates and stimulates blood pressure, and symbolizes fire, revolution, violence and passion, it symbolizes movement, vitality, as well as cruelty and anger.
- **Yellow:** It is the most intelligent color where it stimulates neural centers and symbolizes strength, control, nostalgia, warmth and light emitted by the sun, as well as joy and good mood.
- **Orange:** It increases enthusiasm, burning and abundance, and facilitates digestion.
- **Blue:** It symbolizes serenity, peace, calmness and hardness, emitted from the color of heaven and water, it has intelligence, wisdom and truth, it acts as a sedative for pain.
- **Green:** It symbolizes nature and spring, which brings hope, youth and renewal and increases calm, comfort and recovery, it is a color that frees the soul and balances feelings.
- **Rose:** It symbolizes love and brings a spirit of romance and softness.
- **Violet:** evokes mystery, contemplation, it symbolizes depth, complementary work.
- **Black:** It symbolizes evil and causes sadness, in which colors are absent.
- **White:** It symbolizes peace and purity, serenity, honesty, truth and creativity.
- **Gray:** It is a neutral color, symbolizing both good and evil and incorporating joy and sadness, (it is a mixture of black and white)
- **Brown:** It symbolizes the earth, simplicity, utility.
- **Silver:** Exuberance and spirit of assistance, but weakens the ability to discriminate
- **Golden:** It symbolizes riches and wealth as well as openness and love of life.

3.2. Visual effects and psychological stimuli of color in architecture:

When we use colors on surfaces we get different visual effects, Fig.22 for example, if the ceiling is painted in a dark color that gives a sense of less space, and if we use color on the central wall of the void, then the idea of "spatial shortening" arises visually; Whereas if it is applied to all walls, a perception arises of a space longer than it actually is, if the side walls are only painted, they give an indication of the narrowness of the area, but if the central wall and the ceiling are painted in the same color, the space seems wider, and if we want to give a sense of reduction of height, all surfaces can be painted at half height with dark steps working on the upper surfaces to give us the desired feeling.

Fig.22 Color contrasts give different visual effects. (Pereira,2018).

Colors do not exist without light if the material is not lit, says Israel Pedrosa color has no physical presence: it is only the sensation produced by neural organizations under the influence of light, and more accurately the action caused by the work of light on the vision device, where color is closely related to psychological stimuli and can be used along with the shape and size of each project. (Lilly,2019)

3.3. The psychological and physiological effect of colors:

Just as the colors of a painting or abstract image produce a certain feeling, the colors of the room or building can affect the feelings of the people who use them.

3.3.1 Physiologically:

Studies have shown that blue light slows melatonin production, making people more alert even at night. Interestingly, the vitality of the color wave can be detected through the skin, (Fehrman,2004) as visually impaired people use it to perceive color in a similar way by classifying color into a warm or cold color, defined by its wavelengths. Blue, purple and green are also seen as colors with short wavelengths, while red, orange and yellow are considered warm colors that have a large wavelength, and each length has various effects on humans. (Jalil, 2011)

Ponders" and many researchers have shown that many of the problems that people are exposed to such as low concentration or anxiety, or discomfort, and sometimes discrimination, resulting from an unhealthy environment in which weak colors, monochrome and colorless, also weak or dismal color differences, resulting in excessive stimulation of the nervous system that leads to changes in breathing rate and increased heart rate and blood pressure. Research measuring stress has also identified these indicators as common effects on individuals who have been over-stimulated as a result of an over-stimulating environment that contains solid (high saturation) colors, or colors that are easily distinguishable. (Radwan,2015)

3.3.2 Psychologically:

People associate certain colors with certain feelings because of the cultural and historical symbols and living experiences they have gone through, where people see, for example, that red is scary or causes discomfort as a result of its association with blood, and research has shown

that color is a universal visual language that everyone understands even the animal, and that the color impression and the message it reflects on the scenes is of great importance in the formation of mental mood and atmosphere that gives a sense of the breadth or small size of the space, (Pedrosa,2009) so it is possible that the way the room is colored has different effects and complicated by how its users feel, as well as the exteriors depending on how they are colored, each color has its own emotional features and its effects on people in the architectural void. (Lilly,2019)

3.4. The psychological and emotional impact of the main colors in architecture:

Color is not only aesthetically important, but also of great psychological and sensory importance, providing a range of visual feelings and effects, and can show a certain size, or visually mimic certain aspects so it should be used consciously so as not to give negative results to users, we summarize below the emotional associations of the main colors and their uses in architecture, and evaluate their different effects on people. Table, (2), (Pedrosa,2009)

Features and characteristics of color in architecture		Appropriate uses	Illustrations Figures
1- Blue color	A calm and wonderful color, generous, safe and comfortable, especially in the ceilings, where it symbolizes the sky, it is considered one of the most common uses in architecture, as it gives a feeling of comfort, safety, confidence, and positivity to users, and blue light fixtures are also among the most effective places in outdoor spaces.	It is used in banking agencies, offices and companies. The individual blue elements such as columns or furniture are a comforting factor in the space.	
2- Yellow color	A cheerful and constantly glowing color and it can be used in many different places, highlighting certain elements that do not overwhelm the red color, due to its emotional and beloved associations with people, and because its radiance makes any neutral, gray, or gloomy space appear more joyful and lively, and gives optimism, curiosity, fun, and atmosphere orient.	It is used wonderfully and is popular in children's projects such as nurseries and is often used in commercial spaces or restaurants to attract the attention of pedestrians.	

3- Red color	Red indicates warmth, excitement, and passion, and can also be associated with danger and fear. Dark chestnut tones are read as attractive and exciting, while bright reds are friendly and eye-catching, and overall red, if poorly executed, can be annoying. Touches of red in neutral-colored spaces can also be very effective for drawing people's attention to specific items	It is regularly used in commercial spaces, such as supermarkets or fast-food outlets, because it depicts a certain compulsion and consumer desire.	
4- Green color	A distinctive color in architecture, especially pastel green or emerald - very calming and relaxing, even neon green, no matter how bright it looks, is more calming than other neon colors. However, yellow-green color, if used poorly, may appear clinical, especially in the case of juxtaposition with white. On the outside, green walls and roofs suggest sustainability and friendly warmth.	Green gives calm and serenity, so it is used in spaces associated with health and well-being, such as hospitals and relaxation centers.	

Table (2) The emotional associations of the main colors and their uses in architecture.
By the researcher with help of (Pedrosa,2009)

Features and characteristics of color in architecture		Appropriate uses	Illustrations Figures
5- Orange color	Architectural uses of orange are many and unusual, creating comfortable, light and friendly spaces. Orange spaces are less ostentatious than red, and quieter yet bright and playful. Since it is less aggressive, it is less dangerous, so it is used more frequently. The combination of yellow, red, and orange is an image of enthusiasm, ecstasy, and creativity.	It is often used in creative environments, such as offices, studios, and schools. If it is used with blue, it conveys the idea of impulsiveness and confidence. So, it is adopted by banking agencies and offices.	
6- Purple color	Violet properties, like those of blue, can be soft and relaxing, but to an even greater degree - especially pastel purple in diffused lighting settings, especially purple neon lights, because they are fun, bright, exciting and can make a lasting impression due to their uniqueness. It also gives calm, softness, and happiness.	It is used wonderfully in many buildings and spaces, singly or overlapping with yellow or gray or its degrees, and is often used in recreational, commercial, sports and restaurants buildings.	
7- White color	White spaces are one of the most common features of modern architecture for their connotations of purity, neutrality and cleanliness especially on the exterior walls, and also creates dramatic shadows on the flat facades, while the interior white walls can make users feel calm and alert. White ceilings and walls also scatter light, making interior spaces appear brighter.	It is used to achieve many environmental and aesthetic goals, especially in residential buildings: To dissipate light and heat, and it gives the building a character of purity, comfort and creativity.	

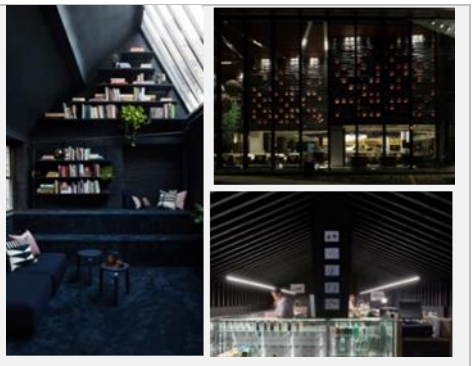
8- Black color	Black buildings make for a feeling of introspection, although in some cases it may be seen as ominous. Also, thoughtful lighting inside the black interior and exterior spaces can help reduce the feeling of darkness. While black wood architecture may look introverted and rustic, black metallic elements often look modern and elegant.	It is used in buildings and spaces that are characterized by excitement, mystery and depth, especially when lighting overlaps with yellow tones, and is often used in recreational, commercial and sports spaces.	

Table (2) The emotional associations of the main colors and their uses in architecture
By the researcher with help of (Pedrosa,2009), (Lilly,2019)

4. The effect of color in some important applications in architecture:

Color greatly affects the receptors in man and translates the mind into feelings and sensations different depending on the color of the surface, and in architecture affects us in a positive or negative way, so it is no less important than the elements and components of other construction, so the choice of colors for any project is a great responsibility, not only for the aesthetic appearance but to achieve the functions of the building to the fullest, (Lilly,2019) when it comes to choosing colors in architecture, it is important that the choice of colors for any project is a great responsibility, not only for the aesthetic appearance but for the full realization of the functions of the building, when it comes to the choice of colors in architecture, it is important to kept in mind, the feeling it will have in the people who will live in it, (mchmaster,2018) where we sometimes tend to customize colors that do not suit the place, job or those who are hesitant, the color of the building is similar to the display of the product that gives the first impression, either positive or negative. Fig.23, (Architect,2016)

Fig.23 Different colors, impressions, sensory and visual effects on people differ. (Lilly,2019)

Colors and our choices are a major responsibility, raising or reducing the value of the building, and here we review some important applications in which colors play a major role:

4.1. The importance of color in children's projects:

One of the most important facilities where colors play an important role are children's buildings and facilities because they are very important in stimulating the child's psychological, sensory and intellectual development, where colors are used to stimulate cognitive, understanding and

learning skills in children, especially in early age, where the child can easily distinguish between colors so it is used a lot in learning processes whether in books or tools used or in their spaces or brushes or destinations or mass shape, among the countless examples are a school for architects “Alto de Pineros” at Base Urbana + Pessoa Arquitetos; as well as Prestwood Primary School; The Kindergarten "Els Colors" by RCR Arquitectes., and many more models around us. Fig.24,25 (Pereira,2018).

Fig.24:25 The contrast of different colors in children's projects gives a sense of joy and love of place and raises children's perception and discrimination skills.

4.2. The importance of color in hospitals:

Colors play an important role in hospitals in improving the mental and health status of patients and individuals, by reading in expert proposals on colors that are preferred to be used in hospitals and health centers either for walls or brushes, where experiments have shown that yellow stimulates the nervous system of some patients while blue makes them feel cold and red makes them feel warm, while orange is calm, green is the color of joy and euphoria, which makes it the right color for specialists' uniforms and surgical rooms, (Jonathan,2018) where the designers of Esther Koplowitz Hospital for Patients with Cerebral Palsy, designed by Hans Abaton, Nemours Children's Hospital, designed by Stanley Beaman & Sears, considered the use of colors as a complementary component of patient rehabilitation to be taken into account, Fig.26, (Pereira,2018) and at Cilento Children's New Hospital in Brisbane, Australia which is an educational hospital specializing in pediatrics, the traditional model challenges a radical rethinking of the design of pediatric hospitals, designed for children in its brightly colored form and mass that incorporates green and purple for nearby farms and gardens. Fig.27, (Dianna,2018)

Fig. 26 The Various colors in the facade of Nemours Children's Hospital, which gave children joy and happiness. (Pereira,2018)

Fig.27 The use of bright green in Lady Cilento Children's Hospital gave a feeling of hope and growth. (Dianna,2018)

4.3. The importance of color in urban spaces:

When dealing with urban areas, color has a significant impact on belonging to the place, and some individuals around the world have been interested in changing the color of the city and working to beautify neglected and dark spaces and turn them into attractive places using colors, where these individuals aim to spread colors everywhere, because they find improving people's behavior after using colors in those places, encouraging them to take better care of their neighborhoods, and instilling a spirit of cooperation among their occupants and reducing the crime rate, the place is no longer unknown, (Radwan,2015) as in the village of Kampung Pelangi, Indonesia of the Danish company BIG, which used a great deal of colors to replenish degraded spaces and restore vitality and spatial identity. Fig.28, (Pereira,2018)

Fig.28 Colors Using gives a sense of place and increases the spirit of belonging. (Pereira,2018), (Radwan,2015)

With the beginning of modernity, we moved away from the joy created by colors in architectural designs, and this changed over time but the changes were partially not going in the right direction as happened in most developing aesthetic styles, but it needed a bolder change in order to move from gray and brown architectural designs to dynamic bio-colors, and in light of the fact that colors can enrich the urban void, it can also harm it if they were not consciously and knowingly used for the requirements of the functional and psychological space, (Radwan,2015). An example of this is the Thonik Studio building designed by MVRDV in Amsterdam, whose colors have been changed by protests by residents, who say they have been disturbed by the color of the building, (Ravenscroft,2020). On the other hand, the designer, "Hense" transformed a group of granaries in Western Australia into a mural and art painting that changed its

traditional form as large gray areas to color spaces that gave the space surrounding it vitality and visual pleasure that affected the mental health of workers and viewers. Fig.29

Fig.29 The using of colors enriches the urban space and gives it vitality and visual pleasure. (Ravenscroft,2020)

In an initiative to transform the city from gray to creative works of art that raise the value of the place and promote the aesthetic values of emptiness and improve the psychological and mood factors of the people, some students of the Faculty of Fine Arts at Helwan University in 2017, in which they thought that "if you want to see change, be the change", and because their profession in life revolves around colors, they saw that their city deserves to be better than it is, their dream was to add an aesthetic touch to their city, as they see the effect that colors have on people, that's why they came up with the idea of getting around the city and coloring parts of it to bring joy to their hearts. Fig.30, (Radwan,2015)

Fig.30 Artistic works that raise the value of the place, enhance the aesthetic values of space and improve the psychological and mood factors of people, for students of the College of Fine Arts. (Radwan,2015)

An initiative was also launched by the youth of the Faculties of Fine Arts also with the team of Sheikh Zayed City Agency to beautify kiosks and power transformers, and turn them into paintings adorning the city,(El-Shami,2018) and in one of the individual initiatives to beautify the face of the city of Aswan, which is part of the network of creative cities of UNESCO as a large tourist and archaeological city, some local artists also took the initiative to beautify the electricity kiosks with distinctive artistic and creative paintings reflecting the local and Nubian environment in their works of art, the main objective was to send a message to visitors about the city's beautiful landmarks, where residents welcomed their efforts, and in one of the individual initiatives of a popular artist called the maker of happiness and smile on faces just to see his drawings adorning the streets of Damietta, where he explained that he is happy with the

reactions of people as soon as they see the drawing because of its good psychological impact on those who see it and which encouraged him to continue. Fig.31, (El-Zoghbi,2021)

Fig.31 Transforming kiosks and electrical transformers into paintings in the cities of Damietta and Aswan, which enhance the aesthetic and mood values of the people. (El-Shami,2018), (El-Zoghbi,2021)

4.4. The importance of color in residential buildings:

The colors of houses within residential neighborhoods directly affect the people who live in them and the inhabitants of the surrounding areas where you see these buildings every day. We will never get tired of the countryside full of flowers in bright colors, so architectural intervention in saturated colors will not have a negative impact., and when social and popular dwellings are painted in bright colors, they become positive catalysts for the people who live there, when we walk in a traditional neighborhood with diverse and bright architectural colors that feel comfortable.

These neighborhoods are usually major points of tourist activities in the city because of the colors of their facades, examples of this type of neighborhood include the Burano neighborhood of Venice or Bo-Kaap in Cape Town, Fig.32, (Mchmaster,2018) and the color effect was clearly expressed in the Nubian village, where Nubia artistic expressions are divided into three categories: Utilitarian, decorative, and symbolic. Utilitarian expressions were represented in the manufacture of carpets and household items, which the colors mixed with the Nubian character made exquisite works of art out of them, as well as decorative expressions in clothes, ornaments and accessories, which are often made by women, and symbolic expressions were represented in decorating the interior and exterior walls, with colors and artistic forms stemming from the unique Nubian environment or religious such as the obligation of Hajj, Fig.33, (Radwan,2015). Thinking about the colorful houses around us, will provide us with positive sensations for our nervous and psychological system.

Fig.32 The colorful facades of Burano in Venice and Bo-Kaap in Cape Town. (Mchmaster,2018)

Fig.33 Colors Expression in the Nubian village with all elements of the house. (El-

5. Color and its relationship to light:

The relationship of color and light cannot be overlooked as the question of determining the colors of objects or colors of light is a complex issue, depends on the properties of the light spectrum itself, in addition to the light spectrum reflected from the surfaces, the colored body seems colored after the reflection of the wavelength of the light falling on it, for example if the body is red it can appear red if the light falling on it contains enough red radiation to make it reflect its color. It can appear dark when the light source does not contain red radiation, (Philips,2008), meaning that if the color is not present in the light and cannot be seen in the lighted element and this is called color performance, Fig.34. It is a term used to describe the ability of industrial light to present the true color of objects, (Mohamed,2015). As well as when mixing a light beam the result is mostly a bright color more than individual colors, If the real colors are mixed, the result is white light, which is known as added colors, the basic colors are red, green and blue which produce all other light colors including white, Fig.35, (Philips,2008) so you should take care of these things when designing colors.

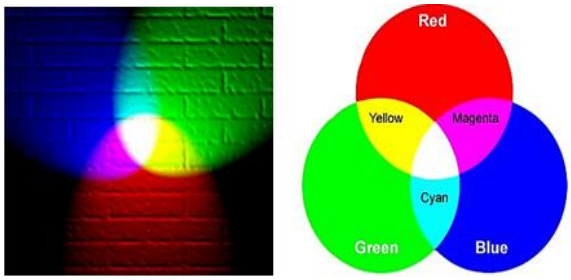


Fig.34 The primary colors from which all other light colors are produced, including white. (Wikipedia,2021)

Fig. 35 The color contrast of artificial lighting with the difference in the light spectrum. (Wikipedia,2021)

5.1. Color lighting and its role in defining architectural identity at night:

As a result of technological advances emerged various and sophisticated styles of colorful and dynamic night lighting, which gave more pleasure and excitement to the buildings and added new aesthetic values to the architecture at night, where the importance of colored night lighting lies in being an important factor for the continued interaction of the building with the

surrounding environment, the formation of the night scene that will introduce the building and achieve social interaction and emphasize its architectural identity. (Saber,2019)

5.2. The creative system of color and light in architecture:

Light and color are two essential elements of architecture, namely the cause of interaction with space or mass, and they affect each other and the way we perceive them, and the color is associated with lighting, shadows, degree of brightness and others, which has to do with the effect on visual sensation, thus determining our perception of emptiness and mass and psychological acceptance, (Ronn,2008). The design of color spectra is a mixture of science and art not only to achieve a certain level of lighting, but is a delicate design and artistic process that adds aesthetic elements to architecture, the main principle of lighting design is a creative process to arrange the functional and aesthetic values of architecture, so understanding the science and art of lighting and its association with color will play a positive role in reaching effective design solutions, (Thanaphanit,2010) and the art of lighting and color spectra emanating from it is not limited to achieving the design requirements of spaces only. It is to express the architectural form, as well as to provide the right atmosphere for the expression of design ideas. Fig.٣٦, (Ronn,2008).

Fig.36 Colored lighting enhances the aesthetic and design factors of the projects, which leads to the building's interaction at night with the community.

5.3. Design objectives for colorful night lighting in architecture:

Colorful night lighting is a tool for achieving many positive design goals, whether on vacuum or mass, such as: (Jason,2005)

1- Harmony between all the conditions affecting the building to achieve environmental comfort.

2- Strengthening the model through the diversity of colors and color photonic configurations.

3- Facilitating the movement of people, color lighting is one of its most important functions is to identify directions and paths during the night.

4- Introducing the place by creating an enjoyable and distinctive mental and visual image of the space or mass.

5- Enhancing the aesthetic and philosophical aspects of the project, whether transparency, joy, ambiguity, job confirmation, attracting attention, or other values that the architect adopts in his design idea. Fig. 37

Fig.37 The importance of color and light relationship in changing the facade style and adding new aesthetic values to the building, especially at night.

Color clearly has tremendous emotional power in architectural designs however when designing with color, even if it is as simple or commonplace as black and white, lighting, materials and design are also essential, each color denotes a range of different emotions from the happiest to the most ominous, only a coherent and comprehensive design can ensure that the use of color generates the intended effect.

Results:

- Color is an essential element in architecture, not only from an aesthetic point of view but also has a great psychological and sensory importance. Colors are responsible for a variety of psychological factors that the mind translates into feelings and sensations that vary depending on the color of the surface. It performs a function no less important than the set of formations and other construction elements.
- Scientific and good thinking about the colored buildings that we pass around or through or use daily will provide us with positive feelings for our psychological and nervous system, as color greatly affects human life psychologically, physically and socially, as well as affecting our identity and the way we see life and the good opportunity to live a better life.
- The use of colors in our designs consciously for what we want to formulate and convey the feelings to the users increases the success of the building in performing its functions and the interaction of people with it.
- The color can show a specific volume, or visually mimic certain aspects of the space, increasing, decreasing, or changing the value of the space or the architectural composition of the block.
- Colors reflect a set of feelings and visual effects that act as sensory stimuli that raise the value of the place and enhance the aesthetic values of space and improve the psychological and mood factors of people. After applying the colors in some neighborhoods, improvements were found in the behavior of the public, and increased cooperation between the occupants because of encouraging them to take better care of their surroundings.
- Colors have a direct and important impact on some projects, especially in children's projects, as they play an important role in raising children's perception, understanding and learning skills. In hospitals, they also lead to improving the psychological and health status of patients, and experts considered them an integral component of the rehabilitation of patients.

- Understanding the science and art of lighting and its association with color will have a positive role in reaching effective design solutions, and determining the colors of objects or the colors of light as one of the important issues, depending on the properties of the light spectrum. If the color is not present in the light, it cannot be seen in the lit element, so attention must be paid to these things when designing light colors, especially as they add aesthetic and spatial elements to the architecture at night.
- Describing relationship of colors and the various features that govern them, or even the many existing studies on these theories, is as complex as it is extensive, as color is associated with psychology, symbolism, and even mysticism; Where colors take on different meanings depending on the artistic, historical or cultural period.

Recommendations:

- Full awareness of the psychological and health factors that colors emit or reflect on the human psyche when determining the appropriate colors for any project.
- When it comes to choosing colors and lighting in architecture, it is important to take into account the feeling it will create inside the people who will live in it, as we unconsciously tend to assign colors that may lead to negative effects on our bodies, personality, behavior and mood.
- We must not hesitate to use positive colors that change and improve the visual and mental image of the city, and we must know how to benefit from them; Through the sites and domains that we use.
- Conducting more researches on the effect of using colors in different environments such as work environments, urban spaces and slums, and measuring the positive or negative impact of this on people's behavior and reactions towards those colors.
- Prompting in the future to work towards initiatives to reformulate the color and urban distortions, especially in neglected places and the axes of movement that penetrate the informal residential communities, and which show many visual distortions that occurred after the removal of many buildings, in order to expand those axes. Where the design and coordination of colors on these axes will play a major role in improving the visual and architectural identity of it, which will positively reflect on the shape and identity of the city in the future, in addition to the psychological, social, health, visual and other benefits, whether for the residents of these areas or the users of these axes.
- In our, academic and research curricula, at all educational levels, more attention should be paid to studying colors, color values, methods of designing and coordinating them in the visual field, and the impact of this on humans in their activities, thinking, behavior, sense of beauty and developing creative abilities, which will have a positive impact on society in general.

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