

Analytical Study of Color Harmony in Urban Spaces of Mashhad, Northeast Iran

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Abstract— In addition to studying the theoretical concepts of color and its application in urban spaces of Mashhad, the aim of the current study is describing the color application and harmony for creating a suitable urban environment which satisfies and solves the problems such as visual uniformity, disorder and anarchy presented in the city. Hence, the main challenge in this paper is studying of the presented condition of applied colors in Mashhad, defining of color harmony in urban spaces and explaining of color application in legibility of different spaces of the city. The method of study is a combination of discovering method including qualitative and empirical methods. The attributive method and field monitoring (direct observation) are used in collecting of information. The results show that the current color condition in Mashhad is far from the chromatics and color application standards in urban spaces. It also notes that the concept of color harmony in urban spaces is predicated to the agreement and correct use of colors in spaces of a city.

Index Terms— Color, City, Color harmony, Urban spaces, Mashhad, Urban, Urban environment, Visual uniformity, Disorder, Anarchy

1 INTRODUCTION

A city is a cultural – skeletal complex that is formed based on the needs, activities and behaviors of its inhabitants.

The humans act in accordance with their subjective or republican needs and proffer their special behavioral models. City and its different spaces are a media for such events, and at the other hand, the spaces are very influential on activities and behaviors of its inhabitants [1]. The array and relation with environment have been very important in designing of initial cities [2]. There are various phenomena in city which are constitutive parts of city. In general, city consists of two elements as form and color which are interdependent. The color is the sign and symbol of each natural and manufacture thing; its importance in human life is similar to the form [3]. The critical importance of color in human life has been accompanied by different and various concepts. The color is flowing in all dimensions of life; hence, its concept is as extensive as concept of life. Etan believes that the color is the life [4]. The color is a part of conscious, semi-conscious and un-conscious of human; he/she reacts in his/her behavior by receiving color and this reaction is not only mental and or conceptual, but also it may be possible that it has a physiologic aspect. Therefore, the color, in most thorough definition, is a psycho-physiologic phenomenon that is created in brain and psyche [5]. The seeing is a reaction against light. The most needed element for this kind of sensation is the presence of color [6].

The color, with its deep power of influencing, has a critical role in design of different spaces [7]. It can be said that the color is of highest importance in behavioral model of urban human and is a powerful social element which supports the visual grace of city in addition to its duty as a messenger and transmitter of concepts [8]. The potential relation of color symbol causes that it has favorably used by environmental designers. In addition, the color has a great variety in different levels in environment and society so that it may has an identity value. Before that the human learn to speak by languages, visual symbols and colors have been used by human to relate by each other and to explain their beliefs and goals [9]. Dr. Ulrich Beer, a great Austrian psychologist which widely investigates about color, wrote that “definitely, there is not anything in the nature more powerful than color in psychological viewpoint; everyone who sees that will be enthuses by it. All of us enjoy from seeing and understanding of colors”. The color is the life because the world without color is dead [10]. The color is a quality that is seems like that whiter, redder, greenery and so on [11]. There are numerous effective factors about the concepts and understandings of colors including culture, continent, geography and custom contracts [12]. Therefore, the understandings of most of phenomena are relatively depending on language, culture and so on. When we look to a colorful surface, two main results will be obtained: a pure physical effect emerges, i.e. eye enchants to elegance and other characteristics of the color, viewer satisfies and exhilarates by the color. Such feelings are temporary and have not a permanent effect. The usual things have a surficial effect on semi-sensitive human but the first view of new things causes a mental effect on human [13]. In low steps of mental sensitivity, the color causes only a surficial effects which ends when its stimulus removes. However, there are many types of surficial

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effects. Eye is interested to light colors and even more interested to light and warm colors: red is an active and interesting color; like the fire that is very interesting for human [14]. The second main result of looking to a color is its psychological effect. The psychological force of color causes a mental vibration and then, the first force, the main physical force, plays the role of a path to psyche for color [15]. Considering the importance of color and its widespread application in all spaces and the application of colors in cities, the aim of the current study is a comparative study of chromatics and color psychology and analysis of current condition of color in spaces of Mashhad to reach a more legibility in urban spaces and to make harmony between the presented colors using companion concepts of colors and finally to accord two elements of form and color in the city [16-27].

The color has been used by human since 15000-30000 years ago. The pathfinder philosophers in Greece have been explained the initial theories about color [28, 29]. Plato and Aristotle are the most important persons but the first thinkable theories about color have been reported in Renaissance. Thomas Young, in 1802, found that color vision is due to the activities of three different receivers in human eyes [30]. Helmholtz, by some tests, also found that the seeing of color in usual persons is resulted from receiving of three color lights. After 70 years, the theory of colorful vision was explained. The theory of antonym colors or "opposite process" in seeing of colors was presented by Ewald Hering, a German physiologist, in 1870 [31]. The consistency theory was reported by Edwin Land [32, 33]. In addition to explaining of colors, the producing or representing method also is under consideration [34-45]. The humankind has always two problems in encountering with color; first problem is that how he/she can described the colors? And second is that how can produce and represent the colors? In this regard, various efforts have been made since long times ago to make a method or tool which can named the colors with number and code and identified the representation of colors, accurately, in every time and everywhere of the world. This tool is known as "color system" [46]. After discovering of white light by Newton in 1731, Le Blon discovered the three main colors and Tobias Mayer in 1745 developed the circle of colors [47, 48]. In 1776, Harris divided the circle of colors to 18 sections and published the first color atlas. In 1810, Philip Otto Runge represented the colors on a sphere [49-55]. In 1839, Chevreul, a Frenchman, presented a color system similar to Philip Otto Runge but with more applicability [56]. However, Wilhelm Ostwald, the great German scientist, criticized the Chevreul's color system and claimed that the main reason for denying this system is the incorrect calculation of distance between grey colors and insufficient hues [57-63]. The Chevreul researches are of critical importance, especially in according of colors and aesthetics since these are systematic and basic [64, 65]. Ewald Hering found that colors are polar and he introduced red, green, yellow and blue, which are mutually complement, as four main colors [66]. The dissention about the main colors between researchers intensified for a period of time until the optic researches of Herman Von Helmholtz and James Clerk Maxwell demonstrated that all colors and white color can be represented by synthesizing of red, green and blue colors [67]. Then, during 19th century, col-

or theorist such as Ostwald, Nicholas Ogden Rood and Albert Henry Munsel introduced their theories [68]. The Munsel color system is still one of the best color references in view of simplicity and completeness [69]. The colors are measurable in Munsel color system by three dimensions of "hue", "chroma" and "value" [70]. By developing of fundamental sciences and emergence of computer, considerable evolutions have been presented in color systems [71]. Various color systems were presented such as CIE (which is the main reference of all color systems), RGB (which is used in optical tools such as TV, cinema, photography, monitor of computers and ...) and SMYK [72]. Discovering of main colors is the most important characteristic of colors to more functionality of colors [73]. The contemporary French theorist, Albert Vanel, is believed that none of colors can be seen by us as an individual and comminute color but we always see a set of colors, together [74]. Therefore, the effects such as contrast, lightness and material texture can change the representation of a color [75]. As previously mentioned, the importance of colors is one of the most interesting research topics and in today life it is interested for environment and interior designers [76, 77]. It should be mentioned that there are more researches in the field of the concept of color in interior spaces than the field of the color in urban spaces [78-85].

The method of study in the current research is a combination of discovering method including qualitative and empirical methods. The attributive method and field monitoring (direct observation) are used in collecting of information so that firstly, the qualitative information are collected to discover the condition of phenomenon and then, the relationships obtained from the qualitative information are described. In the first step, the theoretical principal concepts of color are explained. In the next step, the current condition of color harmony in urban spaces of Mashhad is evaluated.

2 THE THEORETICAL PRINCIPLES OF COLOR BASICS

Regarding the importance of color recognition, the theoretical study of color basics is necessary and it cannot possible to use from color, suitably, in urban spaces without knowing about the theoretical principles of color basics. The theory of color is backed to a long time ago and knowing about that is vital in successful mixing of colors. The color has been under study by various scientists such as Munsel and so on. The theories of color are studying the impacts of colors on mental and physical situation of humankind. In addition, the color is used to explain various feelings and exciting of emotions. The chromatics categorizes all of colors into two group of achromatic and chromatic. The achromatic colors are including black, white and grays. The chromatic colors are including all colors which created by three main colors of yellow, red and blue. The color cycle is comprised of three groups of primary colors (or first degree), second degree and third degree [16]. From physical viewpoint, things have not color. When white light, i.e. sunshine, is reached to surface of a thing, according to composition and molecular structure of that thing, some of wavelengths or colors are absorbed and other colors are refracted by that thing [17]. The color has three principal characteristics and it can be studies from chroma, degree of satura-

tion and luminosity points of view. Regarding the chroma of colors, the colors have psychic, symbolic, mystery, emotional, sensational and natural meanings. For example, red and yellow are of expanding and developing state and blue has contracting and static state. The degree of saturation for a color is its measure of relative purity. When a color mixed with black, white or gray, its purity reduced [18]. The "saturated color" shows the transparency or turbidity of a color. The yellow color of Cadmium is luminous but it is not possible to add another color to it so that it becomes more saturated [19].

The color contrast means the possible difference between two colors. It may be low or high which is considered as minimum or maximum. The first contrast is the contrast between complements colors. The other contrast is related to darkness and brightness between two colors. Moreover, there are contrast of coolness and warmness of colors and largeness and smallness of color surfaces which is labeled as color quantity.

Among the other color contrast, the power and weakness of colors is named as color quality or saturated colors. Each of the color contrasts have their arty characteristics and values, visual impacts, especial symbolic concepts and meanings that totally constitute the base of color recognition from art point of view. The seven contrasts are including: (1) The contrast of hue (the color itself); (2) The contrast of light and dark; (3) The contrast of cool and warm; (4) The contrast of complements; (5) Simultaneous contrast; (6) The contrast of quality (saturation); (7) the contrast of quantity (extension and surfaces of color) [20].

3 THE CURRENT STATE OF COLOR IN MASHHAD

Mashhad is located in 36 degree and 17 minutes of northern latitude and 59 degree and 36 minutes of eastern longitude compared to Greenwich [21]. However, such colorations cannot change the uniform color of the city [22].

The color (or hue) is a physical phenomenon which is seemed due to shining of light and its refractive behavior in front of eye and it is a visual and mental phenomenon [23]. The colors revive the life. They are animate and sensible. And they are used as visual language of our feelings. We can transfer our ideas between each other, without need to saying or writing, by mysterious language of colors. The color and its compositions excite different actions and feelings [24]. The color is a type of language and is of important role in our life. It can be very interesting due to its grace and or changes our psychic states [25]. There is a potential of explaining of a special feeling in nature of each color. For example, red is used to transfer and make the image of power, excitement, love and braveness. However, if it becomes brighter, it changes to pink with its special meanings and if it becomes darker, it changes to wine color with its special meanings which is completely different from those two colors. Therefore, changing of brightness or darkness or softness on denseness of a color may cause to change its language and character [26]. The most interesting characteristic of each subject can be a model for selecting of color and it is related to all things and persons. For instance, green can be very intense and apathetic and or be very animated and sensible. It can be a cause to act or be explaining a disease and decay. At the other hand, it can be a symbol of

peace and ease and be relating to the nature and village and sound lifestyle [27]. Max Lusher believes that blue, green, red and yellow shall be preferred. He believes that selecting of a sound and stable person which is apart from contrasts and obsessions [28]. All elements of a city have their color and are categorized in one of the two chromatic and achromatic groups. The value of a chromatic color (colorful) is recognized when it compared to an achromatic color (colorless, i.e. black, white and grays) [29]. It can be easily found that most of colors that are used in most of urban spaces in Iran and Mashhad are achromatic. Grays are very usual from construction materials (such as concrete, stones and pre-fabricated faces) to asphalt pavements, vehicles, urban furniture (chair, bench, bus station, bicycle stations, newspaper rooms, trashes, stoppers, rails and ...). Although the grays can be mixed with chromatic colors such as blue, red and yellow due to its neutrality, Mashhad becomes a gray city. The grays are so extended that green parts of the city and even other colors of skeletal elements of the city are resembles as colorful spots in an extended gray media.

The proportionately use of colors together is not only an art but also is a science and follows special rules [30]. The correct locating and creative synthesizing of colors together is known as color companionship. Along with the colors of elements, the space also has high potential to synthesizing of colors. The aim of the current study, firstly, is studying of colors used in Mashhad, then is defining of color harmony in urban space and, finally, is psychological or chromatically defining of considered spaces. According to field monitoring and pictorial documents, it can be easily seen that the gray spectrum is dominated in the city. The study of color is related to physics, physiology and psychology. Physics studies the distribution of spectral energy of light which is scintillated from a surface and or is reflected from it. (A special branch of physics studies the chemical aspects of pigments and dyes which are related to the potential characteristics of them in making of various colors). The processes in eye and brain during the impact of colors on eye are investigated by physiology. However, psychology describes the knowledge and thoughts about the color like an element of visual experience. The artistic study of color also in accompanied by these considerations and in particular, psychological approach of color is important in this field [31].

4 THE CONSTITUTIVE ELEMENTS OF COLOR IN URBAN SPACE

4.1 The color in landscape and architecture

The color as one of the most important variables which is, firstly, related to surface of planes and volumes is widely interested for specialists. The describing of color is very important in visual designing. In landscape, a wide range of colors can be found which are natural or manmade. However, only a limited number of colors can be seen together in a place. There are major local differences between colors due to composition of rocks, soil, plants and domestic construction materials [32]. In this regard, the constitutive factors of urban landscape are including architecture, buildings, floors, walls, waterfronts, environmental advertisements, lighting, surfaces and even trees [33]. The color

of each case is important in the general structure of coloration in the city. In some cases, the color shows the structure of a building such as: level of floors, windows and it may be possibly exceeded from structural explaining and used as a decorative tool. In Baroque method, painting was a part of architecture and, principally, the forming of main spatial idea was become possible by painting. The architects of modern method were disagreed with use of color and were believed that the coloration is possible by use of natural color of construction materials [34]. As previously mentioned the presented colors in urban landscape of Mashhad are out of predefined programs and purposes and are not designed based on the principles of application and harmony of color. This lack of color harmony in construction materials is widened from architecture to other elements of urban landscape and urban furniture in Mashhad. In fact, a method of artifact decoration can be seen in Mashhad which is a composition of street pots, pavement, decoration and also constructed spaces which are not any compatibility with other elements of landscaping in the city [35]. The unfortunate fact is that histrionics is considered instead of philosophy of landscape and play of environment.

The urban furniture is a great part of urban equipments and hence, it can be highly influential on urban spaces from color and compatibility points of view. The urban furniture is including the light and its pillar, bench, street chair and pot, signs, tableau, symbols, kiosks, bicycle station, gateways, entrances, rail, fence, mug, statues and so on [36]. The color is more important than texture, form and construction materials since it first perceived. However, the solid move of all elements of a design to the compatibility with environment is very necessary. The color shall be supposed as a part of whole; that whole is moving to union [37]. The recognition of a color in the environment is related to time of seeing, background color, constant colors and natural and artificial sources of light [38]. The gray tonalities are frequent in urban furniture of Mashhad as similar to the most of other parts of the city. For example, such grays can be seen from construction materials of bus stations, which are a composition of metal wires and glasses, to pavements of sidewalks. Even in cases that chromatic colors such as red or yellow are used, most of structure are still gray. The newspaper rooms are gray with red ceiling and bicycle stations are gray with yellow ceiling. One of the reasons for using the grays is its neutrality and its ineffectiveness on other colors, results that the easiest color mixture becomes the mixing of grays with other colors.

4.2 Elements and statues

Since the materials and type of these works has been mostly temporary and unstable, the color was also injected to the city temporarily.

The color has wide applications in urban spaces which one of them is legibility. The color of urban elements and equipments and or complexes, buildings, different playgrounds, scientific, official and commercial centers can follow codes and or can be selected based on principles of urbanism and or color psychology so that it meets more legibility and hence, in addition to beautifying of environment, differentiating of spaces become easier for citizens.

The beautifying is a cultural chain which encompasses all decorative and visual arts.

For correct understanding of beautifying, obscenities and inelegances shall be recognized [39]. The most important heading of urban beautifying is considering and applying of color in the environment [40]. Therefore, one of the most important and major applications of color is the elegance dimension. The color has various effects such as temperature, extension and weight. Warm colors are heavier than cool colors and bright colors are more extensive than dark colors. The color selection is effective in the absorbed amount of solar energy by exterior surfaces of the buildings. If the wall has gray color, the temperature difference between wall surfaces locating in different directions will be as high as 23 degree of Celsius. However, if the wall surfaces have white color, such difference will be as low as 3 degree of Celsius. Using the different colors on external surfaces of walls in a building, it can be possible to control the thermal impacts of sunshine in internal spaces. The bright colors may be reflected up to 90% of polar energy. However, the reflective characteristics of dark colors are 15% or lower [41].

4.3 Color harmony in urban spaces

The color and its visual impact on the mind is one of the most unknown and complex psychic factors of humankind [42]. Once, glamorous colors were popular which their purposes were conquered the viewer and they were easily boasted. Today, simpler and brighter colors (understanding colors) than royal blue, jujube, amber, black and golden colors are popular. Nowadays, blue and yellow and green and orange shadows are more accepted and the concentrations of colors are highly reduced. The current taste of society is close to warm colors like clay, soil, cooper, turquoise, straw, apple, peach, pear, johnnyjumpup, sea color, and sky color [43]. The coloration is considering the pattern of color organization in a work or space [44]. The coordination of two or more colors causes to producing gray as mixing of those colors [45]. The use of suitable and imaginary and compatible may be as effective as symphonic words [46]. In public viewpoint, a color composition is coordinated when it comprises of very similar colors or different colors with identical shadows. Predicating of coordination or non-coordination is basically implied to the amount of acceptability - non-acceptability or interesting - not interesting [47]. Such judgments are self-guesses and have not objective force. The concept of color coordination shall be exited from the territory of mental theories and entered to territory of principles. The coordination is related to balance and symmetry of forces. "Evald Hering" believes that: gray causes to produce equilibrium in eyes [48]. In addition, "Hering" believes that: eye and brain need to soft gray and its lack causes to eye inconvenience. Such opaque gray can be produced by mixing of black and white and or mixing of two complement color and white and or mixing of several colors provided that main colors, i.e. yellow, red and blue, are of suitable ratios. Therefore, when a series of colors consist of two colors and or more colors, including yellow, red and blue with suitable ratios, gray will be produced by mixing of them. It not means that gray shall be used in all urban spaces to gain color coordination. But, this is just a suggestion by specialists in chromatics.

At the other words, the hypothetical mixture of our colors as a colorful material or the result of color mixing in our mind shall be gray.

5 CONCLUSION

The constitutive colors of urban spaces are much extended and encompass a wide range of materials, buildings, green spaces and generally all urban equipments from lighting and bus station to trash bins in a city. Regarding the questions of research and based on the performed investigations about the current state of color in Mashhad, it can be concluded that the most used colors are various types of achromatic tonalities, i.e. grays, and if grays will be used in such extension, succulence, effervescences and vivacity will be highly reduced in the city. In addition, the results of second question of the research show that the unconscious use of colors is very unsuitable than disuse of colors. The concept of color harmony in urban spaces is implied to coordination and correct and conscious use of colors in urban spaces. The color harmonizing methods in urban spaces like Mashhad cannot be performed without considering the all constitutive parts of a space. The colors are impressing by each other and environment and are affecting on each other. The continental characteristics and color, even in different seasons, cause to enjoying and peace and or conversely, cause to stress and lack of peace in citizens in an urban space. As a result, using of harmonizing methods in a city shall be performed by a posteriori and a priori view and it cannot possible to separate the color effect of constitutive elements of the city from definition of the color.

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