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Color in Architecture: Before and After Industry Revolution

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Abstract
Color as a visual element cannot be separated from architectural design. The development of knowledge about color involved artists and scientists. In the past, color was always associated with the activities of artists as creators of decorative works using pigments produced by nature. Artists and scientists assume that color occurs due to the influence of light and dark which is homogeneous. This was later refuted by Newton's findings that color is produced by heterogeneous light. Different colors are a result of different refractive indexes. The discovery of artificial colors by Perkin encouraged the industry to create colors not only to produce colors that exist in nature, but also according to the wishes of the user as an individual. The opportunity to use colors according to the needs of individual users then encourages businesses to control colors so that the industry does not suffer losses if the colors of the products they produce do not sell well in the market. They work closely with color forecasters and color designers to determine color trends according to the interests of producers through color cards. This condition is followed by architects who create color schemes based on their own favorite color palette. This article finds out how the development of science positions color in architectural works? The research was conducted with a historical approach and data interpretation methods through a literature review.

Keywords: Color, Color Forecast, Color Card, Color Scheme, Architecture

1. Introduction

Color is a visual experience that greatly influences human life. Colors have now entered all activities of human life following the development of science and technology. In the past, color was closely related to the activities of artists. To create decorative art in their cave dwellings, in cemeteries, or on their bodies, they use colors produced by nature or synthetically, for example from ochres or iron earths for red, orange, yellow, brown, and gold. The black color comes from charcoal, and the white color comes from animal bones. In the findings of paintings in caves, it appears that the artist used natural and synthetic colors to produce various palettes of hues and shades. But the colors of interest are blue, red and yellow (Orna 2013:2-9; Lambourne 1999:1).

Prior to the 1800s, research on color was very limited and tended to be speculative, physical, psychological, cultural, psychological, artistic, and perhaps even spiritual. Research on color is generally limited to topics related to harmony and color perception, as conducted by Von Castell, Hecht and Oberfeld (2018), Ke-Run, Ya-Qian and Zhi-Qiang (2019), Fontoura and Menu (2021), and color technology as is done by Gasparini (2021). Researchers

may not be interested in discussing the building exterior color as an important aspect for the practical reason that most building exteriors are not explicitly colored. Even though historical findings in the ruins as written by Jacques Ignace Hittorff show that the Greek architecture of Empedocles in Selinus Sicily is believed to be white, it turns out that this is not so, but brightly colored polychromatic (Ellingham 2019; Armstrong 2016:501). This article discusses how the placement of architectural colors is not only as a building decoration, but as an element inherent in the unity of design, from the past to the present.

In the past, artists and scientists tended to think that color was the result of light and dark alone. The size of the scale of darkness makes one color different from another. Red is pure white light that gets the least amount of dark effect. The darkest scale produces black, while the smaller one produces blue. The theory of light and darkness has also been written by Greek philosophers since the Middle Ages, such as Plato (1892:559) in *Timaeus* (390 BC), or his student Aristotle (384-322 BC) that all colors are produced by mixing black and white (Aristotle 1548) in *De Coloribus* (330 BC).

Newton's discovery tacitly raised the doubts of other colorists, but they had no good reason to reject it. Goethe, for example, doubted Newton's theory and chose to follow Aristotle's idea that color represents a mixture of light and dark. White is a representation of light and black is equivalent to darkness (Von Goethe 1970:6-7; Duck & Petry 2016: viii). Although Goethe was considered incapable of understanding Newton's experiments, Goethe's color theory was very well received in several artistic circles (Barsan & Merticariu 2016; Treisman 1996). Artists, for example, assume that the colors of Newton's spectrum are not found in nature. They also state that color is not just a matter of science, but also a psychological problem. They carried out various experiments by mixing pigment colors to produce natural colors.

In 1856 William Perkin discovered the first artificial color of coal tar waste. This bluish purple color is called mauve (France) which soon became a trendsetter (Garfield 2018:8). Furthermore, the industrial revolution in the field of color also made scientists carry out various experiments to produce artificial colors that nature could not provide. Various kinds of color pigments can be mass-produced at an economical cost. This industrial revolution also had a major influence on the development of paint.

Paint that initially functions as a surface coating, for example, protects iron and steel from rusting and corrosion increases as an aesthetic function (Lambourne 1999:2-4), with a variety of color choices according to user preferences. In 1982 the paint company Benjamin Moore introduced a color matching system. The choice of product colors that were originally determined by the manufacturer and distributed to agents en masse, can now be made by anyone (Benjamin Moore 2021). Each user can design the color mix as desired at an individual level.

2. Method

The research uses a historical approach with data interpretation methods. The process begins with collecting literature data related to the topic of architectural color research and the color industrial revolution. The data collected is digital data in the form of documents in the form of text and images. The data comes from historical sources and traces that have been validated and considered valid. Data verification using external and internal criticism methods. The collected data is then grouped by taxonomy. Each data in a group is analyzed with each other. Furthermore, it is synthesized by analyzing data from other groups to obtain conclusions that will be presented in the form of historiography.

3. Results

3.1. Color Morality and Color Cards

Although the industrial revolution in the field of color could produce a variety of desired colors, mass production also resulted in color uniformity including black. white, gray, and brown. Brightly colored products like red, orange, or yellow are still hard to find. Until the late 19th century there was a view that bright colors aimed at

attracting attention were considered inappropriate and should be used sparingly. Colors like gray or light brown are considered to be more dignified and decent, and are therefore mass-produced.

Metaphorically, for example, white is perceived as something pure (Elliot 2015). This statement contradicts the fact that the subjectivity of symbolic meaning is not universal but contextual. In France red is a symbol of nobility (De Saint-Amand 1900:282). This color is also Louis XIV's clothing to counter Spain's black color (McCabe 2015:123; McCabe 2008:238). Louis XIV also wore red heels (Pastoureau 2017:133 and died in the red and golden bedroom in the heart of the palace of Versailles (Bernier 2018:1).

Pastoureau (2020) states that positioning, colors symbolically and associating them with moral status represents what Bourdieu referred to in 1979 as a game of distinction. A person's status is shown through the difference between moral and immoral classes in society. In the social world, the system of power relations and symbolic systems play a different 'taste' as the basis of social judgment. According to Bourdieu, the dominant classes impose this domination not by owning wealth and the means of production, but by imposing the legitimacy of their own tastes and values (Bourdieu 2013; Bourdieu 1977).

Color uniformity is considered an industry's failure to produce bright colors such as red, blue or green. Industries must abandon low-cost mass products and serve customer segmentation according to their respective social circles (Pastoureau 2020:45-49). Attractive colors are seasonal and not timeless like grays and browns that can be adapted to all seasons. Therefore, if the industry mass-produces bright colors, there is a risk that the product has not been absorbed by the market while the color season is over.

The business community realizes that the color industry is a new business that has a risk of loss. Mistakes in determining colors in production have a great potential for failure to sell the products offered. In 1930, Holbrook Jackson, a journalist and writer, spoke about the importance of color determination and color forecasts (Jackson 1930). The UK established a color management authority called the British Color Council. Jackson introduced a practical knowledge instrument in the form of The Shade Card for textile product color users.

Textile manufacturers, garment manufacturers and retailers need information about colors that are likely to be trending in the coming season. This information is important so that they can prepare requests. The Shade Cards are issued by the Chambre Syndicale des Teinuriers in Lyon France, Saint-Étienne France, the *Société de Teinture and d'Apprêt* Basel, Switzerland. (Blaszczyk 2018:35-37). As a result of World War I, America, which had difficulty getting supplies of dying and textiles from Europe, finally formed color forecasting by The Color Association of the United States and the Color Council and Trend Union (Bleicher 2012:34-36).

The trend of the preferred color has been planned and constructed by color forecasters and color designers 18-24 months before the color becomes trendy. They evaluate and analyze the consumer's preferred color possibilities for the next two-year sales season, allowing sufficient time to match the industry's production schedule. These experts conduct research into people of various age groups. They throw in various color ideas and ask respondents to choose them. All industries whose products are related to color, such as fiber/yarn, textile, leather, plastic, paint, dye, etc., will use the services of color planners and forecasters, so that their products conform to color trends when their products are marketed.

Research in color psychology has shown that 62-90% of consumer product ratings are based on color alone (Moir 2011). Even though technological developments allow individual users to choose colors according to their wishes, color trends constructed by color forecasters and color designers always pay attention to consumer behavior which is influenced by the situation and world conditions that occur at that time, which like or dislike will affect the way we express ourselves. This trend is getting wider when information systems no longer recognize distance and time. History records that color trends are strongly influenced by events related to: (1) Social, political and economic issues; (2) The world and stage of entertainment; (3) The world of art; and (4) seasonal cyclical patterns (Blaszczyk 2012). When social, political and economic conditions deteriorate, people tend to use dim colors. But these colors can be alternated with bright colors to represent hope and optimism.

When the 2008 Olympics were decided to be held in China, the color trend immediately towards red which is the symbolic color of China. Favorite color of art figures. Revitalizing Miami Beach by Leonard Horowitz draws on the historical colors of art Deco artists such as Picasso and Gerrit Rietveld (Miami Design Preservation League 2021; Curtis 2013). The color season cycle repeats about once every 20 years. But with the development of information technology, the cycle of this season has become shorter.

3.2. Color Theme and Fasade Revitalization

Until 1840, exterior color schemes were difficult to find in America. The color scheme became an important document when a landscape architect Andrew Jackson Downing (1815-1852) made it for the book Cottage Residences in 1842. As a polemicist, Downing did not like white wooden buildings, and wanted to change the perception of architecture observers. Downing created a palette of grays, yellows, tans, and pinks.

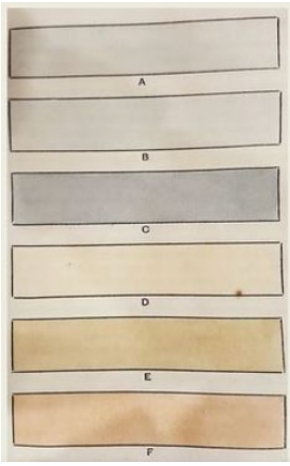

Figure 1: Downing Color Scheme

Source: Downing (1842)

In 1880, Downing's ideas were developed in the form of a multi-color paint scheme and standard ready-mixed paint and color printing by architects. See Figure 1. This color scheme then, became an ideal promotion for the paint industry after the Civil War compared to the unpredictable tones of handmade paint. This standardized color then went hand-in-hand, very useful for buyers in the polychromatic era in the late Victorian era in the early 19th century (Bock 1996:52; Sherwin Williams n.d.; Downing 1842:25).

In 1918, Le Corbusier stated that form preceded the idea of color and that color was only an accessory of form. He considered that form is colorless and color is not independent because it follows form and not vice versa. In 1925, Le Corbusier published *L'art decoratif d'aujourd'hui* (The Decorative Art of Today) which rejected the style of the 1925 Exposition of Decorative Arts which was based on Chinese, Japanese, Indian, and Persian art which was rich in ornamentation. and color. For him, modern decorative art lacks decoration and art Deco is a form of revival of Louis Philippe and Louis XVI moderne (Journel 2015; Corbusier 1987).

Contrary to earlier views, in 1926 Corbusier designed a workers' housing complex, Cité Frugès, in Pessac. Unlike the previous villas which had white exterior walls, but for Cité Frugès, he added brown, yellow and jade green panels. In 1929-1933 Corbusier designed 46 Swiss Pavilion student dormitories at the Cité Universitaire Paris. He designed the main salon decorated with black-and-white nature photo montages. In 1931 Le Corbusier stated that humans need color to live. Color is an element as important as water and fire (Calvano 2006:354).

In 1931, Corbusier created 13 color schemes using 43 color palettes. In 1948, Corbusier replaced the decorations of the Swiss Pavilion with colorful murals that he painted himself. In 1959, he created a polychromatic color scheme using a 63 color palettes (Les Couleurs 2021). The Corbusier 1931-1959 color scheme was originally created by the wallpaper company Salubra. In 1997 this color scheme was produced by the Swiss paint company KT Color Co.

The works exhibited at the 1925 Exposition of Decorative Arts are generally inspired by the anthropologist's discovery of Ancient Mexico (Nuttall 1886) and the 1922 discovery of the intact tomb of King of Pharaoh Tutankhamun by British archaeologist Howard Center (Newberry 1939), European cubist artworks such as Picasso (Klein 2021), pre-Columbian and Caribbean culture (Pool 2018), as well as the emergence of new materials such as chrome plating, stainless steel, and plastic. This exhibition influences the rich style of American architectural luxury with bright and strong colors known as the art Deco style.

In architectural art, the art Deco style is demonstrated by the Chrysler Building (1928-1930) designed by William Van Alen. The interior of the luxurious lobby with yellow and orange nuances is designed to follow the rhythm of the greatness of the Egyptian pyramids. Elevator door with lotus motif ornament from brass and wood shows high quality taste (Knowles 2014:115-116). The art Deco style which was influenced by the Dutch artists, is known as the neoplasticism flow. The distinguishing feature of De Stijl's artist is the use of horizontal and vertical lines with primary colors and achromatic colors of white, black, and gray. They put color only on continuous planes without cuts. consistently uses this style in the architectural design of the Schröder House designed by Gerrit Rietveld (Friedman 2007:65).

Figure 2: Cherokee red at Taliesin West, Scottsdale/Phoenix Arizona

Source: Wikipedia (2021)

In 1936, Frank Lloyd Wright made an organic color scheme for Fallingwater. In collaboration with Martin-Senour Paints, Wright created his favorite color palette called Cherokee Red. This red color evolved from a deep, earthy-brown red, to a dusty orange-tinged, clay red. Wright saw cherokee red as the base color of the earth in homage to the Native Americans who made pots out of red earth. In Fallingwater, for example, 'cherokee red' is only for building materials made of iron (Frank Lloyd Wright Foundation 2017; Old House Magazine 2002:32). This color scheme with cherokater appeared in other Wright designs such as Taliesin West. See Figure 2.

In the 1970s, colored paint was used to revitalize old cities in Europe. This activity is a collaboration between architects, artists and local residents. The color scheme of the city of Turin (Italy) was designed by architect Giovanni Brino based on the original colors of the city's history and traditions. This model was considered very successful in attracting tourists and was soon followed by other old cities such as Tirana (Italy) by artist Edi Rama, and Rio de Janeiro by Jeroen Koolhaas and Dre Urhahn (Prisco 2013), Querétaro City (Mexico) by artist Boa Mistura, or Girona (Italy) by architect Josep Fuse Comalada (Espelt & Benito 2004), and Gamcheon (South Korea) by Jin Young-Sup (Elisa 2019; Lee 2014). This color approach in urban space is offered to reconcile the desire for conservation and the continuity of the vitality of old city spaces (Boeri 2017).

In 2006, Koolhaas and Urhahn started research to paint the facades of slum areas in Rio de Janeiro in the series Favela Painting. They chose to paint three houses right in the middle of Vila Cruzeiro. The project, which was donated by the Firmeza Foundation (Netherlands) and in collaboration with the paint company Coral-Akzo Nobel,

aims for artists to collaborate with local youth to create community artworks. The Boy With Kite themed mural is a symbol for the children of the *favela*. This initial mural was continued by residents who painted cement hillsides with the title Fish Leaping in a River (Darlington 2010). In its development, the Favela Painting project did not last long because the paint faded. This makes maintenance difficult. Furthermore, the community replaced the paint with locally available sustainable materials, namely lime stucco and pigment tiles in the form of a mosaic (Pavela Painting 2018).

Figure 3: Mural painting with the theme Boy With Kite on the facade in the middle of the slum area of Vila Cruzeioro

Source: Koolhaas (2007)

The revitalization model with this approach is also carried out in Indonesia, such as in Jodipan village, Malang. This program is supported in collaboration with corporate social responsibility (CSR) paint industry companies. with participatory-based planning and carried out consistently for the purpose of improving the local community's economy (Wulandari 2017). While the revitalization of other old cities is generally carried out based on local community culture by architects and artists, Jodipan is fully planned with the concept of creating a place branding based on social marketing communication media practitioners. Through the concept of place branding using social media, Jodipan was introduced as a worthy tourist destination to visit (Sulistyaningsih, et al. 2021).

These descriptions show that the choice of color in the past was determined by the architect and the user took advantage of the palettes and color schemes that were not only a favorite of famous architects but also by the current trend situation. The choice of architectural color is part of the style of consumer behavior towards fashion. Industry manufactures and markets products based on architects' color designs. On the other hand, there is a phenomenon of architects making color schemes by involving the participation of the local community. This shows that the determination of color in architecture is also influenced by the development paradigm that developed in the 1970s, where the community participated and was involved in participatory development. The goal is for local communities to be involved in the design and implementation of development projects. With active participation, it is hoped that the projects initiated will be sustainable and bring benefits to local communities (Cornwall 2002; Cornwall & Coelho 2007).

4. Discussion

The history of the development of the science of color, which was originally the area of expertise of artists and physicists, has attracted the attention of many disciplines. The industrial revolution opened up opportunities for color users not to rely on natural pigments because the industry could create synthetic colors according to the user's wishes. Therefore, the choice of color palettes and schemes no longer depends on the color products provided by the industry but can be done by individual users through the application of a color mixing system.

The freedom of choice color is recognized by the business community regarding color as something dangerous because foam causes the failure of the production offered. This encourages business people to control the freedom of color choice to be limited which is marketed as a color trend for certain seasons. This policy involves not only artists and architects as trendsetters, but also media practitioners such as journalists and writers. However, the

architects also realized that the trend of the paradigm of active community participation could not be avoided. Every community has the right to choose what is considered good for their sustainable future, including improving the quality of their environment through the use of color.

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