

Application Research Based on Color Model -- Taking the Blue Color of Cantonese Manchuria Windows as an Example

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Abstract: The aim of this study is to perform numerical quantification of blue glass in Manchuria Windows by collecting blue glass in Cantonese Manchuria Windows and digitizing it using the color model. Firstly, 35 samples were collected and analyzed, and the blue color was divided into four intervals of Blue Black, Dark Blue, Blue and Light Blue in the RGB color model and scaled. Then the samples were classified as hue, saturation, and lightness in the HSB color model. It was found that among 35 samples, the best standard values of blue in the RGB color model were R (66,G91,B193); and the average values of blue in the HSB color model were H (226,S68,B76). This study provides architectural decorative designers with a reference standard for the blue color of the Manchuria Windows, which is of great significance for the study of Manchuria Windows and the preservation of traditional architecture.

1. Introduction

The "Manchuria Window" is a representative of Guangzhou-style-colored windows, also known as "Cantonese Manchuria Window", which is a typical window style of Lingnan architecture and is widely used as a decorative element (Fig. 1). With the development of science and technology, the diversification of materials and the modernization of production technology, the form of Manchuria Windows has changed from the traditional style. The color of the current Manchuria Windows and the early Contemporary Manchuria Window color and early Manchuria Window compared to the emergence of obvious color differences, the design deviates from the aesthetic category of Manchuria Windows. In recent years, many scholars and designers have explored the history and form of Manchuria Windows in different dimensions, but the extraction and analysis of the color values are rare. In this paper, based on the blue glass of the Manchuria Windows, the blue glass of the Manchuria Windows in the Guangfu area is extracted and analyzed using different color models, and its threshold value is analyzed together according to a variety of color models, and a series of research is formed with the subsequent research on other color applications of the Manchuria

Windows.



Figure 1: Cantonese Manchuria Window

As of the publication of this paper, the research literature of scholars on Cantonese Manchuria Windows has been sorted out through reviewing the literature as follows: 31 pieces of literature have been researched and analyzed with the theme of Manchuria Windows. Among them, 21 articles focus on the decorative study of traditional Lingnan architecture, including the study of colored windows focusing on individual architectural themes (e.g. Yuyin Shanfang[Ancient Garden]in Guangzhou) and the study of window styles of Lingnan culture; 6 articles apply the elements of Manchuria Windows to different design categories, such as clothing, furniture, jewelry, and cultural and creative industries; and 4 pieces of design works created with Manchuria Windows as design elements. The above literature mainly focuses on the study of the history, design form, functionality, glass craftsmanship and auspicious patterns of Manchuria Windows. In modern times, Guangzhou was free to do business in foreign trade, and many kinds of colored glass were imported into China through the ports, such as yellow, red, white, blue, green, etc. These imports provided nutrients for the design and development of Cantonese Manchuria Windows. By combing and summarizing the research of scholars, it is found that most of the existing results only mention the color, i.e., more differentiate in the hue of the window glass. In these studies, there is no "color model" based on image technology to study the color of glass, and there is a lack of research results on the color model of Manchuria Windows. Therefore, in the process of reviewing the literature, only the color model can be found independently. For example, in the HSB color model research and achieved corresponding results: Al-Rawi, M.M. (2018) described how to map the color in digital CCD camera images to HSB space, explored the methods and techniques of color mapping, and how to use the HSB space to analyze and process the color information in the images. ^[1]Chang, C. I. (2019) explored the application of hue, saturation and luminance in the HSB color model in hyperspectral imaging, provided basic knowledge and theory about the HSB color model, and described how to use the HSB color model to interpret and analyze hyperspectral image data. ^[2] Monaghan, D.S. (2018) explored the application of the HSB color model in nature, discussed how hue, saturation, and luminance produce and perceive different colors in living things, and explained the advantages of the HSB color model in characterizing natural light and color. ^[3]

This paper is based on the Guangfu area, through the multifaceted space on the Cantonese Manchuria Window field shooting and collection of samples, with the help of image processing technology in the color model for color quantification, focusing on the blue, in the HSB, RGB two kinds of color model for multi-dimensional exploration. Finally, the blue color model is used to digitize the color, and with the help of the threshold value of the data, the standard color is derived from the research in different models, and this is the innovation. The significance of using the color model to digitally study the color space of Manchuria Windows is to establish the standard value of blue in Manchuria Windows, and to set up a coordinate system for the design specification and

design implementation of the current architects. It is not only the inheritance of traditional Cantonese architectural decoration, but also provides certain reference value for scholars and designers in the color study of Manchuria Windows.

2. Artistic Characteristics of Manchuria Windows

Guangzhou plays an important role as a trading port for cultural exchanges between the East and the West. In terms of accepting and innovating foreign cultures, the city of Guangzhou has demonstrated a strong sense of inclusiveness. This phenomenon is fully reflected in the modern architectural decoration. The Manchuria Windows in the residential buildings of Guangzhou are the crystallization of the architectural decoration of Chinese-foreign cultural exchanges in a specific period. At the same time, the craftsmanship and spiritual value of Manchuria Windows have become one of the typical visual symbols in the architectural decoration of Guangfu area. Manchuria Windows: a traditional architectural decorative element of Lingnan in the fusion of Chinese and Western cultures. ^[4] Historically, Cantonese Manchuria Windows are traditional window styles brought from the north by Manchurian Eight Banner soldiers stationed in Guangdong during the Qing Dynasty. It inherited the characteristics of Manchuria Windows with large openings in the early period and was infiltrated by Western culture in the later period, and used a lot of colored glass lighting materials, as well as combining with the traditional craftsmanship for improvement, which resulted in the formation of a unique regional decorative techniques in Lingnan ^[5]. Manchuria Windows and Guangzhou's overseas trade brought new glass materials fusion development of window styles, it set color glass etching inlaid in the traditional wooden frame, becoming a major feature in the study of Guangfu architectural components. The later Lingnan Manchuria Window sashes mostly resemble squares and appear in the form of combinations, for example, some are regularly divided into three columns of windows, with the top and bottom three sashes totaling nine sashes, which can be pushed and pulled up and down to any position to regulate the indoor microclimate, and the window latticework is freer ^[6]. The Manchuria Window is superficially similar to Beijing's Zhizhai window and Suzhou's Hehe window, but actually it is different. In terms of shape, the Zhizhai window and the Hehe window are mostly rectangular, while the Manchuria Window is traditionally square; in terms of construction, the Manchuria Window is a kind of vertical sliding window, with a pair of small hardware parts equipped with soft steel springs placed in the wooden vertical frames at regular intervals, which are used to support the sashes, so that the sashes can be lifted up and down, and stay in any position, which is conducive to the ventilation in the summer. Manchuria Window uses a variety of compositions of wood lattice (commonly known as bucket heart), inlaid with overlay glass etching, patterns, or calligraphy of single-sided stained glass, showing a unique artistic style. ^[7] The history of the formation of Manchuria windows shows that it is a combination of Guangfu and Western decoration. Manchuria Windows are often found in gardens, Xiguan houses, and riding buildings in Lingnan architecture. Among them, blue glass is used more often, and the cool color space creates sanity. The traditional Chinese wooden windows and doors are latticed with straw paper to differentiate the inside from the outside, the straw paper only transmits light, opaque, and easily damaged, but the arrival of the glass material is a perfect match for the Chinese lattice wooden windows and doors. Stained glass with exquisite processing technology and the original pattern of the door and window lattice heart to adaptive changes, not only the original Chinese lattice fan lattice heart of traditional art flavor can be continued, in the addition of stained glass, but also windows become more gorgeous and have a mysterious atmosphere. ^[8]

Manchuria Windows in stained glass etching drawing of the selected subject matter is mostly flowers, plants, animals, and other natural ecosystems under the lifeforms, to vivid and colorful

image decorated with people's visual perception, has been far different from the traditional Manchurian architecture aesthetic concepts, especially different from the Qing dynasty palace architecture in the hierarchical concepts of strict [9]. Manchuria Window wood lattice fan inlaid stained glass flower window has a very strong visual effect and unique identification [10]. Therefore, the most important feature of the Manchuria Windows is that it is inlaid with various shapes of overlaying color glass etchings on the traditional wooden frames, replacing the traditional wooden window lattice with the richly colored glass paintings pieced together in the window cores [11]. Manchuria-Window-stained glass is mainly in the colors of red, yellow, blue, green, purple and white, which highlights the important Lingnan regional characteristics in traditional residential houses.

3. Color space extraction of Manchuria Windows

The color palette of the Manchuria Windows is relatively fixed, i.e., yellow, red, white, blue, green, etc. The scope of sampling the blue glass of Manchuria Windows will be carried out from the spatial and temporal dimensions: in time, the sampling age focuses on the late Qing Dynasty - the Republic of China era- the contemporary era; in space, it is dominated by exhibition space and residential houses, gardens, and commercial buildings.

3.1. RGB color model of blue glass

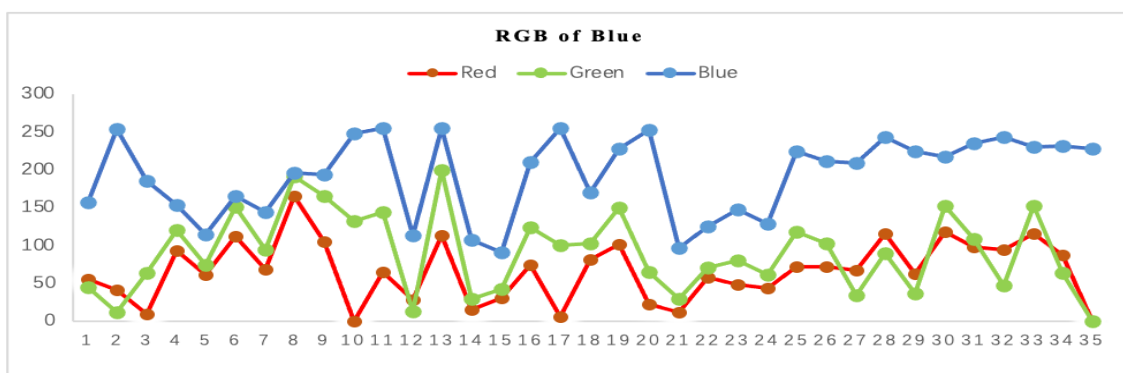


Figure 2: RGB Color Model of blue glass for Manchuria Windows

In the chromatic color system, blue is a typical cold color system, and is the coldest color, called "cold pole", which represents science and technology, rationality, intellectualism, coolness, vitality, nobility. Among the three primary colors, blue has the shortest wavelength. In nature, blue color easily reminds people of the sky and the ocean. In the ancient Chinese book of poetry, there is already a record of picking "blue", "picking blue in the morning, not enough for a lapel". It means that the whole morning was spent on picking bluegrass dyed green, but still not enough to fill a lapel. In addition, Xu Shen "Shuowen Jiezi" explains "blue, dyed grass. From cursive, monitor sound". It means blue, used for dyeing grass, the character form adopts "the Chinese character of grass (cǎo)" as the side, "the character of monitoring (jiān)" as the sound side. In China, blue color has the meaning of loyalty, mystery, sublime, wide, deep, and infinite. At the same time, in Europe blue is a noble color, "blue bloods" has become the pronouns of the nobles. Blue is also more common in the glass of Manchuria Windows, a color that can make the mind rational and calm.

In view of the love of the people for blue in ancient and modern times, this study samples 35 samples based on the RGB color model by sampling the blue glass in the Manchuria Windows (Fig. 2). Among them, the exhibition spaces include 10 samples in Guangzhou Museums (x-axis numbered 1, 2, 10-15, 18, 19); 1 in Liwan Museum in Guangzhou (x-axis numbered 16); and 11 in

Guangdong Folk Arts Museums (x-axis numbered 3, 26-35), 7 in field collections (Xiguan Houses, restaurants, libraries, etc.) (x-axis nos. 17, 20-25); 6 in publications (x-axis nos. 4-9). For this collection, the B curve (blue curve) in the RGB color model has a high relative value compared to the other two curves, with a threshold value of 91-255 for blue in the 35 sample.

According to the research needs of this paper, the blue color in the RGB color model is divided into 4 intervals (Fig. 3), each spanning 64 units, which are Blue Black (0-63), Dark Blue (64-127), Blue (128-191) & Light Blue (192-255). Of the 35 Manchuria Window samples with blue color extraction, the samples in Blue Black are 0. Blue Black has a low color brightness and is a blue color close to black, which is less commonly used in Manchuria Window design. Numerically, the samples are 17% in Dark Blue, 23% in Blue, and Light Blue is the most aggregated interval in this sample, with a value of 60%.

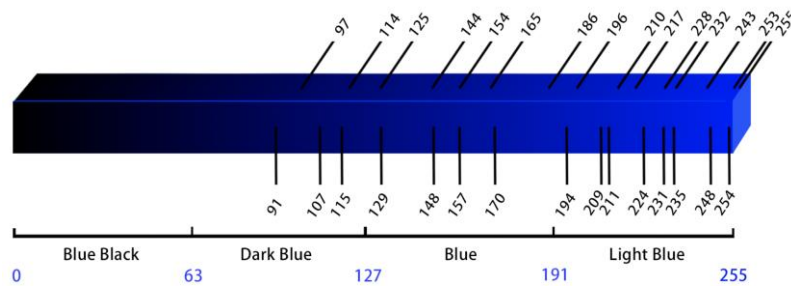


Figure 3: Blue phase threshold for Manchuria Windows

3.2. HSB color model for blue glass

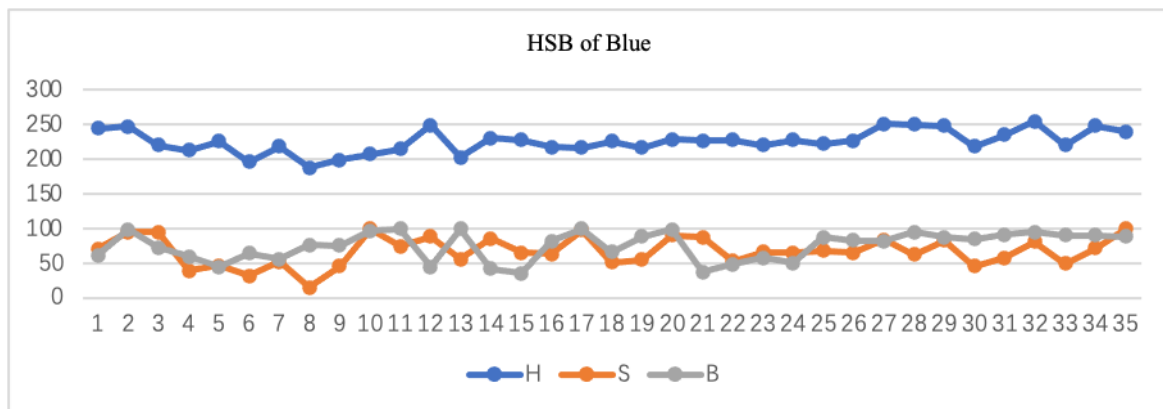


Figure 4: HSB Color Model of blue glass for Manchuria Windows

The HSB color model takes the human eyes as the medium and uses human's perception of color as the basis to describe the space from three different dimensions: H (Hues) for hue, S (Saturation) for saturation, and B (Brightness) for brightness. It converts natural colors into computer colors to describe the basic characteristics of colors. The medium of the HSB color model is the human eye, which is a typical way to describe colors based on the perception of the human eye. It is a model of information acquisition closer to human senses and applying it to describe the basic characteristics of the blue glass of Manchuria Window has important research value. In the HSB color model, when the values of S and B tend to be high, i.e., the higher the saturation of blue and the brightness of blue are, the blue glass color is more intense and brilliant. In the case of sufficient light, such as daylight and artificial light, the translucent properties of Manchuria Window glass are more directly displayed. As a result, the saturation and brightness of the blue color blocks out some of the light. Compared to the human eye directly affected by the visual stimulus generated by the refraction of

light, the light through the blue glass translucent stacking effect is relatively moderate, thus creating the comfort of colored space.

Based on the characteristics of the HSB color model, it is often used in color matching to describe the basic characteristics of color in terms of hue, saturation, and lightness, which can guide colored window designers to better match the colors.

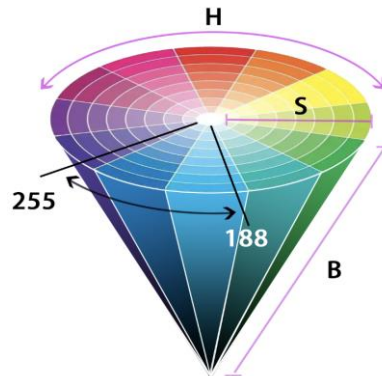


Figure 5: Blue phase threshold for Manchuria Windows

First, on the blue phase (H), 35 samples were sampled based on the HSB color model (Fig. 5), and the blue color was in a relatively stable value. As shown in Fig. 4, from the cross-section color phase, we can see that the value of 35 blue samples of the Manchuria Window ranged from 188 to 255. 10 samples are distributed in Guangzhou Museum (x-axis numbered 1, 2, 10-15, 18, 19); 1 in Liwan Museum in Guangzhou (x-axis numbered 16); and 11 in Guangdong Folk Arts Museum (x-axis numbered 3, 26-35); 7 in field collections (Xiguan Houses, restaurants, libraries, etc.) (x-axis nos. 17, 20-25); 6 in publications (x-axis nos. 4-9).

Secondly, as the S-curve in Fig. 4, the 35 collected samples were categorized as high (80-100), medium (40-79), and low (0-39) in terms of saturation. From the values of the orange curve, there are 12 Manchuria Windows with high saturation, 4 of them are distributed in Guangzhou Museums (x-axis numbered 2, 10, 12, and 14); and 5 in Guangdong Folk Arts Museums (x-axis numbered 3, 27, 29, 32, and 35), 3 in field collection (Xiguan Houses, restaurants, libraries, etc.) (x-axis no. 17, 20, 21). In terms of medium level of saturation, there are totally 21 samples. Among them, 4 samples are distributed in publications (x-axis no. 4, 5, 7, 9); 6 in Guangzhou Museum (x-axis no. 1, 11, 13, 15, 18, 19); 6 in Guangdong Folk Arts Museum (x-axis no. 26, 28, 30, 31, 33, 34); 4 from field collections (Xiguan Houses, restaurants, libraries, etc.) (x-axis numbered 22-25); and 1 from the Liwan Museum in Guangzhou (x-axis numbered 16). Saturation at low values is glass in 2 samples from publications (x-axis number 6, 8).

Finally, the 35 collected samples are categorized as high (80-100), medium (40-79), and low (0-39) in terms of brightness, as shown in the B curve in Fig. 4. The gray curve presents 19 Manchuria Windows with high levels of lucidity, distributed in 5 samples from Guangzhou Museums (x-axis numbered 2, 10, 11, 13, and 19); 1 from Liwan Museum in Guangzhou City (x-axis numbered 16); 10 from Guangdong Folk Arts Museums (x-axis numbered 26-35); and 3 from field collections (Xiguan Houses, restaurants, libraries, etc.) (x-axis numbered 17, 20, and 25); There are 14 brightness at the medium level samples, distributed in 6 from publications (x-axis numbered 4-9); 4 from Guangzhou Museums (x-axis numbered 1, 12, 14, 18); 1 from Guangdong Folk Arts Museum (x-axis numbered 3); and 3 from field collections (Xiguan Houses, restaurants, libraries, etc.) (x-axis numbered 22-24). There are two cases with low brightness, one from glass in the Guangzhou Museum (x-axis no. 15) and one from field collection (Xiguan Houses, restaurants, libraries, etc.) (x-axis no. 21).

4. Conclusions

The purpose of this study is to obtain the blue threshold value of Manchuria Windows by collecting the blue color of Manchuria Windows and analyzing the data with the help of computers, taking the different times of the late Qing Dynasty, the Republic of China era and the New China as the vertical axis, and then taking the different spaces of gardens, residential houses and exhibition spaces as the horizontal axis, and collecting samples to obtain the blue color threshold value of Manchuria Windows, and then reaching at a blue color standard value used for Manchuria Windows. This standard value provides a certain reference value for practitioners of architectural decoration design and researchers of Manchuria Windows.

4.1. Standard blue color for Manchuria Windows

Based on the above, blue glass for Manchuria Windows tends to be Blue & Light Blue, which is the general public's perception of blue. Blue as the "cold pole" of the chromatic color system and high purity and other characteristics in the Manchuria Window is widely used. The research process uses computer to sample and analyze the extracted blue glass values, resulting in the average of the blue values of the Manchuria Window, i.e., the standard values shown in Figure 6, which are located in the blue color of the RGB color model (66, 91, 193). This value is the threshold for the general perception of blue color by the public. This value is defined as a standardized Manchuria Window blue value through the study to provide a standard color for contemporary Manchuria Window design and production, as well as to define the blue glass of Manchuria Windows. In the space design, it provides users with a comfortable color experience space.

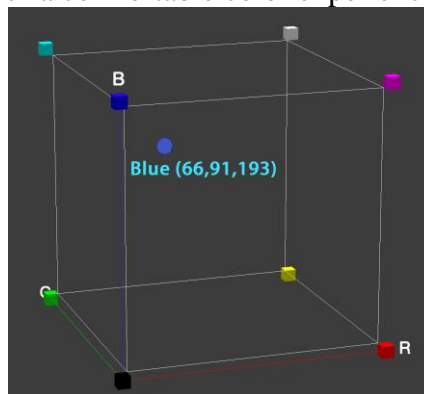


Figure 6: Standard colors (RGB) for Manchuria Window Blue

4.2. Blue model for the human eye

In the analysis of the blue HSB color model described above, the blue curve of the H-curve (e.g., the blue HSB curve in Fig. 4) is clearly at a high level. The thresholds for blue in the 35 samples range between 188 and 255, which is typical of the cooler color palette. In the HSB model, apart from the solid threshold shown by the blue color, it can be seen from Figure 4 that the brightness (B) value fluctuates up and down in a regular manner, i.e., the fluctuating trend is related to the color saturation (S) in the glass, and it is also closely related to its own hue value (H). Through the collection and analysis of samples, the color commonality of blue in the H S B model is mapped out. Based on the systematic calculation, the average value of blue color in HSB for Manchuria Windows was derived: Blue (226,68,76), and this value was taken as the standard color of blue color in HSB model for Manchuria Windows (Fig. 7). Based on the characteristics of the HSB color model mediated by the human eye, this average value of blue reveals technology, rationality, and

nobility, which is in line with the aesthetics of the eastern and western public.

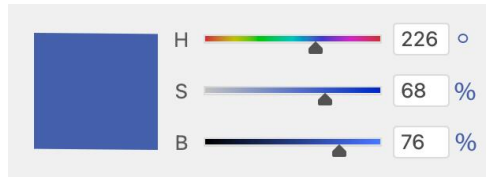


Figure 7: Standard colors for blue HSB models in Manchuria Windows

Based on the RGB and HSB model analysis of the blue glass in the Manchuria Window, the final values of the two-color models are derived. In the design practice, it provides designers with the color values of Manchuria Windows for reference. At the same time, the study of color requires a large number of field investigations, and subsequent studies will continue to use single and multiple colors. Blue is only one of the common colors in the glass of Manchuria Windows, and this paper extracts and analyzes the blue model, which is only a stage research result of the whole Manchuria Window. This study can provide the theory and method for the subsequent research, and then study the other color systems of the Manchuria Window in stages, to add to the construction of the theory of the decoration of Lingnan houses and the inheritance of the Lingnan culture.

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