International Journal for Housing Science and Its Applications
Publish August 10, 2025. Volume 46, Issue 4 Pages 3886-3897

https://doi.org/10.70517/ijhsa464509a

Application and Research of Song Dynasty Painting Pigments in the Aesthetic Creation of Ancient Architecture

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Abstract Chinese traditional oil-decorated color painting is an extremely valuable part of China's ancient architectural heritage and one of the accomplished highlights in the history of world architectural art. This paper takes the ancient architectural painting pigments of the Song Dynasty as the research object, introduces the concept and characteristics of the ancient architectural painting art of the Song Dynasty, as well as its color change process. On this basis, it restores the stylistic composition of Song Dynasty ancient architectural color paintings. According to the requirements of Song Dynasty ancient architectural color painting cultural relics site and the characteristics of HH-XRF instrument, the application of pigments in the aesthetic creation of ancient architecture is studied through the design of Song Dynasty inorganic pigment color painting panels. For the analysis of the color painting pigments in Yuquan Temple, the main purpose is to use X-ray spectrometer to analyze the elemental compositions of the six color painting pigment samples collected from the West Hall of Yuquan Temple, so as to presume the chemical compositions of the pigments. After laboratory analysis, it was found that Song Dynasty painting pigments were mainly traditional mineral pigments such as lead, iron red, stone green or chlorocopperite. The pattern styles are mainly divided into five modeling styles, and the pattern styles of such colored paintings are mostly some auspicious patterns that symbolize the good. Through its full excavation and organization, it can provide reference for the color painting pattern and construction technology and color painting pigment in the repair of ancient buildings and imitation ancient buildings nowadays.

Index Terms ancient architecture, painting pigment, color painting board, aesthetic creation, construction technology

I. Introduction

Ancient China's historical period of the formation of architectural painting style is closely related to the development of color painting pigments, color painting pigment development to the Song Dynasty, color categories have been quite complete, pigment differentiation is more detailed, the development of technology has also been quite mature, which has achieved the Song Dynasty color painting complex, subtle style [1]-[4].

The two main types of pigments commonly used for painting in ancient China were mineral pigments and vegetable pigments. Mineral pigments express mineral colors, which were called stone colors by the ancients. Stone color is called “heavy color” because it is thick, intense and heavy in both texture and color [5], [6]. Vegetable pigments show the plant color, with fluidity, permeability and transparency and other qualities, the ancients called “grass color” [7], [8]. Grass color compared to stone color, showing clear, light, light and other characteristics, also known as “light color” “light color” [9]. Mineral pigments are inherent in nature, while vegetable pigments matured along with the development of the dyeing process, therefore, the ancient people's knowledge and use of mineral pigments preceded that of vegetable pigments [10], [11].

The relative coldness of vegetable color in color painting is related to the practicality of architectural color painting, that is, one of the very important roles of color painting is to protect the wooden structure, and the thick and insoluble mineral pigment, applied on the surface of the whole wooden roof frame, can form a complete protective layer, which can well insulate the sunlight, resist the erosion of wind, rain, snow, and the change of cold and warmth [12]-[14], and secondly, the mineral pigment has a very strong covering power, which can cover the surface of the wooden structure, and can be used to cover up the surface of the wooden structure. Secondly, mineral pigments have strong covering power, which can cover the natural defects such as knots and cracks on the surface of wooden structures, so as to achieve the effect of beautifying the building, and furthermore, many mineral pigments have toxicity, which can prevent the wooden components from being bitten by insects, and so on [15]-[17]. And plant pigment is difficult to play these roles, which determines the subordinate position of plant pigment in the field of

architectural color painting, and therefore when the plant pigment in the field of literati painting is getting higher and higher, the Song Dynasty architectural color painting and literati painting are getting separated, and the color painting is also separated from the painting, forming an independent aesthetic system [18], [19].

Up to now, the analytical research on the chemical components of the painting pigments of ancient buildings in the Song Dynasty and their production technology has rarely been reported. The innovation of this paper is to carry out in-depth practical investigation and conduct a large number of experiments based on the use of X-ray diffraction analyzer and other analytical instruments, for the first time on the Chinese ancient architecture of the Song dynasty oil painting production process and chemical composition of the qualitative and quantitative analysis of the method, to carry out a more systematic study, so as to more real restoration of the Song dynasty painting pigments of the traditional process of color, pigment composition and so on. Finally, combined with the Song Dynasty ancient architectural paintings, we analyze their aesthetic characteristics, analyze the aesthetic and cultural connotations of their locality, culture and era, reveal their aesthetic value, and verify the theory of cultural and regional character, with a view to providing references for the traditional architectural paintings to be summarized and inherited.

II. The art and characteristics of ancient architectural paintings of the Song Dynasty

II. A. Painted Art in Ancient Architecture

II. A. 1) Concepts and Characteristics of Painted Art

Painting is the art of coloring the walls, ceilings, columns, etc. of wooden buildings with drawings or various patterns. Although the building is colorful and beautifully decorated, it is not only decorative, but also serves to prevent the surface of the wood from cracking or rotting, prolonging its life, and hiding the rough surface of arguably the most important role. It is a must in China, which has traditionally been dominated by wooden official buildings. It is also used to emphasize the nature or majesty of the building. As a result, palaces or shrines dedicated to deities appear more ornate and detailed.

China's ancient traditional architecture is a painting, focusing on the art of color, the royal buildings in the north, red walls, red pillars, yellow tiles painted, brilliant and rich, as if the work of heavy color, full of the Northern Song Dynasty Jinbei. Southern gardens and temples, white walls, black columns and tiles, calm and indifferent, like ink writing, all the Southern Song literati interest. Classical Chinese architecture colorful, color variety, large color block padding contrast, forming a unique Chinese flavor color scheme.

The basic colors of Chinese painted art are red, blue, yellow, white and black, known as the five colors as shown in Figure 1. Many colors are made based on these five colors, and the five colors are painted according to the five elements of color. The five elements are the five elements that generate everything and change dynamically in Eastern philosophy, i.e. wood, fire, earth, gold and water. That is, blue represents wood, red represents fire, yellow represents earth, white represents iron, and black represents water. At the same time, the five colors also refer to the five directions including east, west, south, north and central, which are combined with the four directions of deities that symbolize defense. According to the five elements, the beauty of colored paintings implies that the chi of all things in the universe merge with each other to create the meaning of good chi.

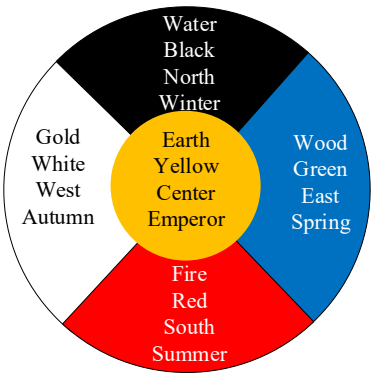


Figure 1: The five-element ring of China

The significance of using various colors in color painting is as follows.

(1) Black

Equivalent to the number of the five elements, it is in charge of human wisdom. It has the function of highlighting the dark side in the color of colored paintings. Black is mainly used in landscape paintings or when drawing lines on the edges of patterns.

(2) Yellow

Means bright, represents the dazzling sunlight, symbolizing the center. In China, yellow symbolizes glory and wealth.

(3) Cyan

It symbolizes the color of spring, when everything is born, i.e., the symbol of creation, life, and new life, and is used as a color to drive away ghosts and pray for blessings.

(4) White

Equivalent to gold in the five elements, it means innocence, truthfulness, life, purity, etc.

(5) Red

Equivalent to “fire” in the five elements, it means generation and creation, passion and love, positivity, and is used as the strongest color to ward off evil spirits. In addition, it implies vitality like the blazing sun, which is believed to be able to overcome what is harmful to human beings.

II. A. 2) Color Changes in Chinese Colored Paintings

From the early days of the Dunhuang Grottoes to the Southern Song Dynasty, the architectural drawings painted on the murals were lacquered in the red color series. From the earliest Dunhuang time Mogao Grottoes of the middle (397 to 439 AD), Tang (960 to 1035 AD) Song times the structure of the building and the pattern of the have changed, but red is still the main color tone. But with the different times, the use of color is also slightly different.

(1) Before the Tang Dynasty, the original color of materials

The color of ancient Chinese buildings initially reflected the function of nature. Before the Tang Dynasty, the color of Chinese buildings mainly reflected the natural function and the original color of the materials, and there was no artificial piling up of buildings to apply color.

(2) Tang Dynasty, the color reflects the grade

Ancient Chinese architecture to the Tang Dynasty, only really began to apply a large number of colors on the building for decoration. The Tang Dynasty was the heyday of architectural development in Chinese history, with majestic buildings, simple shapes, and strong body styles. In the Tang Dynasty, there was a unified plan for architecture, and the buildings were under the control of the “Ministry of Rites”. Therefore, there is a hierarchical division. Yellow became the special color of the royal family, the palace temple using yellow, red tones, red, green, blue, etc. for the royal officials and eunuchs of the color, the people's houses can only use black, gray, white and other colors. Tang Dynasty prevalent straight lattice windows, window roots on the pattern of tortoise brocade pattern and the pattern of dense ball and so on. It can be said that the Tang Dynasty was to use color decoration to render the class power of the ruling class.

(3) Song Dynasty, color reflects the mainstream

The Tang and Song Dynasties were in the same lineage, and Song Dynasty architecture was the inheritance and development of Tang Dynasty architecture. Painting pigments in this period began to use a large number of architectural components also began to tend to standardization, the organic combination of decoration and architecture is a major feature of the Song Dynasty. Song dynasty architecture temple tower decoration scale is reasonable, the building color is mainly red, the roof or all covered with glazed tiles, or with glazed tiles and green tiles to match become a shear edge type roof, color painting and decoration of the proportion, composition and color have achieved a certain artistic effect. As a result, the architecture at that time gave a soft and splendid impression. The colors of Song Dynasty buildings fully reflected the mainstream culture at that time, and had a guiding significance for the development of architectural decoration culture in the following dynasties.

II. B. The modeling style of ancient architectural paintings in the Song Dynasty

The classification of styles of Chinese architectural color paintings is not so simple. Because at the same time there will be characteristics of different times and regions.

Ancient Song Dynasty ancient architectural color paintings handed down, although very rare. But according to the Song dynasty color painting relics handed down to date, as well as the Northern Song dynasty architectural monograph “building method style” in the detailed records. It can be seen that the Song style painting is roughly divided into five colors throughout the painting, grinding jade painting, green and green halo prism between the painting, green decorative painting and Dan powder brush decoration painting, five modelling styles.

(1) Five-color all over painting

To warm colors, mostly with red, Zhu, red, yellow and other pigments. Patterns used in a variety of Huawen (several kinds of flower-shaped patterns), Zawen (dense pattern), large-scale components in Huawen, Zawen also painted in the middle of the Flying Immortals, birds, beasts, cloud patterns, and so on.

(2) Jade painting

Song Dynasty grinding jade decorative a light form of painting, more programmed than the colorful all over the suit. Patterns pattern more specifications, with the color more to green halo, less decorated with vermilion, the base color to white and green paint decoration, the outer contour of more green and green halo, square heart pattern more lock pattern, roll grass, is the heart of the two ends of the use of green halo to Ruyi head of the square heart of the two ends of the outer contour.

(3) Green overlay halo prismatic color painting

Green is also the main tone, but do not paint the Chinese pattern, Zuo Ge, only with a folded halo, the column body with green or green patterns.

(4) Decorated in green

The upper part of the main red tone, arch beam square full brush earth Zhu, edge with green, green stacked halo, such as the front green halo is flanked by green halo, adjacent components of green and green halo interchangeable. But the columns are still painted green halo, only the column head and foot painted vermilion or colorful Jin Di.

(5) Dan powder brush decorated with color painting

Also known as red and white color painting, all in red as the main tone, arch beam square and columns full of brush earth Zhu, the lower edge of the white line, components of the bottom surface through the brush yellow Dan. Then, the surface through the brush a tung oil, is the simplest one in color painting. To earth yellow instead of earth, called yellow earth brush decoration.

III. Analysis of the pigment process of Song Dynasty paintings

III. A. Qualitative analysis

III. A. 1) XRD and XRF analysis methods

Any kind of crystalline substance, its internal plasmas are always arranged in a periodic repetition in three-dimensional space. Moreover, the repetition period is of the same order of magnitude as the wavelength of X-rays. Therefore, when X-rays pass through a crystal, the crystal acts as a three-dimensional grating and produces a diffraction effect. Any crystalline substance, when compared with other types of crystalline substances, is more or less always different from each other. Thus, the diffraction effect of X-rays from different crystals will be different from each other, and the internal structure of a crystal can be determined according to the diffraction effect of the crystal.

X-rays are electromagnetic waves with a short wavelength and high energy. When X-rays irradiate a substance, in addition to scattering and absorption, X-rays with sufficiently high energy can ionize the electrons on the inner shell of an atom. At this time, the atomic shell on the electron will jump to the inner shell layer to fill the empty space on the inner shell layer, which will also emit X-rays. X-rays that irradiate matter are called primary X-rays. X-rays that are re-emitted after absorbing X-rays are called secondary X-rays, also known as fluorescent X-rays.

The wavelength of fluorescent X-rays is different from the wavelength of incident X-rays and depends only on the type of element in the substance. For a given element, the fluorescent rays have a corresponding characteristic energy or characteristic wavelength. Therefore, by determining the energy or wavelength of the fluorescent ray, the type of atom can be determined, and the elemental composition of the substance is known. Based on the intensity of the fluorescent X-rays at that wavelength, the content of the element to which it belongs can be quantitatively determined.

III. A. 2) Characteristics of sample size and analytical methods

Routine XRD analysis requires relatively large sample volumes (about several hundred mg) pressed into aluminum sample frames or glass plate sample tanks.

If the sample volume is reduced and a small amount of sample is placed directly on a sample plate made of a crystalline substance, the diffraction peaks of the substance on the sample plate are iterated on the sample's diffraction pattern, making it more difficult to analyze. Experimentally, placing a small amount of sample on a plate of non-crystalline material, such as a glass plate, its diffraction pattern will appear a clear amorphous diffuse peak and distort the sample peak, or even drown part of the diffraction peak. While using a sample plate of single crystal silicon wafers cut along a certain crystalline surface, it is in the range of 5~120. There are no diffraction peaks in the scanning range and the background values are very low.

Scrape a trace of the sample placed on the slide, and then moved to the center of the monocrystalline silicon plate, and drop a small amount of anhydrous ethanol, ethanol volatilization powder samples will be adhered to the sample plate, the monocrystalline silicon wafer containing the sample plate is inserted into the diffractometer sample holder. This sampling method is more suitable for testing and analyzing precious relics.

Ancient architectural artifacts are made in different ages, construction technology methods and locations, and even for similar artifacts, there may be minor differences in their impurity content and crystal structure [20]. These differences can be reflected in the X-ray diffraction pattern. When such samples are analyzed with abundant

information, the age, origin and composition of the cultural relics can be scientifically identified according to the small differences in the diffraction pattern.

The objects tested in this experiment are all analog samples, so the conventional sampling method is used. Although more samples of cultural relics are collected, but considering the ancient architectural oil paintings are ancient cultural relics, which are not renewable. So in the test of cultural relics samples, should try to use the method of micro-damage. The sample preparation method for XRF analysis is very simple, and samples can be saved by recovering samples from XRD tests, and with the development of portable XRF spectrometers, nondestructive analysis of cultural heritage samples is slowly being realized [21]. XRF analysis is characterized by easy sample preparation, fast analysis speed, good reproducibility and low cost, and is suitable for elemental analysis of cultural samples. The results of XRF analysis can be used to assist in XRD analysis and testing of spectral decomposition work.

III. A. 3) Test samples

Shaanxi Yuquan Buddhist Temple was built during the Northern Song Dynasty, and was later restored during the Ming and Qing Dynasties, but in general its architectural art has always retained the characteristics of the Song Dynasty period. Among them, the colorful paintings on the beams in the West Hall are the masterpieces of architectural paintings and decorative arts in the whole northern Shaanxi region. West Hall beam frame paintings pigment is not easy to fade mineral pigments, the color is not easy to fade over the years. So that after more than 500 years, the West Hall of the beam frame painting can still give people a bright and shiny feeling, painting colors as bright as the first painting. West Hall in the beam frame paintings in the color collocation on the whole bias warm colors, to yellow, red, green, blue and so on. At the same time, the west hall of the beam frame painting in the bright eight frame beam, five frame beam, three frame beam square heart part of the main pattern of the following orange background, the main pattern of a layer of gold dust brush, so that the main pattern is more prominent. At the same time, the warm color combination makes the color painting of the whole West Hall brighter and warmer.

In the process of field investigation, the author collected a total of six samples of colored pigments (samples 1-6) from different parts of the beams and frames of the West Hall of Yuquan Temple, covering six colors of colored pigments, namely, black, red, white, blue, green and red. In data processing and analysis, X-ray fluorescence and other instruments were mainly used in combination with various analytical methods to select suitable and effective non-destructive and minimally-destructive methods to detect and analyze different parts of the beams and frames as well as different colors of the colored pigment samples in the West Hall of Yuquan Temple according to the actual situation.

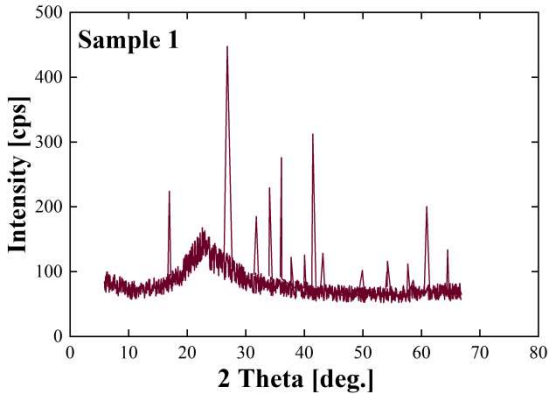
III. A. 4) Qualitative test results

Due to the high beams of the West Hall of Yuquan Temple, it was difficult to collect the colored pigments, so the number of samples collected was relatively small. Therefore, according to the number of samples and the characteristics of the samples themselves, most of the pigments collected were analyzed by EDX-3600L Energy Dispersive Fluorescence Spectrometer to analyze the elemental composition, and then further speculate the basic composition of the pigments. The elemental composition of the pigments of each sample was measured by X-ray fluorescence spectrometer as shown in Table 1 and Figure 2.

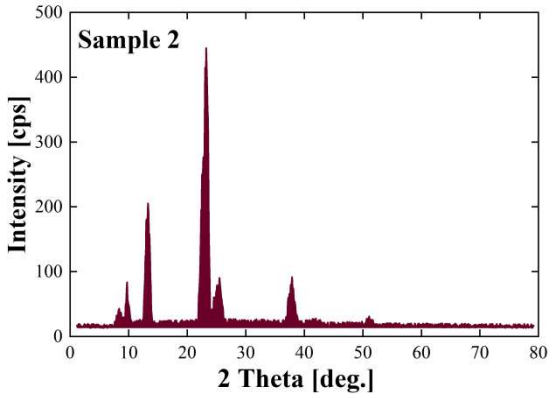
Table 1: Analysis table of pigment components in color painting samples

Chemical composition	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Na	0.3147	0.9488	0.7054	0.1146	0.3394	0.7177
Mg	0.8605	0.2489	0.2496	0.5992	0.2292	0.0013
Al	0.8442	1.0869	0.6925	0.1975	0.7420	0.0748
Si	4.0158	8.4185	1.8028	2.3643	2.5166	0.9666
P	1.9301	0.0469	1.7728	0.8582	0.8370	0.9556
K	0.2729	1.8072	0.7503	1.2357	3.2736	0.6253
Ca	78.1211	40.5411	80.1907	85.7852	45.1480	10.3802
Ti	0.2366	3.0163	0.2808	11.4591	1.2933	0.5106
Mn	0.3053	0.1539	0.1711	0.0285	0.0099	0.7054
Fe	3.6074	50.5869	0.2376	2.9265	4 .1044	0.4139
Co	0.0000	0.0000	0.0000	0.0000	0.0000	0.1203
Cu	0.3198	0.6301	0.8420	0.4922	0.9585	0.0064
Zn	0.2429	0.2371	0.8604	0.0505	7.6712	0.5148
As	8.8136	0.0924	0.4518	0.2107	1.7966	0.9281

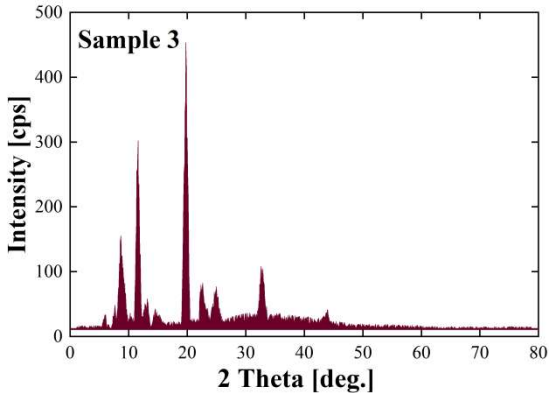
Rb	0.6401	0.3647	0.3032	0.4823	0.1951	0.8894
Sr	0.6019	0.9088	0.5115	0.2108	1.8372	0.1360
Zr	0.2113	0.4037	0.2795	0.1750	10.4984	0.3381
Ba	0.0000	0.0000	0.0000	0.1632	10.1712	0.4741
Pb	0.5063	5.8960	0.9279	0.3959	11.7027	9.7745



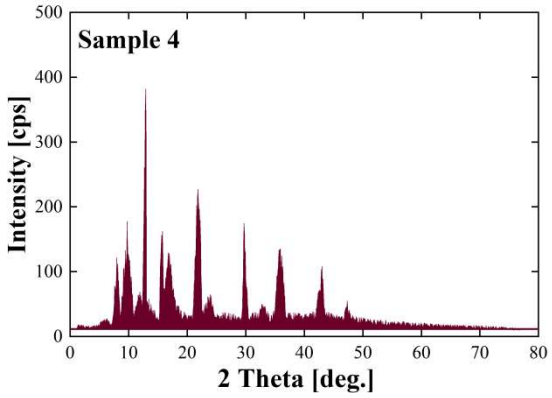
(a) X-ray fluorescence spectra of sample 1



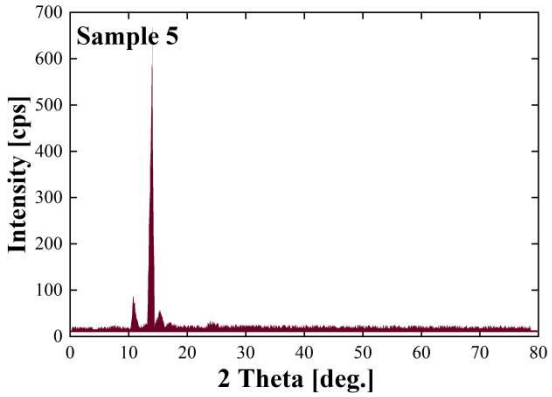
(b) X-ray fluorescence spectra of sample 2



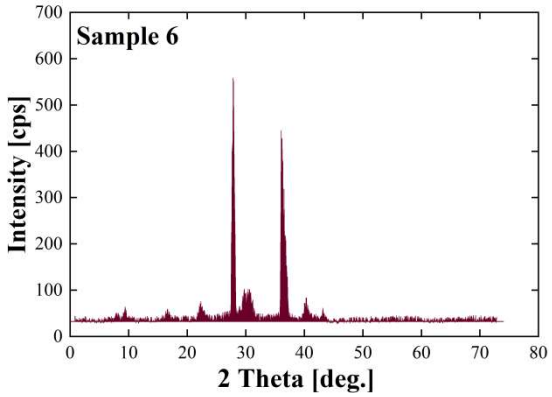
(c) X-ray fluorescence spectra of sample 3



(d) X-ray fluorescence spectra of sample 4



(e) X-ray fluorescence spectra of sample 5



(f) X-ray fluorescence spectra of sample 6

Figure 2: X-ray fluorescence spectrum analysis of each pigment sample

Through field investigation, it was found that the red pigment (Sample 2) preserved on top of the rafters and columns in the colored paintings of the beams in the west wing of the Yuquan Temple was red clay, which is often used in some family temples as well as residential buildings in northern Shaanxi to decorate with this natural mineral pigment. When the red clay becomes colored to show red color, it is mainly due to the large amount of Fe element in the clay, and its strength reaches 461.58 cps.

The samples analyzed by EDX-3600L energy dispersive X-fluorescence spectrometer contain a small amount of Na, Mg, Al, P, and K. However, none of these elements are the ones that show the color, and the source of these elements may be the dust in the surface of the colored paintings. All the paint samples of the West Hall of Yuquan Temple contain a large amount of Ca, and the chemical fractions of Ca in the six samples are detected to be between 10.3802 and 85.7852, which we guess that they should come from the lime layer in the lowest layer of the paintings and the dust on the surface of the paintings, and that the bottom layer of the beams and frames of the paintings in the West Hall of Yuquan Temple is only a layer of lime layer brushed on the bottom layer of the beams and frames of the paintings. Therefore, it can also be concluded that the material of the bottom layer is calcium carbonate. And, over a long period of time, calcium carbonate has diffused with each other and various color pigments, combining into a dense whole. This leads to the generally high content of elemental Ca in various pigments.

The black pigment in Sample 1 is used in more places in the colorful paintings of the entire beams and frames of the West Hall of Yuquan Temple, and according to the on-site observation, it can be seen that the black pigment is the more common ink, i.e., charcoal black, in life. As shown in the test, in addition to Ca element, the component of As element in Sample 1 reaches 8.8136, and As element is one of the common elements in charcoal.

The white pigments commonly used in ancient architectural paintings are titanium white (TiO_2), chalk ($CaCO_2$), lead white ($2PbCO_3 \cdot Pb(OH)_2$), barite ($BaSO_4$), dolomite ($CaMg\left[COs\right]_2$) and gypsum ($CaSO_4 \cdot 2H_2O$). The content of Ca element in the white pigment in Sample 3 is obviously high, so the white color-forming material here should be calcium-based pigment, probably chalk, dolomite and gypsum, because the process of leaching powder was used in the color painting of the West Hall of Yuquan Temple, so the white pigment in Sample 3 is more likely to be the gypsum of the leaching powder composition.

After comprehensive analysis and observation, the pigments used in the beam painting of Yuquan Temple are in the same line of inheritance as those used in architectural color paintings of the past dynasties, and they are all the pigments often used in ancient architectural color paintings of the Song Dynasty in China. As most of the mineral pigments are relatively stable in chemical properties, they are not easy to undergo chemical changes under general environmental conditions, thus leading to changes in the color of the paintings. Therefore, Yuquan Temple West Hall of the building color painting, can be after so many years, still as bright as when it was first painted.

III. B. Process Flow and Drawing Techniques

Through the field investigation found that the Yuquan Temple West Hall in the beam frame painting did not do more complex ground battle layer, just a layer of lime brushed on the wood, as a base layer, leveling painted after the color painting. And, not in all parts of the beam frame are brushed with lime. The painting procedure of its beam frame color painting can roughly include the steps of starting the score, tapping the score, draining the powder and applying the color. The color pigments used are mainly traditional mineral pigments, which are basically the same as those used in the traditional color paintings of ancient Chinese buildings. The painting process of the beams and frames in the West Hall mainly consists of the following steps:

(1) Starting the score

The spectrum in the ancient architecture color painting over the drawing process of a relatively high technical content, and plays a decisive role in the key construction process. In the Song dynasty official building color painting process, the spectrum drawn pattern whether in line with the characteristics of the times, whether accurate, as well as drawing techniques, etc., directly affects the quality of color painting. Therefore, for the Song dynasty official building color painting pattern style requirements are more stringent.

(2) Shooting the score

After drawing the spectrum, use the needle to tie out uniform pinholes in the spectrum on the vellum, and the direction of the pinholes is mainly along the direction of the decoration. Then, transfer the tapped score to the wooden components. And will be made in advance with a thin cloth wrapped in gypsum powder bag against the surface of the spectrum, repeated patting, the powder inside the bag of gypsum powder along the pinholes previously tied through to the surface of the wooden components. So that all the shot complete components on the vellum after the pre-drawn pattern printed on the surface of the wooden components, shoot the spectrum requires a clear pattern of decorative correct, continuous and smooth.

(3) Drainage powder

Leaching powder is also a color painting process in the technical and proficiency requirements of the work of a

high degree. When leaching powder, it is mainly through the forceful squeezing of the hand, the powder tube will be made in the powder paste squeezed out to form a semicircular powder, the powder paste is mainly made with gypsum to modulate. The slurry is mainly made of gypsum. The consistency of the slurry is adjusted according to the needs of different parts and the thickness of the vermicelli. When draining the powder, it is mainly to follow the spectrum pattern outlined on the surface of the wooden architectural components previously photographed, and no unauthorized creation is allowed in this process.

(4) Coloring

The first thing to do when coloring is to brush the whole once over the big color, small color, etc., mainly to brush the bottom of the green, green, red, etc.. When brushing the color, first brush the weaker coverage of green, and then brush cyan, red. When brushing the color, can not leave obvious brush marks on the surface of the wooden components, not to mention the phenomenon of leakage, color mixing and so on. After brushing, wait for the color to dry completely before applying the second color.

III. C. Production of Pigments for Song Dynasty Paintings

III. C. 1) Song Dynasty color painting materials

Before making the color painting boards used in the experiment, it is necessary to conduct sufficient research on the materials of color painting to achieve the maximum restoration of the results of simulating the ancient architectural color painting site inspection. This study chooses Song Dynasty color painting materials as the research object, Song Dynasty color painting according to the location and function can be divided into the ground battle layer (base layer), color painting layer (surface layer).

The ground battle layer is both the grass-roots level of color paintings and the protective layer of wood base, and the ground battle mainly plays a protective role. Ground battle layer with brick ash, blood, white, gray oil, oil, lime and line hemp and other traditional materials to a certain ratio, according to different parts of the process requirements, combined, applied to the surface of the wooden components, forming a solid and stable protective layer.

The pigment layer, applied on top of the ground battle layer, is painted on the big wooden frame because of its rich colorful patterns, and is divided into several grades according to the grade, such as Washi color painting, spinning color painting, and Su-style color painting, etc. The pigments are generally selected from inorganic minerals. Pigments are generally chosen from inorganic mineral pigments, but chemical pigments are also used, and vegetable pigments are seldom used. According to the classification of color pigments, they can be divided into seven color families: red, yellow, blue, green, white, black and gold. Previously, the inorganic mineral properties and components of pigments have been detected with XRF instruments. In this paper, pigments are mainly introduced to inorganic mineral pigments, as shown below:

(1) The red family, vermilion (HgS), zhangdan (Pb_3O_4), and iron oxide red (Fe_2O_3).

(2) Yellow, andrography (As_4S_4), chrome yellow ($PbCrO_4$), and earth yellow (α-$FeOOH$).

(3) Blue color, lime ($2CuCO_3 \cdot Cu(OH)_2$) and ultramarine ($Na_6Al_4Si_6S_4H_20$).

(4) Green, lime green ($CuCO_3 \cdot Cu(OH)_2$) and Paris green ($Cu(CH_3COO)_2 \cdot 3Cu(AsO_2)_2$).

(5) White, Lead White ($mPbCO_3 \cdot nPb(OH)_2$) and Titanium White (TiO_2).

(6) The black series, soot, also known as carbon black. Carbon black is an impure product made by incomplete combustion or thermal decomposition of organic substances, carbon black covering power, weather resistance, sun resistance are very strong.

(7) Gold color system, red gold and Kukin.

III. C. 2) Color plate design

In the Song Dynasty, most of the color paintings were made with animal substances, such as skin glue and bone glue, to modulate various pigments and leaching powder, which is generally known as “glue to make color paintings”, therefore, the glue in this experiment was boiled with traditional bone glue. In this study, the setting of large color is to get the basic data of each color and each pigment detected by the instrument, the setting of small color is to get the detection data of pigment halo color, and the setting of layering is to analyze the influence of multi-layer pigment on the test results, so as to satisfy the requirement of subsequent experiments to investigate the influence of pigment layering on the data results. There are many cases of multi-layer pigment superposition in the actual painting, which is more common in the Su-style color painting, and the detection points will be encountered by multi-layer pigment superposition when using HH-XRF in-situ detection. Due to the penetrating nature of X-rays, it can not be determined from which layer of detection data, in the design of the color painting board, the use of layered design, color painting board of the base color selection of color painting rules in the color painting, green, cyan, red is the

most common color painting in the color painting of the big colors. Green, cyan and red are the most common big colors in color painting. They are often used as the base color when painting, so stone green, Paris green, stone green, ultramarine, Zhangdan, cinnabar and iron oxide red are set as the base color. The layering design is divided into two cases:

(1) Overlay of different colors.

(2) Superimposition of the same color.

The color and pigment superimpositions are shown in Table 2.

Table 2: Layers of pigments

First layer	Second layer
Green (stone green, Paris green)	Green (Paris green, stone green)
	Red (Zhangdan, iron oxide red)
	White (lead white + titanium white)
	Black (black cigarette)
	Fragrance (Realgar + vermilion + Black smoke + ultramarine)
	Jin (Chigin, Kujin)
Blue (stone blue, ultramarine)	Blue (ultramarine, stone blue)
	Red (Zhangdan, iron oxide red)
	White (lead white + titanium white)
	Black (black cigarette)
	Fragrance (Realgar + vermilion + Black smoke + ultramarine)
	Jin (Chigin, Kujin)
Red (Zhangdan)	Red (cinnabar)
	White (lead white + titanium white)
	Black (black cigarette)
	Blue (ultramarine, stone blue)
	Green (Paris green, stone green)
	Jin (Chigin, Kujin)
Red (iron oxide red, cinnabar)	White (lead white + titanium white)
	Black (black cigarette)
	Blue (ultramarine, stone blue)
	Green (Paris green, stone green)
	Jin (Chigin, Kujin)

III. C. 3) Color plate production

The size of the experimental color painting board is 10cm×10cm×2cm red pine wood block, the surface of the wood block to make a single phi gray ground battle, the glue is boiled with traditional bone glue. Pigment samples are recommended by the “Song Dynasty Ancient Architecture Atlas” of ancient architecture professional repair construction units to provide for the pigment powder, in the red, yellow, blue, green, white, black and gold in seven colors of pigment selected inorganic pigments as the experimental object. The specific production process is as follows:

(1) Making substrate

Soak the paper substrate, spread its fully absorbent paper substrate on the drawing board, fix it with water tape and leave it to dry.

(2) Perforation of the film

UV film with a perforator will be punched out 1 * 1cm square holes, affixed to the dry substrate, drive out the air between the UV film and the substrate

(3) Sample making

Mix and prepare gelatin and hot water in the ratio of 1:10, mix and prepare pigment and glue in the ratio of 1:10, put the mixture of pigment and glue on the top of 60℃ water bath and heat to keep it not solidified, drop it into the square holes of the UV film, and spread it evenly to keep the surface of the pigment flat.

(4) Preservation of samples

In order to maintain the stability of the nature of the samples, the specimens with dried pigments were kept in a dark place with a temperature and humidity of 35℃ and 50±5% for 30 days.

The 18 completed color painting panels were produced as shown in Fig. 3.

Figure 3: The painted relics of the Song Dynasty are often made of inorganic pigments

III. D. Application of Pigments in the Aesthetic Creation of Ancient Architecture

In the public areas of the ancient architecture of the Song Dynasty, paintings and pigments can be seen everywhere, showing different regional styles. These decorative arts, embodied in the Chinese ancient architecture of residential culture and aesthetic taste.

(1) Showing the style characteristics of different cultures

Architectural paintings in different regions, with strong regional cultural characteristics of religious culture, the Central Plains culture, marine culture patterns, etc., the pattern is different. Ancient architectural paintings containing Buddhist culture pigments use a lot of threads and butterfly patterns. In the choice of pigment, more than russet-based, gold lacquer paintings on black background, fill in the color more than the use of superimposed color technique, so that there is a color difference effect.

(2) The decorative cultural connotation of lyric value psychology

Aversion as a building to avoid disasters of natural forces suppressing the evil spirits, folk houses painted aversion to the spine set up successive days gossip, Taiji. Temples are set with dragons, the gate is set with door gods, and the lintel is set with the Eight Immortals colored to expel ghosts and assist the architectural space to resist the invasion of evil spirits.

(3) Corresponding to the natural environment with metaphysical beliefs

After the Wei and Jin dynasties, the rise of metaphysics, feng shui math in-depth building construction, pay attention to the “orientation”, “birth” of the law and the integration of the environment. Chinese houses have “south” characteristics, according to the gossip south for dry, the building regardless of the orientation, are painted in the main door for dry trigrams. The right rear of the building for the Kan Gua symbolizes the north-west, “the birth of grams” of the law of a water fire, chi dragon and tiger, cloud pattern and other kinds of aquatic and wave pattern, painted on the beam to inhibit the fire-like.

(4) Showing the ideal of life through auspiciousness

Auspiciousness is the concept of symbolizing auspiciousness, seeking good fortune and longevity, and avoiding bad luck. Ancient architectural painting as for the mansion more emphasis on “qin, chess, calligraphy and painting”, “ink, paper and ink stone” of the literati life mood, or active or retreat. There are also decorative motifs based on secular expectations such as praying for good fortune, wealth, children, and longevity, with “wealth, children, and longevity” or “fortune, wealth, and longevity” being the most prevalent. Bats, butterflies, grapes, treasure bottles, auspicious ten-thousand-character panchanges and peonies represent the symbolism of wealth and prosperity, or Western paintings reflecting the imagination of modern civilized life.

IV. Conclusion

Traditional ancient architectural color painting is a concrete presentation of plebeian culture, with the integration of anthropology, aesthetics, and architectural disciplines characterized by the following preliminary arguments:

(1) Painting pigments began to be used in large quantities during the Song Dynasty, and building components began to be standardized, and the organic combination of decoration and architecture was a major feature of the

Song Dynasty. The colors of Song Dynasty buildings fully reflected the mainstream culture of the time, and the development of architectural decoration culture for the subsequent dynasties, often used color decoration to render the class power of the ruling class.

(2) The aesthetic characteristics of the development and inheritance of painting pigments in the Song Dynasty can be understood in terms of their regional, cultural, and contemporary connotations. It is inferred that it has regional characteristics originating from the original hometown and after localization, and also has the function of providing architectural space with the decorative cultural connotation that expresses the value of psychology, which confirms the aesthetic value of the theory of cultural and regional character in architectural paintings.

It is hoped that through the above research, we can pay attention to the color painting technology and protection technology of Chinese ancient buildings in Song Dynasty, correctly understand the protection of architectural cultural heritage, promote the exchange of traditional color painting technology and protection, restoration technology exchange and interaction, and complement each other, and give hints and guidance to the development of cultural relics protection strategies with their own cultural characteristics of differentiation.

Funding

1. Supported by “2022 Fujian Provincial Social Science Fund Project”; Project name: A Study on the Neo Confucianism of Painting in the Song Dynasty (Project approval number: FJ2022B105).

2. Supported by “2021 National Social Science Major Bidding Project”; Project name: Research on the Contemporary Revival of Traditional Chinese Art (Project approval number: 21ZD23).

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