

Restorative Style Seen in the Shishinden Hall Area, Kyoto Imperial Palace, and How It Has Been Used

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The palaces and halls of the Kyoto Imperial Palace built in 1855 incorporate Japanese architectural styles ranging from those of the Heian Period to the time of construction, retaining the original ambience of the court cultures that had blossomed in Kyoto for more than a millennium.

Even though the architectural space in the area of the Shishinden Hall, the main building of the Kyoto Imperial Palace, was designed aiming for the restoration of the architectural style of the Heian Period, in practice, some parts deviate from the faithful reproduction of the style. For all that, by focusing on how the architectural space has been used for rites, it is clear that the architectural forms and the usage based on traditional ritual procedures correspond well to one another. Behind this correspondence, there were carefully considered choices based on building use, in order to, under various constraints, restore the bygone historical architectural style of the Heian Period.

Thus, the Kyoto Imperial Palace was built after fully identifying the essential needs of the Japanese court, and understanding the construction philosophy is nothing else but understanding the history of the Japanese court cultures.

Science Research and Analysis Associated with Restoration Work on Corridor around the Shishinden Hall Area, Kyoto Imperial Palace

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The corridor and the gates surrounding the South Courtyard of the Shishinden Hall of the present Kyoto Imperial Palace are painted with coating materials. Concerning the coating of Japanese historical buildings, Nikawa animal glue and Urushi lacquer have been conventionally used as the coating materials. However, those coating materials are deemed to accelerate the deterioration so rapidly that recoating is often required. The present corridor and the gates of the Palace are no exception. The fact of the restoration of recoating can be traced back in the historical resources. With regard to the coating materials, we are able to trace back in the source of reconstruction of 1790 with the description of "Koumyotan", which refers to "red lead". However concerning the coating materials of the present Palace built in the Ansei era (1855), no definite historical sources have been confirmed although recoating restoration had often been carried out. Therefore, we have performed scientific study to specify the coating materials for restoring the original color tone of the reconstruction 1855. We analyzed samples from the inner round columns of the Palace as follows: (i) SEM-EDS analysis to observe and specify the elements of the samples (ii) X-ray diffraction analysis (XRD) to analyze crystal structure; and, (iii) Visible spectroscopic analysis to measure color tones. As a result of these analyses, it was found that the lower layer had been coated with Bengala (red iron oxide), and the outer layer had been coated with Koumyotan. In this restoration project, as coating Koumyotan over Bengala might cause uneven coloring, a pre-mixed pigment with Koumyotan and Bengala was used. The comparison of the colors of the collected samples and manufactured paints by visible reflection spectra, $L^*a^*b^*$ color space and color difference ΔE^*ab was performed in order to specify the materials based on the digitization of the color variation.

Meanwhile, during the process of the restoration work, a white substance was detected on a coated film. Since this may be considered to be the cause of deterioration of coating film, verification analysis of the components of the white substance was conducted to clarify the causes of the development of the substance. Through XRD analysis, Thenardite (Na_2O_4) was detected, indicating the occurrence of precipitation of salts. After verification, it was found that this phenomenon may have been generated under unfavorable conditions due to the use of the combination of a coating remover and primer, the season in which the coating was conducted and the coating period, as well as temperature and humidity environments. As our restoration work team were able to cope with respective problems, the efflorescence has been successfully suppressed. We will continuously observe the coated films to elucidate the mechanism of the efflorescence occurrence.

Material Science Research on White Pigments Used in the Paintings on Room Partitions in the Seiryoden Hall, Kyoto Imperial Palace

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In the six years from 2019, replacement of the furniture in the Seiryoden Hall with new items has been scheduled, including the reproduction and undercoating of the 24 paintings drawn on the fusuma sliding-door papers, and 12 of those affixed on the nageshi beams running between columns in a room, and the metal fittings, frames, etc. In the first year of this project, the primary purpose of our research was to investigate the microstructures of the coloring materials used in the three paintings; (i) Kara-e paintings entitled “*Kara-e Honmon no I*” on which historical events, scenery and customs in China drawn by Tosa Mitsusada in the Kansei era, positioned under the East Eaves of the main building; (ii) Yamato-e paintings (a traditional Japanese style painting used as in a term the opposite of Kara-e) entitled “*Koromode no Mori*” that depicts landscape and customs in Japan created by Tosa Mitsubumi in the Ansei era, positioned in the Daiban-dokoro (a station of court ladies) under the West Eaves, and, (iii) “*Cranes in clouds*” created by Tosa Mitsukiyo, positioned in the upper part of the nageshi beam across the two rooms of the main building. The experimental methods were as bellow: stereoscopic microscopes and digital microscopes to observe surface conditions; UV-visible spectrophotometer to measure the colors; portable X-ray fluorescence spectrometer for elemental analysis; scanning electron microscope (SEM) to observe the microstructures of the sampled pigment fragments and energy dispersive X-ray spectrometer (EDS) to analyze composition; and X-ray diffractometer (XRD) to determine crystal structure. The results of the analyses showed for the first time that: (i) calcium sulfate (plaster) was used in the delimiter lines of “suyari-gasumi” (mists depicted horizontally in bands) in the painting “*Kara-e Honmon no I*” created in the Kansei era; and, (ii) gofun, a white pigment made from scallops, was used in the white petals of small chrysanthemums. Likewise, gofun pigments made of plaster and scallop shells were also used in the delimiter lines of suyari-gasumi mists in “*Koromode no Mori*” drawn in the Ansei era. There have been no cases reported to date in which plaster was used as a coloring material, which constitutes a significant result achieved through this research. Furthermore, plaster was detected in the trunk of a tree and pond water, indicating the possibility that plaster was used as a white pigment in many different parts in paintings. (iii) Incidentally, gofun white pigment and a kind of white clay were used in a section of the primary coat of the suyari-gasumi mist in “*Cranes in clouds*” positioned in the upper part of the nageshi beams. In addition, indigo was used in depicting the water of a pond and the moss on a tree trunk, proving that dyestuffs were also used frequently as coloring materials.

Report on Master Plan for Moss-covered Grounds in Katsura Imperial Villa

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In recent years, due to drying resulting from global warming and urbanization in the surrounding areas, the environments around the gardens of Katsura Imperial Villa have greatly changed, resulting in the decline of ground-cover plants, especially mosses, and partial vegetation removal. Furthermore, the recent increase in the number of visitors and consequent tramping down of mosses also contributed to the decline. Accordingly, a master plan for the recovery of moss-covered grounds was devised in order to establish management methods responding to the current environments.

Based on the master plan, first the types and distribution of the mosses existing in the Katsura Imperial Villa were surveyed to understand the current state of the moss-covered grounds; then a survey was conducted regarding areas in which the current vegetation should be maintained, and in which the repair work of planting new moss is required. The areas requiring repair were classified into three stages, depending on urgency.

In addition, both a short-term and a continuous management policies based on the current conditions were formulated by conducting a cultivation test and a drying-countermeasure test during the summer season to establish cultivation methods for mosses suited to the Katsura Imperial Villa.

The short-term management policy gives immediate priority to the rapid recovery of currently damaged areas; however, it focuses on the selection and planting of mosses suited to each zone in the garden, not the simple repairs mainly using hair cap moss (*Polytrichum commune*) undertaken in the past.

The continuous management policy has been formulated mainly to: (i) prevent the decline of existing mosses; (ii) establish the supply system of moss for repairs, based on in-house cultivation; and, (iii) guide visitors in order to suppress damage caused by visitors entering the moss-covered grounds and the consequent tread pressure.

In the future, management will be carefully and thoughtfully undertaken by increasing the range of moss species researched for repair and surveying species-specific growing speeds, while implementing measures according to management policies.