Japanese Gateway, Royal Botanic Gardens, Kew, London

Results of Architectural Paint Research

28/03/2024

HIRST Conservation

Project Summary

Project	Japanese Gateway, Royal Botanic Gardens, Kew, London
Nature of Project	Architectural Paint Research to selected elements of the structure.
List Entry Number	125179
Listing Date:	10th January 1950
Listing ID	Grade II
National grid reference	TQ 18345 76142
Address of building	Japanese Gateway Chokushi-Mon or Gate of the Imperial Messenger, Royal Botanic Gardens Kew, Kew Green, Richmond Upon Thames, TW9 3AB
Name and Address of Conservator	Hirst Conservation Limited Laughton, Sleaford Lincolnshire NG34 0HE
Name and Address of Client:	Clews Architects Acanthus House, 57 Hightown Road Banbury, Oxon, OX16 9BE
Date of Site visit	22nd January 2024
Author(s) of Investigative Report	Jacqueline Churchill & Charlotte Owen
Methods Employed	Cross sectional analysis; documentation.

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1. Scope of Research

This report discusses the results of architectural paint research to selected facets of the Japanese Gateway Chokushi-Mon or Gate of the Imperial Messenger (hereafter referred to as the Japanese gateway), at the Royal Botanic Gardens Kew, London. The research was undertaken at the request of Clews Architects, Banbury.

The aim of this programme of research is to understand the nature of applied decoration to the structure of the Japanese Gateway.

Sampling was undertaken by Jacqueline Churchill and Charlotte Owen of Hirst Conservation in January 2024 with high level access provided by the client.

No independent archive research has been undertaken as part of this study. Any information or archival images contained in the report has been obtained through limited internet searches or following review of the Condition Survey Report undertaken by Martin Ashley Architects, Twickenham in 2021 (supplied by the client). All details are listed in the Bibliography in Section 9.

Figure 1: Image taken in January 2024 of the south elevation of the Japanese Gateway.

2. Definitions of the Aims of the Project, Discussions of the Research Strategy and Details of the Methodology

2.1. Aims and Objectives of Paint Sampling

The aims of architectural paint research are:

- To understand the original design intention, where possible;
- To inform the ongoing conservation and maintenance of the site.

2.2. Collection of Paint Samples

Samples were taken using mechanical means using a small chisel and hammer or scalpel, given individual reference codes and the sample sites recorded photographically and diagrammatically (these are illustrated in Section 6).

2.3. Microscopic Assessment of Samples

The samples were mounted in clear casting resin and polished to provide a cross section through the paint layers. Assessment at 50x, 100x & 200x magnification in incidental light allowed the layer structure to be assessed. The majority of the sample images have been assessed in darkfield mode with additional analysis and image capture undertaken at 500x magnification in brightfield mode. In addition, fluorescence microscopy was employed to identify the basic stratigraphy of paint schemes and to establish basic composition of paint films.[1]

Assessment of samples in incidental light and UV fluorescence allows each scheme to be identified though dirt films, 'oiling out' layers, fading of upper surfaces of films and variations in fluorescence properties.

2.4. Micro-chemical Analysis of Paint Films

Further investigation of key layers was achieved by stain test and simple chemical techniques (Plesters, 1956)..[2] This was undertaken in order to understand the basic composition of the layers.

[1] Microscope used was a Nikon Eclipse LV150NL stand with LV-UEP12 Universal EpiFL-Illuminator 2. Visible & UV light was produced by CoolLED pE-300 Ultra pE-300-UT-D-SB-27E-30(3200k). UV-2A FL Filter cube, Excitation wavelength range: 390-490nm, Splitting mirror :510nm, Absorption wavelength: 515nm

[2] Plesters, Joyce. Cross-sections and chemical analysis of paint samples *Studies in Conservation,* (Volume 02, pp 110-157, 1956)

Assessment for lead content was undertaken on samples in the laboratory. Analysis was limited to microchemical 'Spot' tests using dilute sodium sulphide (Na_2S).

2.5. Advanced Analysis

No advanced analysis has been included in the scope of works. However, as noted at the outset, analysis by additional techniques may be recommended to inform further understanding of binding media or composition of varnishes that cannot be determined by methods identified above.

Therefore, further analysis by FTIR, SEM-EDX or py-GCMS may be required subject to further discussion. Fourier Transfer Infra-red (FTIR) analysis is used to measure the detail of binders and fillers in paint films; Scanning electron microscopy-energy dispersive X-ray analysis (SEM-EDX) is used for the elemental composition of paint samples targeting specific layers of paints. Pyrolysis Gas Chromatography-Mass Spectroscopy (py-GC-MS) is a further analytical tool used to understand identification of polymers.

2.6. In-situ Investigation

Where employed, colour readings are taken using a handheld colour measurement tool[3] and are adjusted slightly by eye to take into account the yellowing and greying of paint films over time.

Any intention to recreate colour schemes should make use of colour swatches or test panels prior to final colour scheme selection as any historic colours applied at different periods will have been seen when the colour of surrounding masonry was likely to be different from the existing appearance. Therefore, the choice of colour schemes should take into account the colour changes to the building to ensure an appropriate colour palette is selected.

[3] NCS Colour Scan 2.0, which can give colour translation details in LRV D65 10°, CIE Lab D65 10°, RGB D65 2°, Adobe RGB D65 2° and CMYK Euro. Cites the nearest NCS colour reference and can also indicate sheen/gloss.

3. History and Context

3.1. Archive material

No independent archive research has been commissioned as part of these works and all material herein contained has been provided by the client / their agent or through appraisal on material available through internet searches. Should any further information be provided then Hirst Conservation reserves the right to reappraise the findings of the survey and make appropriate revisions to the results.

The details of any documents or web sources are listed in Section 9 – Bibliography.

Figure 2: Ornately painted Karamon Gate following a three year restoration, in 2021. (The Mainichi, 2021)

3.2. Brief History of Building

The following section contains images taken from the Condition Survey by Martin Ashley Architects (Martin Ashley Architects, 2021) where a more detailed history of the development and use of the building will be found. The information used in this section is designed to illustrate the changing ownership of the building in relation to its decorative history. The original source of the images is also listed in the Martin Ashley report, page numbers have been listed alongside caption details to support referencing these items.

The Japanese Gateway was constructed as a 4/5th scale replica of the Karamon Gate in Kyoto, Japan (Figure 2). It is understood that the Japanese Gateway has never been decorated in the colourful style as its counterpart in Kyoto.

It had been commissioned by the Kyoto Exhibitor's Association for the Japan-British Exhibition held in Shepherd's Bush, London in 1910, where it was seen by in excess of 8 million visitors during the six month exhibition .

The Japenese Gateway was gifted to King George V following the exhibition, in turn he gifted it to the Royal Botanic Gardens at Kew (see Figure 3), where it still stands today.

From the archive image, Figure 3, it should be noted that the appearance of the upright posts looks as though it is lighter in colour than that of the rest of the structure.

Figure 3: Japanese Gateway c.1910, after its relocation to Kew. (© Royal Botanic Gardens Kew)

There have been three occurances of restoration to the Japanese Gateway over the years. The first in 1936 and second in 1957, both sets of restoration were carried out by Torii Kumajiro, who was a Japanese woodcarver who had worked at the 1910 Exhibition.

The third instance of known restoration was carried out between October 1994 and November 1995. This included a full restoration of the structure and the replacement of the original cedar bark roof with a traditional copper one.

A Condition Survey was carried out in March 2021 by Martin Ashley Architects on behalf of Clews Architects & Royal Botanic Gardens Kew.

Date	Event
1910	Commissioned by the Kyoto Exhibitor's Association for an exhibition in London
*c.*1910	Gate gifted to King George V in turn gave it to Kew
1936	Restoration works carried out by Torii Kumajiro
10th January 1950	Added to Listed Building Register
1957	Restoration works carried out by Torii Kumajiro
1994-5	Restoration works carried out; full restoration and replaced cedar bark roof with copper
March 2021	Condition Survey carried out by Martin Ashley Architects

Table 1: Summary of relevant history

4. Japanese Gateway

4.1. Overview

Figure 4: View from the south of the Japanese Gateway, January 2024.

At the time of sampling, the Japanese Gateway had scaffolding within the south elevation of the structure to enable access to higher levels (see Figure 4). Full access to the interior of the roof was not possible due to the height and nature of the scaffold, analysis was therefore limited to the central area of the interior.

Documentary evidence suggests that the Japanese Gateway is made from hinoki wood which is a Japanese cypress (Historic England, n.d.), a softwood. Copper ornamentation is seen to many areas of the structure including the beams, posts and doors.

Close inspection of the structure's finishes revealed that the majority of the woodwork appears to be a warm brown colour, with the cross-beams at the top of the structure a darker brown. It is believed that this has been applied in a traditional Japanese lacquered technique (*urushi*).

Details on the ridge-piece, beam ends, and brace are picked out in a white paint, these areas are carved with scrolls, reminiscent of clouds often seen in Japanese imagery (Figure 5).

Figure 5: Image showing the similarity in the scroll detailing as to that in Japanese cloud art imagery.

There are notable areas all around the gateway of differing colour finishes to the wood. For example, in the roof space on the south elevation, the surface of a beam appears to have been treated in a different manner to much of the rest of the structure. This may suggest a variation in workmanship and what appears to be a later coating (possibly a polyurethane varnish) that has been applied to the surfaces. This has discoloured and brush strokes are visible (Figure 6) suggesting this is likely to be part of a later intervention and not in line with the known methods of traditional lacquering.

Figure 6: Image showing the brush strokes in possible later protective coating.

Further inspection of the structure revealed that there were also some areas of darker films, suggesting the remains of an earlier scheme that may have been removed. The interior ceiling timbers on the south side appear to have an uneven colour (Figure 7), this could be the result of partial removal of earlier schemes. It was also noted that the existing colour of this area has more of a red appearance with the previous scheme appearing as darker patches. Unfortunately, safe access to this area was not possible from the scaffold tower provided.

Figure 7: Image showing the ceiling timbers on the south side of the structure.

Discolouration and deteriorating paint films were observed in all elevations, although facets on the south elevation, which is more open to weathering, appear to have been affected more (Figure 8).

The Japanese Gateway is held up on six vertical posts, four square ones at each corner and two columns in the middle, which are circular in cross-section. They are decorated with copper bands at the base, middle and top, see Figure 8.

Figure 8: East elevation, showing the increased deterioration of the painted surfaces to the south (left) compared to those on the north side (right).

Two samples of applied decoration were removed from the south-western posts on the south side (Figure 9). The paint films to these posts were significantly degraded with many areas being exposed to the timber substrate and peeling or flaking paint, where an underlying red colour was noted. This had also been noted on the south-eastern post too.

Figure 9: Images showing the red colour beneath the peeling films on the south-western post.

On the north elevation there is evidence of pigeon roosting to the upper levels above the doors. Bird 'spikes' have been installed but apparently to little effect; remains of a nest and guano were present. As a result, damage has been caused to the internal higher level decorative bird (crane); displacement of facets and losses to tail feathers has occurred, due to the nesting birds (see Figure 10). One of the smaller wooden decorative feathers[4] has been retained with the samples to aid any additional analysis. Bird droppings have fallen on the internal beams and doors, the corrosive nature of the guano will have caused damage to both the wood and the copper ornamentation.

[4] This will be returned to the client following completion of the analysis.

Figure 10: North elevation, showing the damaged decorative carvings and evidence of bird roosting.

A pair of doors are situated in the middle of the Japanese Gateway, located between the two central columns. They are hinged on the south side. The gates are currently painted in a similar style as the rest of the structure. The paint films are in poor condition due to the coin damage and exposure to water and environmental factors, this is more significant on the south elevation.

On both sides of the door there is deterioration to the wooden surfaces assumed to relate to the throwing of coins as offerings, where they have impacted on the wood there are a series of dents and nicks to not only the applied decoration but the wood itself (see Figure 11). This can be seen more prominently on the south elevation, where the coins still remain on the ground.

Figure 11: Image of south elevation doors, showing the damaged caused by coin offerings.

On closer inspection of the north side door beast carvings, traces of paint films and scarring or ghosting was observed, suggesting that they may have been in a different configuration at some point in the past (Figure 12).

Figure 12: Close up of carved beast on north side of door, showing possible scarring of altered position.

A locking bar is located on the south side of the doors, this is solid wood and square in profile. It is held in place with three metal bars, one centrally and one at each end. Damage has been caused through use, more so in the centre, where paint films have been worn away.

Figure 13: South elevation, showing the doors and locking bar. (left image: © Clews Architects; right image: © Hirst Conservation Ltd.)

Whilst inspecting the Japanese Gateway, it was noted that there appeared to have been some recent testing to the copper ornamentation, this was located on the south side of the base of the north-eastern post (Figure 14).

Figure 14: South side of north-eastern post, showing the copper ornamentation test areas.

4.2. Discussion of results

4.2.1. Overview

In total, 29 samples of applied decoration were taken from the structure with the majority from the south elevation, due to access. These were taken from a combination of decorative carvings, vertical posts and the doors. Fifteen samples were taken from the internal higher level facets on the south elevation[5]. Six samples from the posts on the south elevation, four samples were taken from the south side of the doors and a further four from the north side. Locations of the samples can be found in the Section 5.

A number of samples have been rejected from the final analysis as these were taken to ensure a full decorative history could be recorded in the programme of research. However, samples such as 06, 13 and 18 retain some evidence of the earlier schemes, though samples 08 and 23 have only fragmentary evidence suggesting significant loss. Losses can be through natural paint failure, abrasion as part of preparation for redecoration or through impact damage.

This report will discuss the various paint films that are seen in the cross sectional photomicrographs. Looking at the current decorative scheme and comparing it to earlier schemes, where identified.

Starting with the substrate, the structure is of a 'softwood timber framed construction, probably Cedar with elaborate carving details', *hinoki*, which is a Japanese cedar is the most likely source (Martin Ashley Architects, 2021).

This may be true of the majority of the timber used, though may be some evidence of a variation used for the wood of the decorative carvings of the flower and beast panels on the north side of the doors. Sample 26 from the enrichment carving to gate to the north side has an even, regular cell structure (see Figure 15) however samples taken from other parts of the structure have a more irregular, lozenge shaped pore structure. There is also evidence of clean, fresh-looking timbers associated with areas of repair / replacement. Comparison of the timber substrate also reveals areas of possible compression or abrasion to the surface of facets with some samples revealing residues of past paint films embedded in the pores but no longer visible as a flat paint coating. Such evidence indicates likely losses possibly from exposure to the elements and possibly from removal prior to redecoration.

Further analysis of the underlying timbers may be of interest.

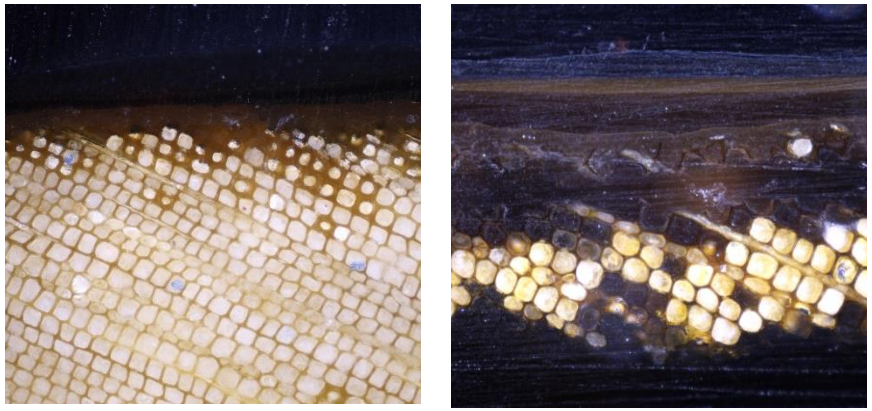


Figure 15: Sample 22 (left) and Sample 26 (right), photomicrographs showing the timber substrate differences in visible light taken at 200x magnification.

[5] It was not possible to get a clear overall image of this area due to the location of the scaffolding, it has been recorded here as a point of architectural recording.

4.2.2. White painted timber

When looking at the Japanese Gateway, as it is today, there are areas that have been clearly picked out in white paint to highlight their decorative beauty, as noted before it is reminiscent of the clouds found in Japanese art. Of note is the internal brace on the south elevation, see Figure 16.

Figure 16: South elevation, decorative brace, showing the areas picked out in white paint.

Sample 04 was taken from an underside position of the brace that is currently painted white. The cross section in Figure 17 (left), shows that the timbers look fresher/cleaner, than in other samples, which may suggest that this may be a later repair. Although, due to its position and function it a number of factors such as a variation in the use of timber, its protected position at the top of the inside of the Gateway, suggests it has not weathered in the same manner as other samples.

This facet is currently painted white, and there is some evidence to suggest it has always been treated in this manner due to the presence of underlying paint residue in the cellular structure of the substrate. There is also evidence of an intermediary varnish film above this fragmented scheme. This would suggest that this chamfered section of the decorative brace may not always have been painted white. This is comparable to a similar chamfered facet found in Sample 08, seen in Figure 17 (right). This is also true of Sample 01, which was taken from the base of the ridge-piece. A single white paint film, similar to the first seen in the other comparable cross sections, was observed over approximately eight earlier varnish films.

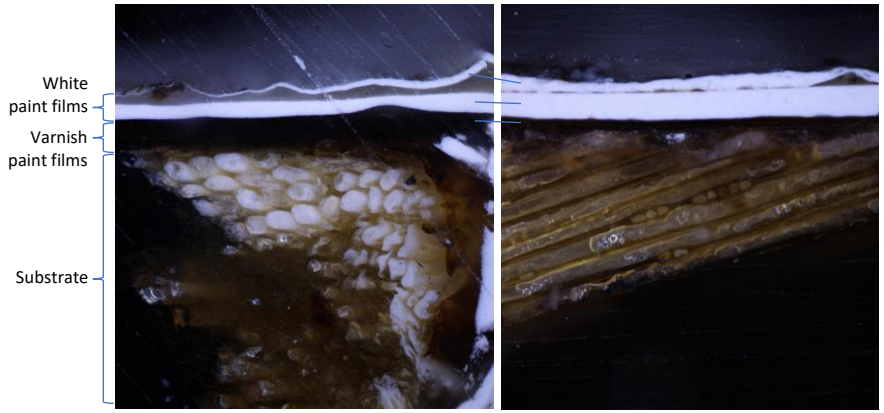


Figure 17: Sample 04 (left) and Sample 08 (right), photomicrographs showing the paint film differences in visible light taken at 200x magnification.

When looking at Sample 05 (Figure 18 - left), the earliest white paint film appears to be sat within the cellular structure of the thin section of timber substrate, this is also true of a similar earliest scheme seen in Sample 06 (Figure 18 right). This could mean that the surface was broken/roughed up when the paint film was applied, perhaps indicating this was done so over worn and weathered timber. This film reacts under

UV light and the florescence suggests that it is an oil-based paint with a later varnish applied over it.

Sample 06i appears to be the most complete set of paint films of the white painted facets, with what appears to be approximately seven schemes of decoration, although it is not clear how this information fits into recorded history of the structure.

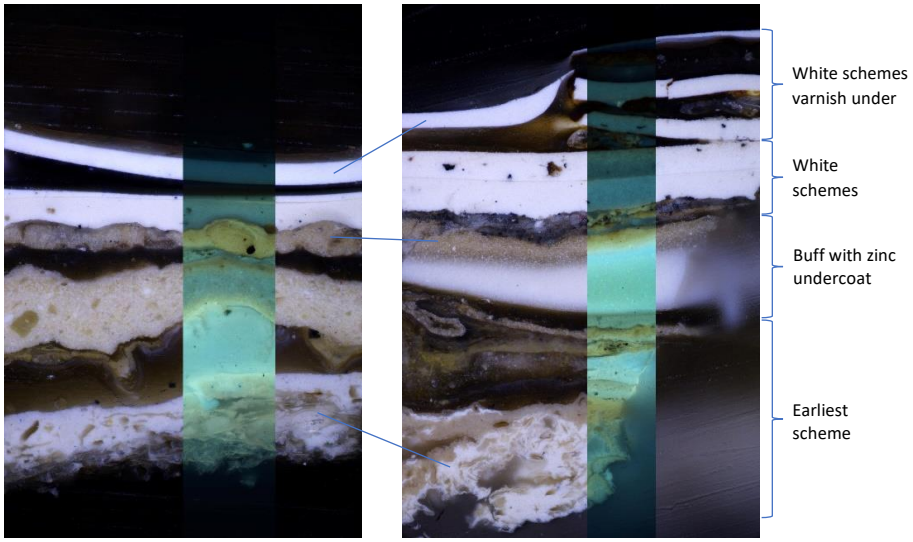


Figure 18: Sample 05 (left) and Sample 06i (right), photomicrographs showing the paint films in visible and UV (inset) light taken at 200x magnification.

The earliest scheme has a number of buff coloured paint films lying over a mottled white paint film, which is likely be an undercoat. It appears that there may have been an intention for this facet to have had a contrasting finish to the lacquered timber around it, but buff coloured rather than white. The samples indicate that the later use of a bright white paint deviates from original design intention.

A drop of dilute sodium sulphide (Na_2S) was applied to Sample 06 to test for the presence of lead; a positive reaction was seen to many of the buff paint films confirming the presence of lead-based paints.

The later white undercoat, to a buff topcoat, is likely to be a white, zinc-based oil paint film; due to the fluorescence observed and the appearance of the barytes inclusions. This scheme is comparable to one found in Sample 13, from the high-level central strut on the south elevation. No reaction for lead was seen in the this white paint film when; however it could contain lithopone pigments, which were used from the 1870's as a substitute for lead carbonate (white lead), further analysis would be required to confirm this.

It is interesting that not all of the paint films seen in Sample 06 compared to those seen in 05. There seems to be a series of four schemes of decoration with white paints, with the buff colour undercoats showing a positive reaction when testing for lead pigments or paint.

Sample 12 sees some similar schemes as those found in the other white paint sampled cross sections. We see a repeat of the earliest paint scheme, not shown in Figure 19, but appears in the cross section image in Section 6.

This is then followed by a buff paint film with the inclusion of a small number of blue pigments. Although their presence could suggest that there may have been some use of colour, it is believed that there would not have been enough to create a significant colour variation. A test was carried out with a mild acid (HCl) to Sample 12, a positive reaction was seen in the form of carbonation and bleaching of the blue pigment. The reaction indicates the likely use of French Ultramarine available from the mid-nineteenth century onwards.

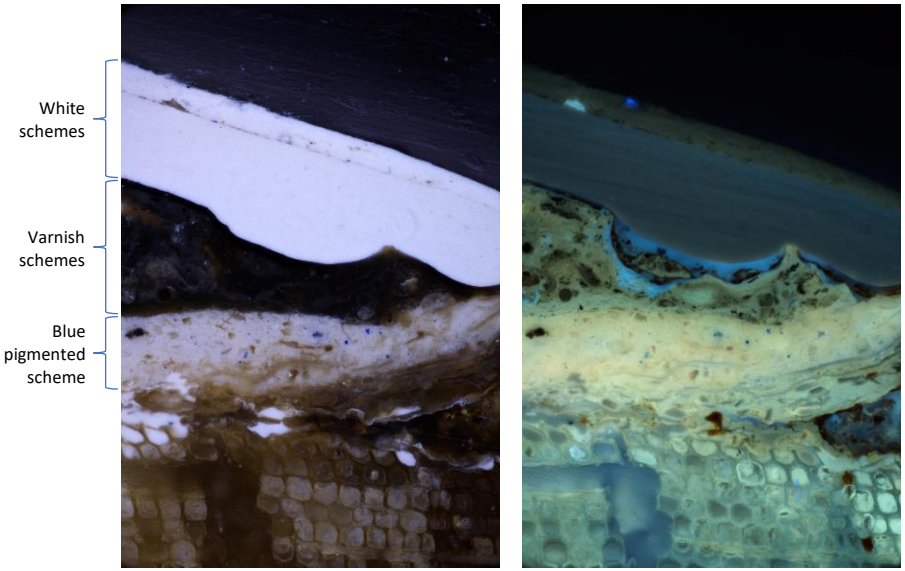


Figure 19: Sample 12i, photomicrographs showing the paint films in visible (left) and UV light (right) taken at 200x magnification.

When the varnish schemes are viewed under UV light there is evidence of detritus or impurities, this could be due to a poorly prepared surface, poor quality materials or dirt getting onto the film before it has fully cured. There are different forms of 'lacquering', each employing different steps and processes, many of them include the use of charcoal. Two such techniques call for sprinkling a fine charcoal powder in between layers of varnish or using lumps of charcoal made from hardwood to polish the varnish after it has dried for a few days (Kopplin, 2002). If either of these were used, or something similar, it could explain the dark inclusions seen.

Finally, we see a repeat of the two later white paint schemes seen in the other samples. This sample is broadly comparable to Sample 13 (Figure 25), however in 13 we see a few extra interventions, that could be fillers used in the restoration process.

4.2.3.Lacquered timber

Analysis of the samples shows that there have been losses to one or more of the earlier schemes, this could be due to damage, environmental exposure or the preparation of surfaces prior to redecoration.

In sample 09 an initial film can be seen applied to timber substrate with a thin dark film visible over it(Figure 20). The appearance of this film under ultra-violet light indicates it is a modern coating. Above this is a broken scheme which has also suffered some losses through time, this is then followed by a brown pigmented scheme, the addition of a pigment could be to renew the appearance of discoloured wood, or the craftsmen employed different techniques than had been used before. There appear to be three or four schemes in this sample, which all indicate an intended lacquer appearance.

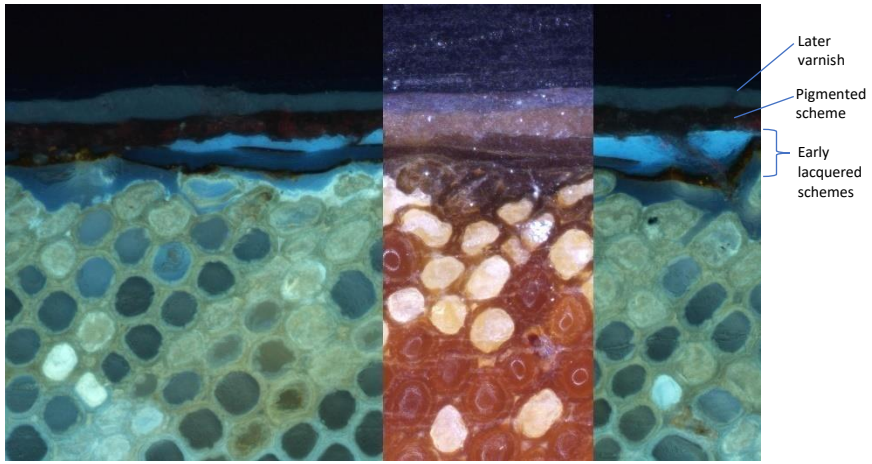


Figure 20: Sample 09, photomicrographs showing the paint films in visible (inset) and UV light taken at 200x magnification.

Analysis indicated that both the chamfered edges in Samples 06 and 08 appear to not have originally been decorated in white, but to have had a

lacquered appearance. Under ultra-violet light Sample 08 is largely comparable to 06ii, but there is evidence on an additional film with some red florescence suggesting possible use of shellac prior to the white schemes, see Figure 21.

Again, these appear to be later interventions but the lack of this additional film in 06ii may suggest that there was a variation in appearance or that there has been a subsequent loss of film; due to the condition of the paint films.

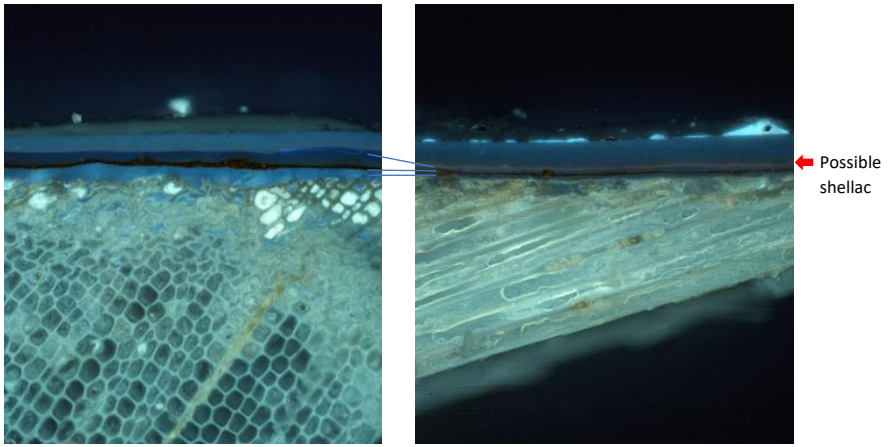


Figure 21: Sample 06ii (left) and Sample 08 (right), photomicrographs showing the paint films in UV light taken at 200x magnification.

Sample 11 has a different appearance under ultra-violet light than the varnished layers seen in the other samples, see Figure 22. The initial scheme is made up of an organic oil-based coating, which has been applied to the surface of a smooth timber substrate.

The secondary scheme appears to contain a lot of detritus within it, which could mean that it has possibly never fully cured allowing dirt to get embedded within the paint film, or it was a poorer quality material containing impurities in the oil.

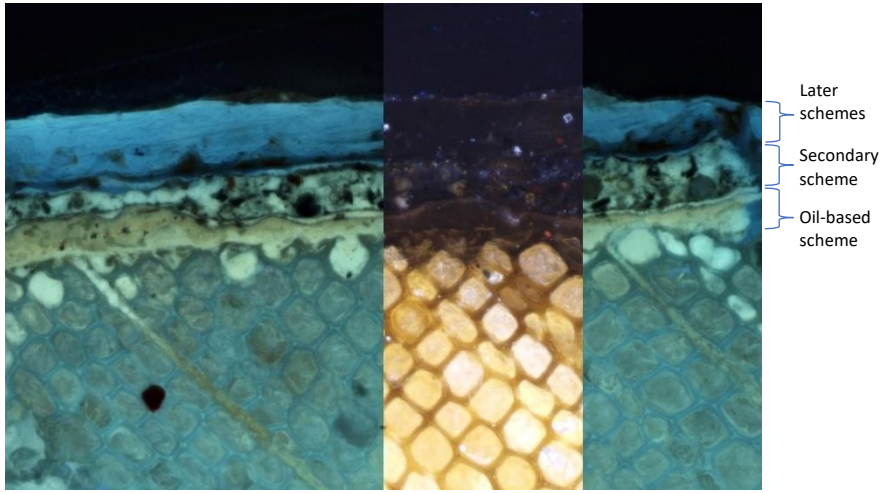


Figure 22: Sample 11, photomicrograph showing the paint films in UV and direct (inset) light taken at 200x magnification.

Within the later schemes there is some use of pigmentation; noticeably a dark red that is likely mixed with black, however this is not discernible under microscopic analysis. It was noted on site that the later varnish layer has discoloured and was detaching from the underlying coatings; in places this exposed the dark red film. This was noticeable in the areas of more exposure to weathering and would appear to be a deliberate attempt to provide colour to exposed timbers.

This dark red film was also noticed in cross section to Sample 16, from the south-east post, see Figure 23. The red film, seen clearest in direct light (left), lies under a brown pigmented varnish as one of the later coatings. Underneath these later films are the remains of fragmented earlier coatings similar to those seen in Sample 09, these may have been lost through damage or the restoration of the surfaces. It was noted that

these films also show an intended lacquered scheme. Evidence of earlier surviving schemes, although they also appear to be fragmented, can be seen in Sample 14 (see image in Section 6).

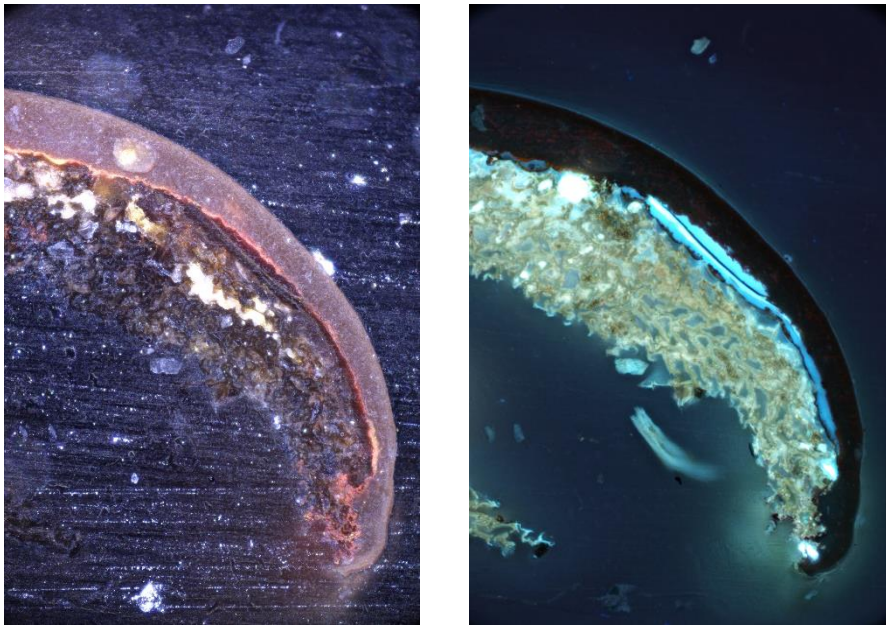


Figure 23: Sample 16ii, photomicrographs showing the paint films in direct (left) and UV (right) light taken at 200x magnification.

Samples 22, 28 and 29, all from the enrichment decorations on the north side of the doors, proved to be interesting and significantly different in their cross sections from those encountered on the rest of the structure (Figure 24). Samples 28 and 29 are similar, with the exception that Sample 28 shows broken additional earlier lacquered films, that are similar to those seen in Samples 06, 08 and 09.

Sample 29 (right) retains the timber substrate this has a different appearance and would be interesting to understand the material used for the decorative elements, which may help to understand why some areas have had different treatment in regard to coatings. It appears to be a well prepared surface for the earliest scheme to be applied to. The yellow/orange fluorescence seen here would suggest the use of a shellac coating (Webb, 2007, pp. 157-9).

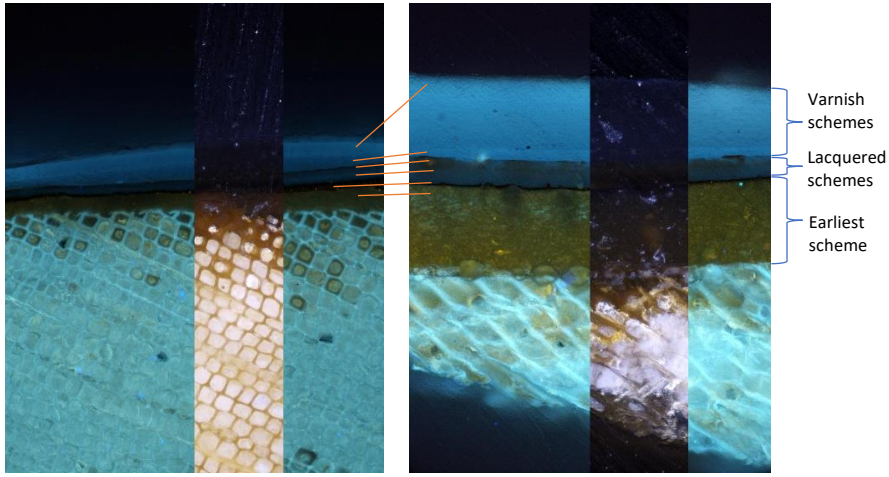


Figure 24: Sample 22 (left) and Sample 29 (right), photomicrographs showing the paint films in UV and direct (inset) light taken at 200x magnification.

The later varnish schemes are also similar with those seen in Sample 22 (left) showing different thicknesses of application than the three films seen in Samples 28 and 29.

To one of the detached smaller carved tail feathers from the internal north elevation, a number of cleaning tests were carried out to the surface to further understand the nature of the applied coatings. This was to determine if waxes, water-based varnishes, lacquer, shellac or modern varnishes were used. The softening of the coating with acetone indicated a modern synthetic coating such as polyurethane varnish; this was also noted from the cross sectional analysis. However, the other solutions

used had no discernible effect on the test sample; indicating these coatings are unlikely to be present to the tail feather. Further analysis is recommended as it would be useful to understand the nature of the varnish film more.

4.2.4.Conclusion

Following the analysis of the samples taken there is no evidence to suggest use of polychromy associated with the original Karamon Gate in Kyoto. This should be considered when planning any redecoration and/or conservation. However, it can be assumed that there have been alterations in the colour intention over the years.

From the sampling strategy carried out, it is understood that the areas currently given a lacquered appearance had always been intended to do so. The earliest evidence suggests that there was an intended Japanese lacquer technique employed, but that later interventions may have moved away from this technique in favour of other coating choices. The outward appearance of the structure was broadly similar, across the wood facets, but analysis shows that there have been a number of different mediums used. The upright posts have seen a red tinted film added to them, possibly in an attempt to restore some of the weathered colour to the wood. A number of areas have had brown pigmented varnishes applied over earlier schemes to retain the brown wood appearance.

The early image, Figure 3 in the archive section, appears to indicate that there is some variation in the appearance of the main structural (corner) bases than seen to the upper elements. Whilst it is a black and white image, and therefore not possible to determine colour (and may also have some association with the direct sunlight), there does seem to be some colour variation across the structure. The use of a lighter coating to the cloud carving is evident though analysis would suggest that this has now been painted in a brighter white than was first intended.

The original decorative scheme, for the majority of the structure, was likely to have been the brown lacquered appearance. Samples 04 and 08,

both show that at a later date it was felt that some of the chamfered edges, next to white facets, would also be decorated using white paint.

Evidence in Samples 05 and 06 show that the original 'highlighted' areas may not have been painted in a white paint, but a more muted buff/cream colour, whilst still retaining the design intention to differentiate features. Sample 13 has the most comprehensive paint archaeology (Figure 25), with the earliest scheme seen at the bottom of the photomicrograph and what appears to be a dirt film lying over it. This dirt film would have built up during the years between construction and the restoration work that was carried out in 1936. Dirt films are not so apparent, in the upper white paint layers likely associated with the introduction of the 1956 Clean Air Act. The reduced fluorescence in the bright white paint films would also indicate use of modern synthetic paints widely available after the Second World War.

It is here, within these white schemes, that we see paint films containing detritus or impurities, this could be due to a poorly prepared surface or elements getting into the paint film before it has fully cured. Such detritus may also suggest considerable period between redecorations. Consideration should be made to this when considering materials and processes.

The slight variation noted in the cross sections taken from the enrichment carvings within the gate to the north elevation would also suggest subtle variation in the use of wood finishes. However, it was also noted that some of the sections of carved enrichment may have been moved due to shadows left in the panel flat when examined at close quarters.

Whilst there is some evidence of a shellac based coating, in some samples, it is not seen to a significant number. This perhaps suggests that a significant amount of the original coatings have been lost, either through natural deterioration of the films through weathering and as part of the preparation of the surface for the renewal of the finishes by the Japanese craftsman in the earliest scheme of restoration. Cultural attitudes to restoration have changed since the early nineteenth century and the approach from the Japanese craftsman may also significantly differ to that which is employed today. Therefore, removal of underlying coatings may have been a traditional practice.

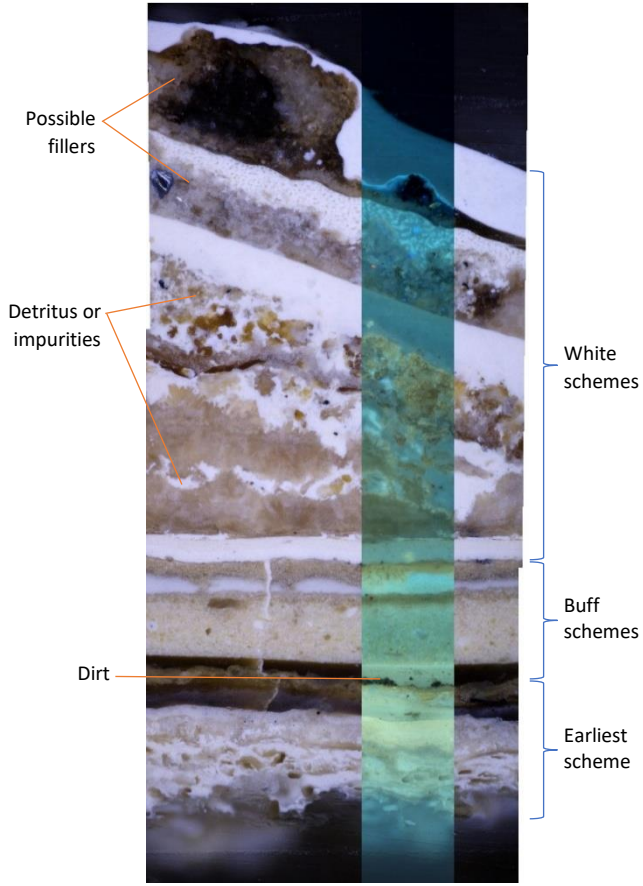
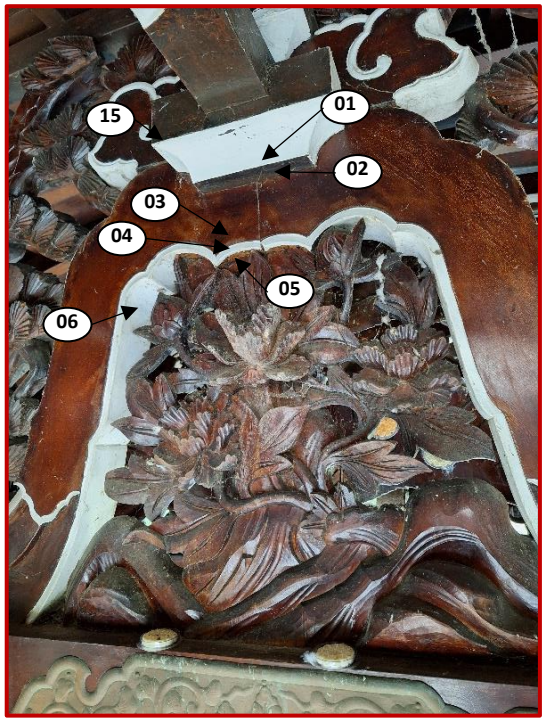
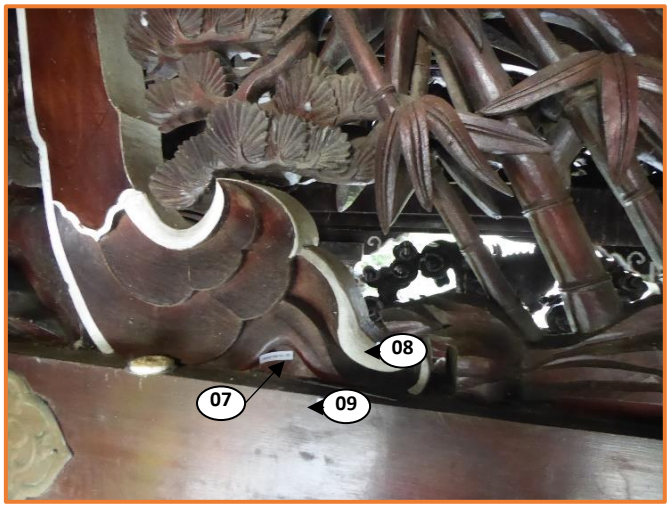


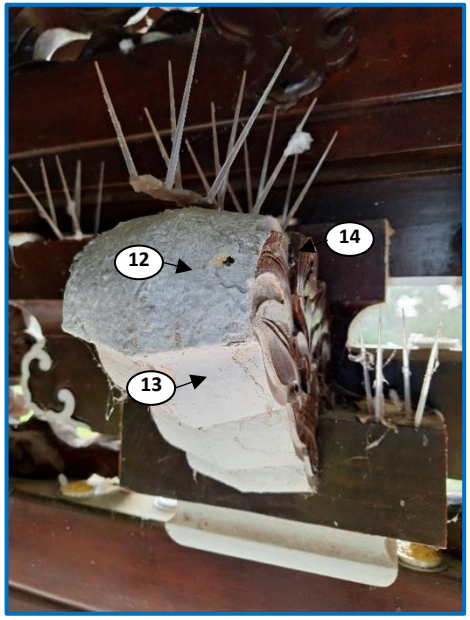
Figure 25: Sample 13, photomicrograph showing the paint films in direct and UV light (inset) light taken at 200x magnification.

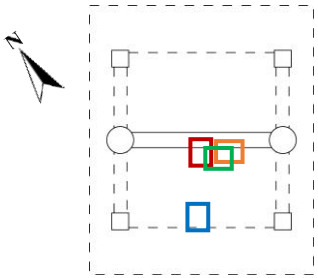
5. Sample Locations

5.1. South elevation, upper facets







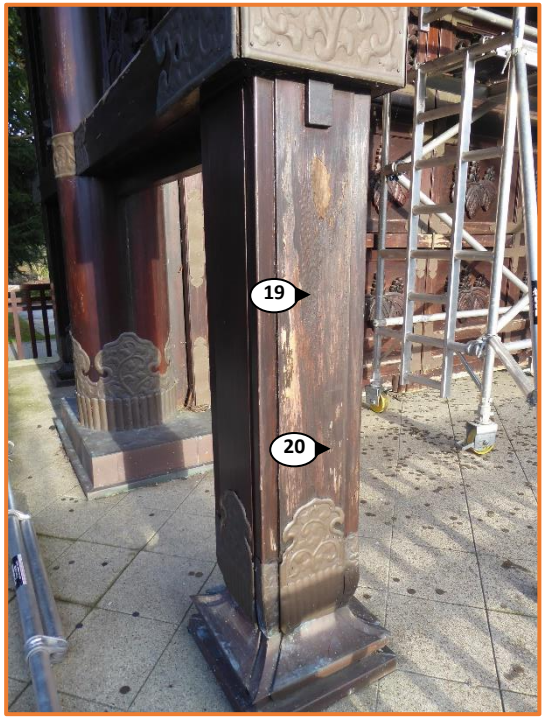


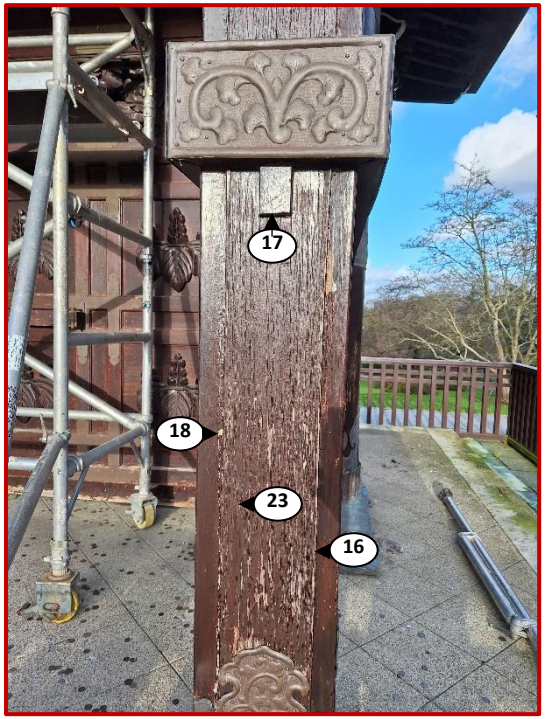
Sample locations:

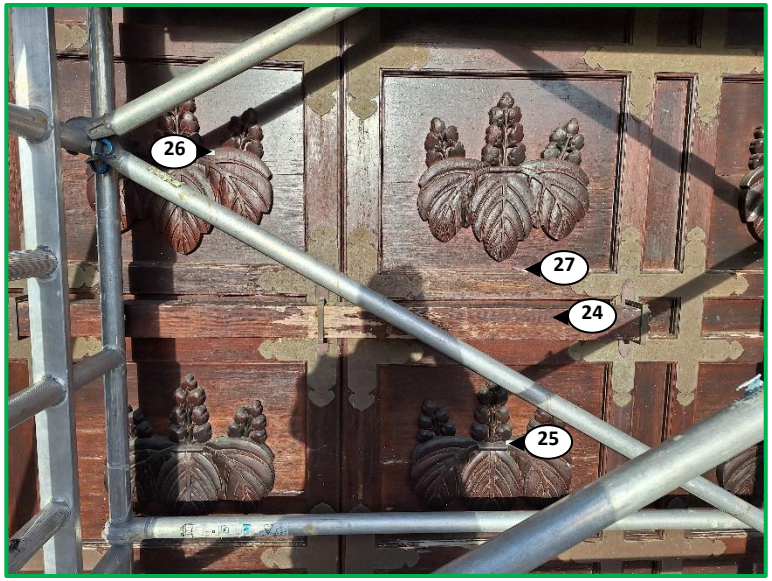
01 – South elevation, south side of central façade, base of ridge-piece, arris
02 – South elevation, south side of central façade, underside of ridge-piece, flat
03 – South elevation, south side of central façade, brace, left section, front, flat
04 – South elevation, south side of central façade, brace, left section, moulding, chamfered edge
05 – South elevation, south side of central façade, brace, left section, moulding, underside at top
06 – South elevation, south side of central façade, brace, left section, moulding, underside at side
07 – South elevation, south side of central façade, carved detail recess *
08 – South elevation, south side of central façade, carved motif, chamfered edge
09 – South elevation, south side of central façade, upper main horizontal beam, above gate
10 – South elevation, south side of central façade, top rail, above hinge plate, west
11 – South elevation, south side of central façade, top rail, above hinge plate, east
12 – South elevation, inner side of southern façade, central strut, top, arris
13 – South elevation, inner side of southern façade, central strut, under side, arris
14 – South elevation, inner side of southern façade, central strut, west side, carved decoration, top
15 – South elevation, south side of central façade, top of ridge-piece, corner

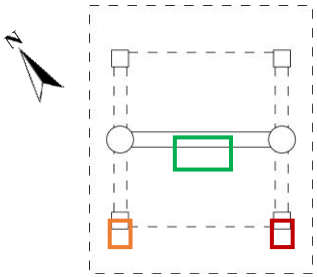
* Please note these items have been rejected for appraisal following assessment at our laboratory.

5.2. South elevation, lower facets







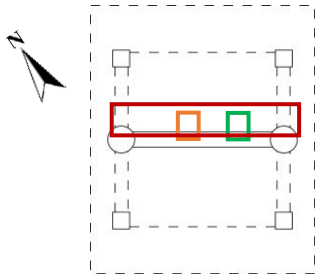


Sample locations:

16 – South elevation, south-east post, south side, right chamfer
17 – South elevation, south-east post, south side, underside of end of east rail
18 – South elevation, south-east post, south side, left chamfer
19 – South elevation, south-west post, south side, upper flat front
20 – South elevation, south-west post, south side, lower flat front
23 – South elevation, south-east post, south side, flat front
24 – South elevation, doorway, locking bar
25 – South elevation, doorway, right door, bottom left panel, wood enrichment, top of leaves
26 – South elevation, doorway, left door, top right panel, wood enrichment, top of leaves
27 – South elevation, doorway, right door, rail below top left panel

* Please note these items have been rejected for appraisal following assessment at our laboratory.

5.3. North elevation, lower facets



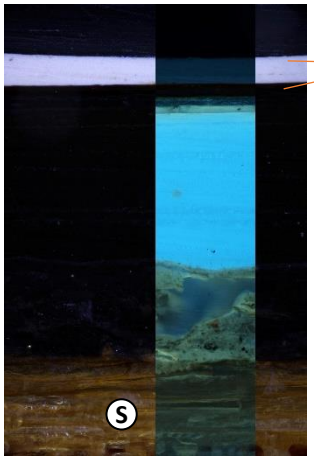
Sample locations:

21 – North elevation, doorway, right door, bottom left panel, flat
22 – North elevation, doorway, right door, bottom left panel, wood enrichment, top of mane
28 – North elevation, doorway, left door, upper central panel, wood enrichment, top of leaves
29 – North elevation, doorway, left door, upper central panel, wood enrichment, top of leaves

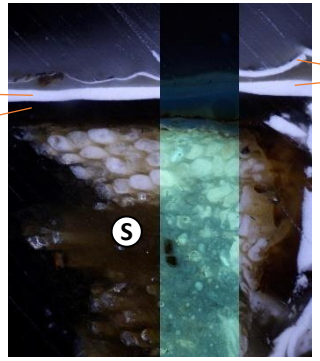
* Please note these items have been rejected for appraisal following assessment at our laboratory.

6. Photomicrographs

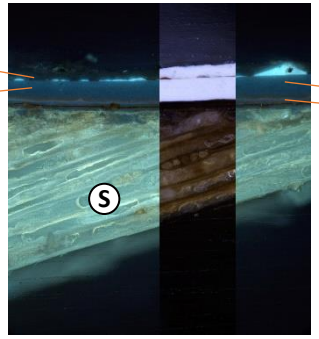
6.1.1. White facets



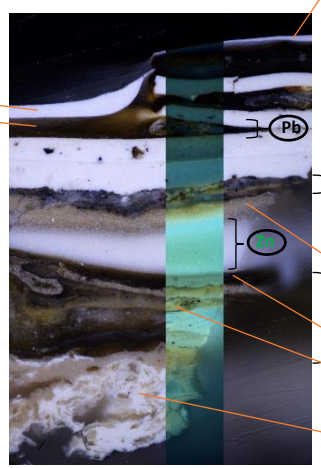
Sample 01 (200x mag) *– South elevation, south side of central façade, base of ridge-piece, arris, timber substrate.*



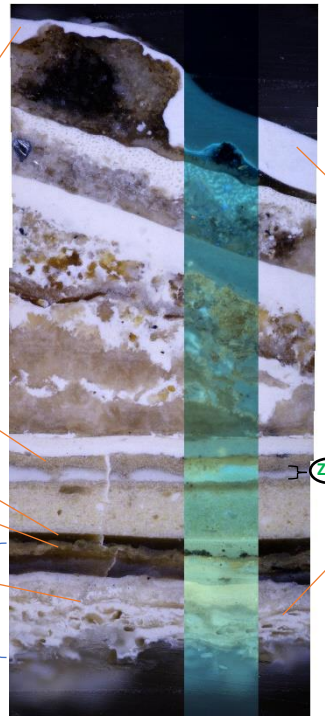
Sample 04 (200x mag) *– South elevation, south side of central façade, base of ridge-piece, arris, timber substrate.*



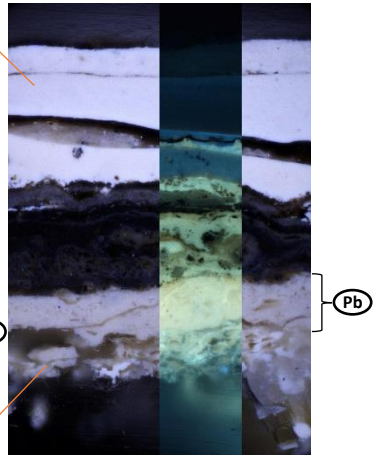
Sample 08 (200x mag) – South elevation, south side of central façade, carved motif, chamfered edge, *timber substrate (main image is UV light, insert is in direct light).*



Sample 06i (200x mag) *– South elevation, south side of central façade, brace, left section, moulding, underside at side, timber substrate (not shown).*



Sample 13 (200x mag) *– South elevation, inner side of southern façade, central strut, under side, arris, timber substrate (not shown).*



Sample 12 (200x mag) *– South elevation, inner side of southern façade, central strut, top, arris, timber substrate (not shown).*

Initial observations:

- *Evidence of lacquer prior to white paint films in Samples 01, 04 & 08, suggesting white may not have been original intention.*
- *Sample 06i shows there were a series of buff schemes, with the final one having a white zinc-based oil undercoat.*
- *Final colour scheme seen to the sampled facets has been applied in white paint films, where previously may have been different.*
- *When Samples 06 and 12 were tested, a reaction was seen in a number of films, indicating the presence of lead-based paint or pigments.*
- *Sample 13 compares to 06i to some extent showing facets likely to be intentionally treated in the same manner. But 13 has also had more interventions – possibly filler. Initial scheme here would appear to have a dirt film over so we might take this as scheme 01*

Key

(1) Number of scheme(s)

Links decorative scheme

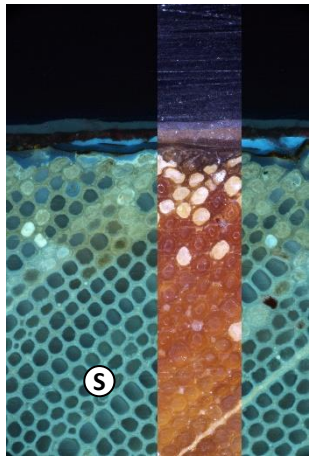
(Pb) Lead-based oil paint scheme(s)

(Zn) Zinc-based oil paint scheme(s)

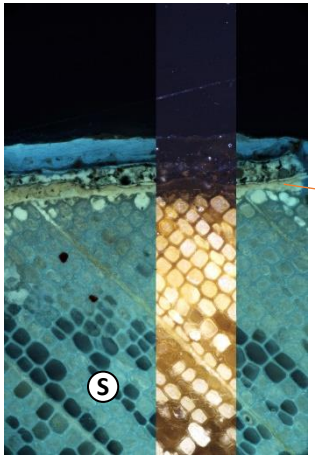
(S) Substrate

All images above are shown with UV inserted image.

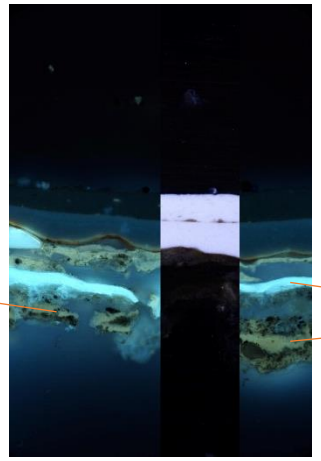
6.1.2. Lacquered facets



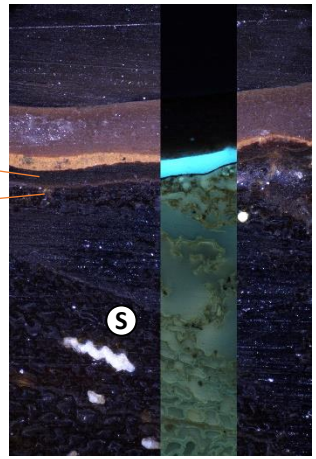
Sample 09 (200x mag) – *South elevation, south side of central façade, upper main horizontal beam, above gate, timber substrate.*



Sample 11 (100x mag) – *South elevation, south side of central façade, top rail, above hinge plate, east, timber substrate.*



Sample 14 (100x mag) – *South elevation, inner side of southern façade, central strut, west side, carved decoration, top, timber substrate (not shown).*



Sample 16 (200x mag) – *South elevation, south-east post, south side, right chamfer, timber substrate.*

Initial observations:

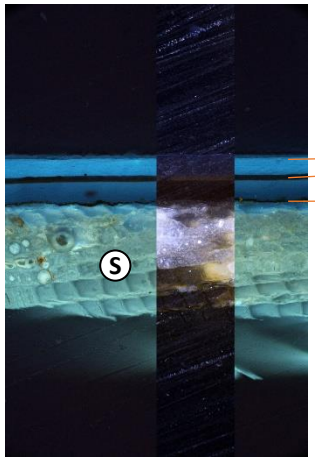
- *Early schemes seen at the base of Samples 11, 14 and 16, although in 14 they are broken.*
- *Sample 11 shows a secondary coating which contains debris which could mean that it wasn't a very well prepared layer, or that it did not fully cure.*

Key

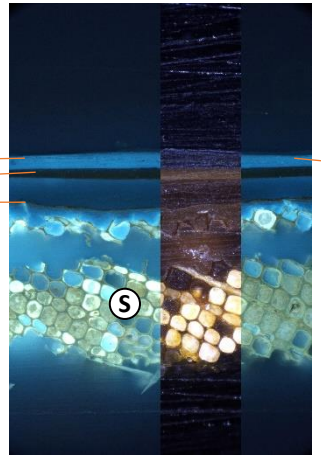
- (1) Number of scheme(s)
- Links decorative scheme
- (Pb) Lead-based oil paint scheme(s)
- (Zn) Zinc-based oil paint scheme(s)
- (S) Substrate

Images above are shown with direct light inserted image over UV, except S16 which has a UV inserted image over direct light.

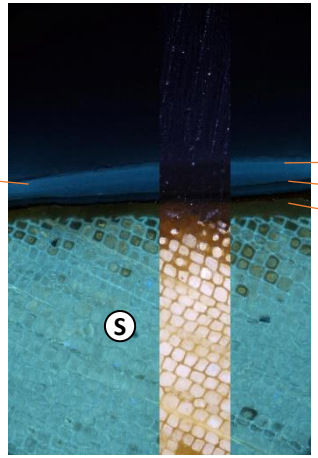
6.1.3. Enrichment door carvings



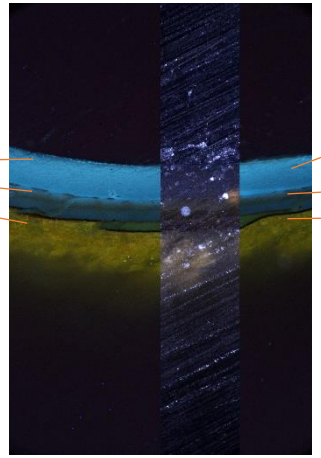
Sample 25 (200x mag) *– South elevation, doorway, right door, bottom left panel, wood enrichment, top of leaves, timber substrate.*



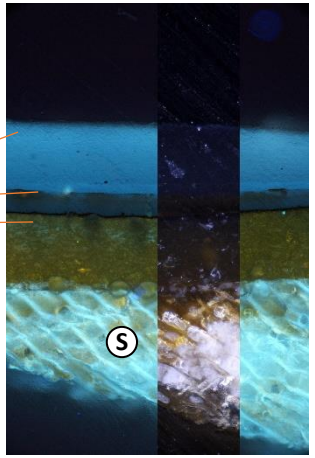
Sample 26 (200x mag) *– South elevation, doorway, left door, top right panel, wood enrichment, top of leaves, timber substrate.*



Sample 22 (200x mag) *– North elevation, doorway, right door, bottom left panel, wood enrichment, top of mane, timber substrate.*



Sample 28 (200x mag) *– North elevation, doorway, left door, upper central panel, wood enrichment, top of leaves, timber substrate (not included).*



Sample 29 (200x mag) *– North elevation, doorway, left door, upper central panel, wood enrichment, top of leaves, timber substrate.*

Initial observations:

- *The substrate for the enrichment carvings seems to be different for Sample 22, which appears to have a visibly smaller grain than the others.*
- *There is comparability between how the carvings on the south side of the door, Samples 25 & 26, have been treated. This also applies to those found on the north side of the door, Samples 22, 28 & 29.*
- *The carvings on the north side of the door have an earlier possible shellac coating, which is absent in the carvings on the south side.*
- *In the secondary scheme of Sample 28, there have been earlier losses, this could be due to knocks or the preparation of surfaces.*
- *The most recent film looks to be a polyurethane varnish and is present on the samples from both sides.*

Key

(1) Number of scheme(s)

Links decorative scheme

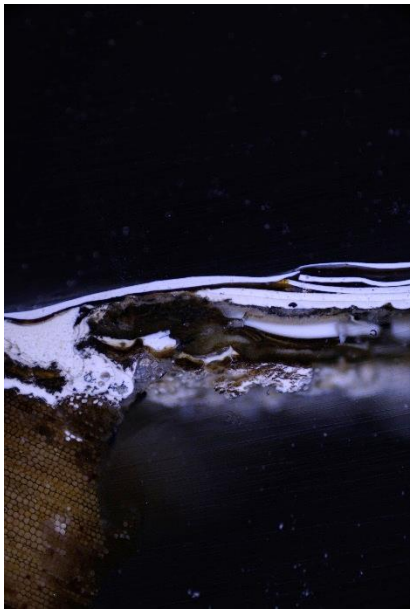
(Pb) Lead-based oil paint scheme(s)

(Zn) Zinc-based oil paint scheme(s)

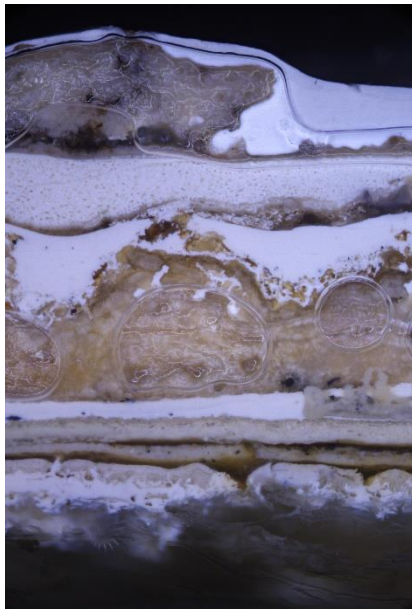
(S) Substrate

All images above are shown with direct light inserted image.

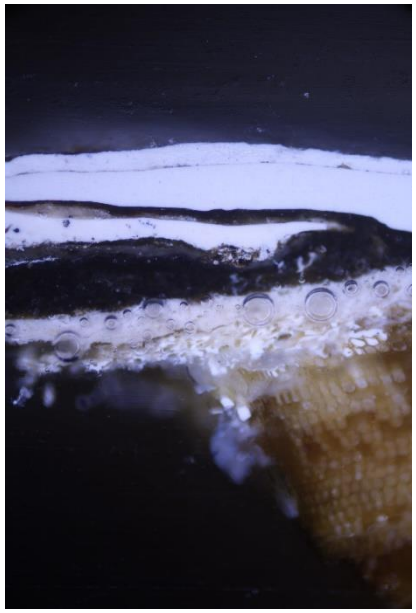
6.1.4.Microchemical stain tests:



Sample 06 – South elevation, south side of central façade, brace, left section, moulding, underside at side*: following test for the presence of lead (positive). Earlier buff schemes have turned black following solution of dilute sodium sulphide.*



Sample 13 – South elevation, inner side of southern façade, central strut, under side, arris*: following test for solubility (positive). Earliest scheme and buff schemes have reacted positively, along with the white paint films showing signs of softening and movement.*



Sample 12 – South elevation, inner side of southern façade, central strut, top, arris*: following test with a mild acid (HCl), evidence of carbonation and bleaching shows the likely presence of French Ultramarine pigmentation in the earlier paint film.*

7. Recommendations

7.1. Appropriate Redecoration Strategy

A number of areas contained failing paint films and all areas of flaking paint should be removed prior to redecoration. Whilst every effort should be made to retain paint archaeology, suitable preparation is required to ensure appropriate bonding of the paint films, especially given the elevated nature of some of the facets and any future access limitations.

The structure has had a possible polyurethane varnish applied over the previous paint coatings, which is now failing and flaking, this is more evident on the south elevation. Further analysis of this varnish film should be considered with regard to a methodology for redecoration to ensure that the removal of this top coating won't affect the coatings underneath.

If it is possible to retain some paint archaeology prior to redecoration, following removal of failing paint films, this ensures physical evidence is retained should any existing research be lost.

It would be beneficial for the location of retained schemes to be marked onto drawings to ensure these areas can be identified in future should any further research or analysis be required.

Uncovering and colour matching would be recommended to ascertain the original colour intended for the white facets. Was it a buff/cream, or perhaps a lighter shade as seen in Sample 12, with the blue pigmented paint film. However, there has been some losses in the area accessed and so a targeted strategy should be adopted.

It is suggested that Sample 28 and/or 29 is subject to advance analysis, this would help to identify the top varnish and the earliest scheme, that could be shellac.

7.2. Health & Safety

The proportion of the white paint films were found to contain lead which is toxic. Where paint removal is to be undertaken, methods should ensure safe working practice. Therefore, dry removal should be avoided to prevent the creation of air-borne, lead-containing dust, unless suitable extraction with a HEPA filter can be in place. The use of a heat gun should also not be used without the operative wearing suitable PPE and appropriate Hot Works permits in place. Any waste material from the use of paint strippers should be disposed of according to lead contaminated waste regulations.

Positive identification of paints with a high lead content: Where original architectural features are still extant, early paint films were identified as lead oil paints and tested strongly positive for lead. Most of these are encapsulated by later, non-lead paint films though there is localised failing. Those working in close proximity to these facets need to follow guidelines for working with lead contaminated waste and wear suitable PPE at all times.

7.3. Colour Tests Prior to Redecoration

If the recommendations for uncovering and colour matching are followed, it is strongly advised to undertake trial panels viewed in-situ prior to the final specification for colour where there is an interest in recreating the design intention of the original architect.

Any intention to recreate an earlier colour palette should take into consideration the changes in any surrounding buildings or landscape and associated patina since construction. Therefore exposed "original" colours may need to be adjusted accordingly.

8. Glossary of Terms

Cross-section: a sample, mounted in clear resin, polished to exposure all the paint films for microscopic examination.

Decorative scheme: an intended finished appearance of a space.

Dirt layer: a layer of dust or debris sandwiched between decorative schemes. Often seen in exterior paint samples where paint films were applied before the Clean Air Act (1956) and surfaces were not heavily prepared before the application of the new paint film. Dirt films can also be seen in samples from areas of heavy carbon deposits such as interiors where open fires, gas lighting etc. were employed. Dirt films can be indicative of long periods of time between schemes of decoration.

Oil Paint: Dry, finely-ground pigment which is made into a paste with an oil, such as linseed, poppy or walnut. The paste may then be diluted with more oil and/or a spirit such as turpentine or white spirit.

Lead oil paints: Lead paint is a traditional paint type, with a basic composition of oil (usually linseed, oil type varies according to paint use), lead white paste or pigment, and other pigmentation. The translucency of white lead oil paint increases with age by virtue of saponification of basic lead white with oil, forming lead linoleates. This represents a graceful alteration of the paint, leading to a more yellowed tone with time.

Gilding: an application of gold or metallic leaf applied to a surface as part of a decorative scheme. Oil or water gilding can be used, and exterior oil gilding can include double gilding for a more durable finish.

Paint sample: the physical sample of paint. The sample should include all paint films and a small section of substrate where possible.

Paint film: a single application of paint, a number of paint layers make up a decorative scheme.

Paint scheme: a combination of a number of paint layers to form the intended scheme of decoration e.g. primer, undercoat and topcoats.

Photomicrograph: an image of a cross-section taken through the microscope.

Primer: a preparatory film applied beneath an undercoat, can be applied as a continual film or as a spot primer where the underlying or existing coatings need additional preparation prior to the application of a new scheme of decoration.

Synthetic resin, oleo-resinous: Alkyd resins were developed in the 20th century and are based on a synthetic resin. They quickly replaced oil paints, gaining great popularity after WWII, and provided a high gloss paint which was easier to work than traditional oil. They were available as gloss or matt, the gloss and eggshell having a particularly 'plastic' appearance.

Substrate: the underlying material upon which the paint film has been applied.

Topcoat: One or more applications of the final paint colour of a scheme. A topcoat can be used to pick out an architectural facet or have a number of paint layers to make up a polychrome or stencilled scheme.

Undercoat: a preparatory paint film(s) applied to a surface prior to the application of a topcoat or varnish film. An undercoat can be built up in several layers.

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10.Official List Entry

ROYAL BOTANIC GARDENS KEW Japanese Gateway Chokushi-Mon or Gate of the Imperial Messenger

(Formerly listed as Japanese Gateway Chokushi Man on Gate of the Imperial Messenger, previously listed as Japanese Gateway Chokushi Man on Gate of the Imperial Messenger, ROYAL BOTANIC GARDENS) 10.01.50

A replica of the famous gateway in Japan. It was made for an exhibition in London in 1910, and presented to the Gardens. Six piers in rectangular formation, with gates hung within centre pair. Timber, with traditional copper roof (which replaced the original made of cedar bark as part of the 1995 restoration works), gabled on all four sides. Rich carving within gables, and to screens and corbels below.

Listing NGR: TQ1834576142

(Historic England, n.d.)

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Head Office
Laughton, Sleaford,
Lincolnshire NG340HE

Tel: 01529 497449
hirst@hirst-conservation.com
www.hirst-conservation.com