

*Abstract*

It has long been the practice in Hong Kong that historical buildings are “preserved” through restoring the original layout and form of the buildings, yet paying lesser attention to preserving or reviving the original materials and techniques that were deployed at the time of construction. This paper will discuss how the participation of conservators has changed the mind-set and concept of the curators and architects in the preservation of a historical building, as illustrated by the conversion of the Kom Tong Hall, a private residence built in 1914, to the Dr Sun Yat-Sen Museum in memory of the Chinese statesman. With resort to scientific studies and instrumental analyses, the original finishes on the metal balustrades and on the plaster moulding in the main hall were unveiled and the properties of traditional glazing putty were reconsidered. This information has helped to make the retention of the building’s historic features and details achievable.

*Résumé*

Pendant longtemps, à Hong Kong, on a préservé les édifices historiques en restaurant la forme et le revêtement originaux des constructions, mais en ne prêtant que peu d’attention à la conservation ou la mise en valeur des matériaux d’origines et des techniques en usage lors de la construction. L’article discutera comment la participation des restaurateurs a changé la façon de penser et la conception des conservateurs et des architectes quant à la préservation des édifices historiques, ainsi que l’illustre la conversion du Kom Tong Hall, résidence privée construite en 1914, en Musée du Dr Sun Yat-Sen, à la mémoire de l’homme d’Etat chinois. Grâce à des études et des analyses scientifiques, les finitions originales des balustrades en métal et des moulures en plâtre dans le hall principal ont été révélées et les propriétés du mastic du vitrage traditionnel ont été revues. Cette information a rendu possible le maintien des caractéristiques et des détails historiques des édifices.

*Synopsis*

Las prácticas de “preservación” de edificios históricos mediante la restauración de la estructura y la forma

## Bringing back the grandeur: conversion of Kom Tong Hall to Dr Sun Yat-Sen Museum

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*Keywords*

historic building, stained glass, glazing putty, gold-gilding, lead comes, lime, tung oil, scanning electron microscope, traditional

**Introduction**

Kom Tong Hall is a four-storey Edwardian style classical building and is amongst the very few century-old mansion structures surviving in Hong Kong. It was originally a private residence of Ho Kom-tong, a Chinese comprador. It was later sold to the Church of Jesus Christ of Latter-day Saints and used as a religious centre since 1960. When the Hong Kong Special Administrative Region Government acquired the building in 2004, with the plan to convert it into a museum in memory of the great Chinese statesman Dr Sun Yat-Sen, it was found that the building had been refurbished a number of times. Some of the alterations and additions over the years had been completed to meet the previous needs of a residence or a religious centre. Moreover, the restoration project had to be completed within 14 months so that the museum could be opened within 2006 to commemorate the 140th birthday of Dr Sun Yat-Sen. It was indeed a great challenge for the conservators to convert the historical building into a modern museum, while retaining the uniqueness of the building features under a tight time frame (Figure 1).

Before drawing up and implementing the conversion plan, several interviews had been conducted with the previous owners regarding the past history, ornamental design, colour scheme and construction method of the building. With reference to the old architectural plans and the information collected from various sources, it was decided that the building should be returned to its original 1914 appearance in terms of the layout and settings by removing the later additions and alterations of less historic significance. The restoration programme thus included façade cleaning, window restoration, structure consolidation, defects repair, restoration of distinct elements, addition of building services required of a public museum, etc. Amongst the others, the restoration of the distinctive gilded surfaces and stained glass windows is discussed in detail below.

**Gold or not?**

The metal balustrades are of régence style decorated mainly with a tracery of plant scrolls. They are generally found along the verandas on the first and second floors of Kom Tong Hall. All of them had been painted in black when the building was taken over by the Government, but according to the interview with the descendants of Ho’s family, the floral decorations on the balustrades should assume a brilliant gold colour at the time when the building was built and the old black-and-white photographic records also revealed a different colour tone on the balustrades. After some negotiations

original de estos edificios ocurren desde hace muchos años en Hong Kong. Sin embargo, sus metodologías prestan poca atención a preservar o recuperar los materiales y técnicas originales que se utilizaron en las construcciones iniciales. Este artículo describe la manera en que la intervención de los conservadores ha cambiado la actitud y los conceptos usados por restauradores y arquitectos en la preservación de edificios históricos. Un ejemplo de ello es la restauración del Kom Tong Hall, una residencia privada construida en 1914 para albergar el Museo Dr. Sun Yat-Sen, en memoria del estadista chino del mismo nombre. Iniciando programas de investigación científica con análisis instrumental se descubrieron los acabados originales de las balaustradas metálicas, los métodos de confección de las molduras de yeso en la entrada principal y nuevos conocimientos de las propiedades de la masilla vidriada tradicional. Esta información ha ayudado a la conservación de las características originales y detalles históricos del edificio.

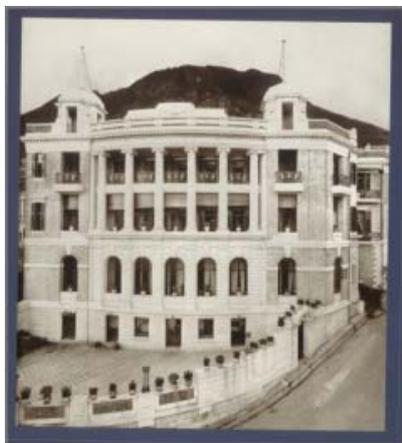


Figure 1. Original appearance of Kom Tong Hall upon its completion in 1914. (Courtesy of Mr Andrew Tse)



Figure 2. Cross section of paint stratigraphy from the balustrade under visible light (left) and ultra-violet fluorescence (right)

with various stakeholders, the curator decided to restore the bright yellow appearance of the floral decorations on the balustrades. In the first instance, the architect tended to achieve the purpose with the use of a golden paint which was a lot more simple and convenient in application, yet meeting with the objective to restore the original form and appearance of Kom Tong Hall.

As one of the collaborators in the preservation project, the conservators had questions on the nature of the original materials which gave a brilliant yellow colour as described by the descendants of the Ho's family. Was it simply a golden paint, rather than gold gilding?<sup>1</sup> Bearing in mind the general principles that the aim of conservation is to preserve the authenticity of all the elements of the entire heritage site and to retain for the future its historic information and all its value (Agnew and Demas 2002), the conservators reckoned that repainting the floral decorations in gold colour should not be adopted without fully knowing what the original materials and techniques were, even though the gold paint might generate the desired effects in surface appearance and lustre given today's paint technology in terms of the imitation of colour tones, shininess and texture.

In fact, gold-gilding is a total different kind of decoration technique which has been accorded a higher degree of merits because of the following reasons:

- Gold-gilding is a traditional technique dated back to 2300 BC in ancient Egypt (The history 2007). This is the technique still in use today, in which the gold leaf is laid on the top of the surface of a substrate with an adhesive.
- The lustre due to the good reflectance of gold, especially after burnishing in leaf gilding is far much richer and brighter than ordinary painting.
- The lustre and colour rendered by gilding could last for years, but the golden paint may only last for months due to the oxidation of copper particles in the paint emulsion, which in turn leads to a discolouration in the imitation bonze paint.

The key to making a sensible and informed decision on the material selection for the surface finishes is therefore to identify the original materials and techniques used on the metal balustrades. To this end, extensive technical analyses by X-ray fluorescence spectrometer and scanning electron microscope on the old paint remaining on the metal surfaces were carried out, (Figure 2) yet the on-site search for gold element using the former<sup>2</sup> was negative.

#### *Scanning electron microscopy*

To complement the research, the surface paint samples, both scrapings and cross-sections collected from the balustrades were analysed in greater detail with a FEI Quanta 200 scanning electron microscope, equipped with an energy dispersive X-ray spectrometer<sup>3</sup> (SEM/EDS). Thirty samples from various parts of 14 metal balustrades on both the first and second floors were examined at 10–15 kV, at high vacuum with a back scatter detector. The samples were not sputter coated as there was no charging observed on the paint layer of the cross-sections by using high scanning rate and not very high voltage. Traces of gold element were found on five of the samples belonging to the surfaces of the floral decorations and the letter carving 'H' on the metal balustrades. These results clearly indicated that the surfaces of these decorative features were originally gilded gold (Figure 3a and b).

Similarly, technical analyses employing SEM/EDS were performed on the paint samples gathered from the plaster mouldings of the main hall. Contrary to the black paint finish on the metal balustrades, the motif patterns on the plaster mouldings in the main hall were still furnished in golden colour when the building was handed over to the Government. The areas of golden colour were in agreement with the images shown in the Ho's old family photographs. Therefore, 20 samples, both scrapings and cross-sections were taken from these areas for analysis in order to determine whether the motif patterns were gold gilded or just painted in golden colour (test condition being the same as that for samples collected from the balustrades). The result

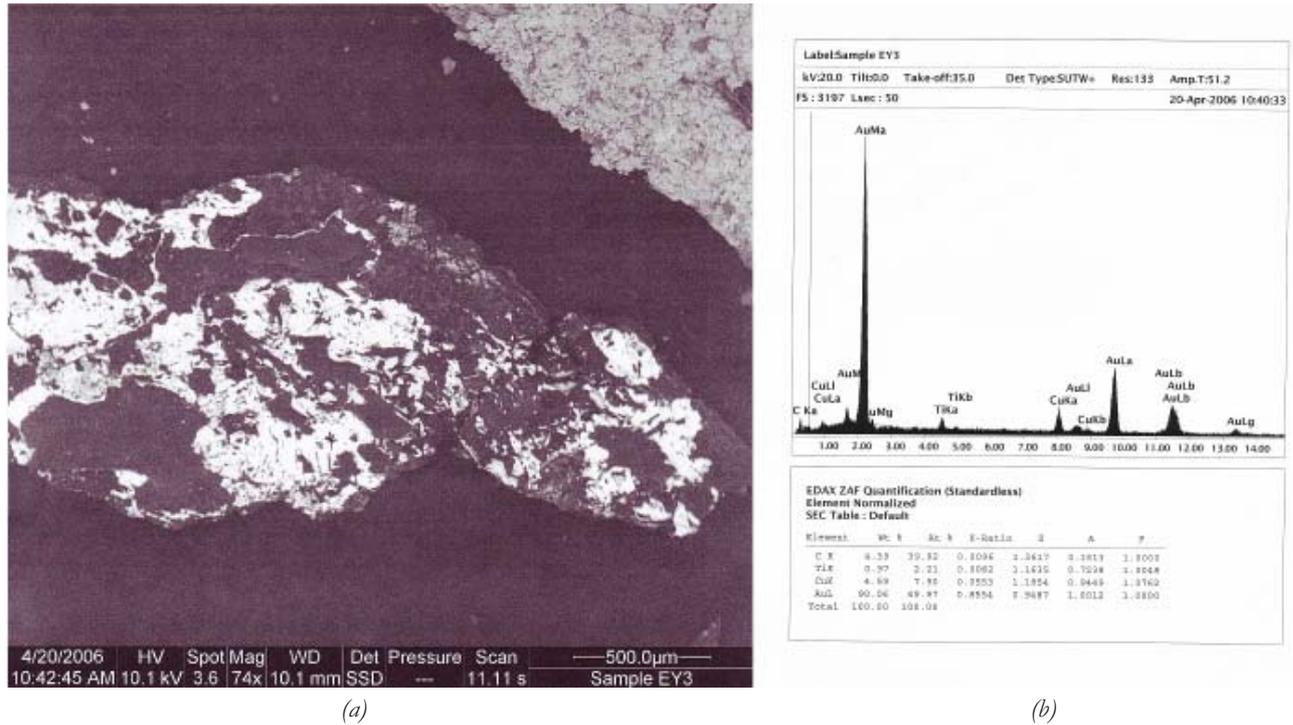


Figure 3a&b. SEM/EDS result for paint sample from plant decoration on a balustrade at Kom Tong Hall

revealed that there was an abundant quantity of gold gilt in all the samples collected from the mouldings at the ceiling or colonnades (Figures 4a and b, 5). It was evident that plaster was used as the ground substrate under the gilded surface and the workers had not removed the old gold gilt finishes before applying the new paint during previous renovations in order to avoid damaging the plaster mouldings.

The evidence derived from the above technical and analytical studies leaves no doubt as to the fact that gold gilding was applied originally to generate the glittering appearance of the building. These findings had in effect rendered changes to the original restoration plan, and both the architect and the curator

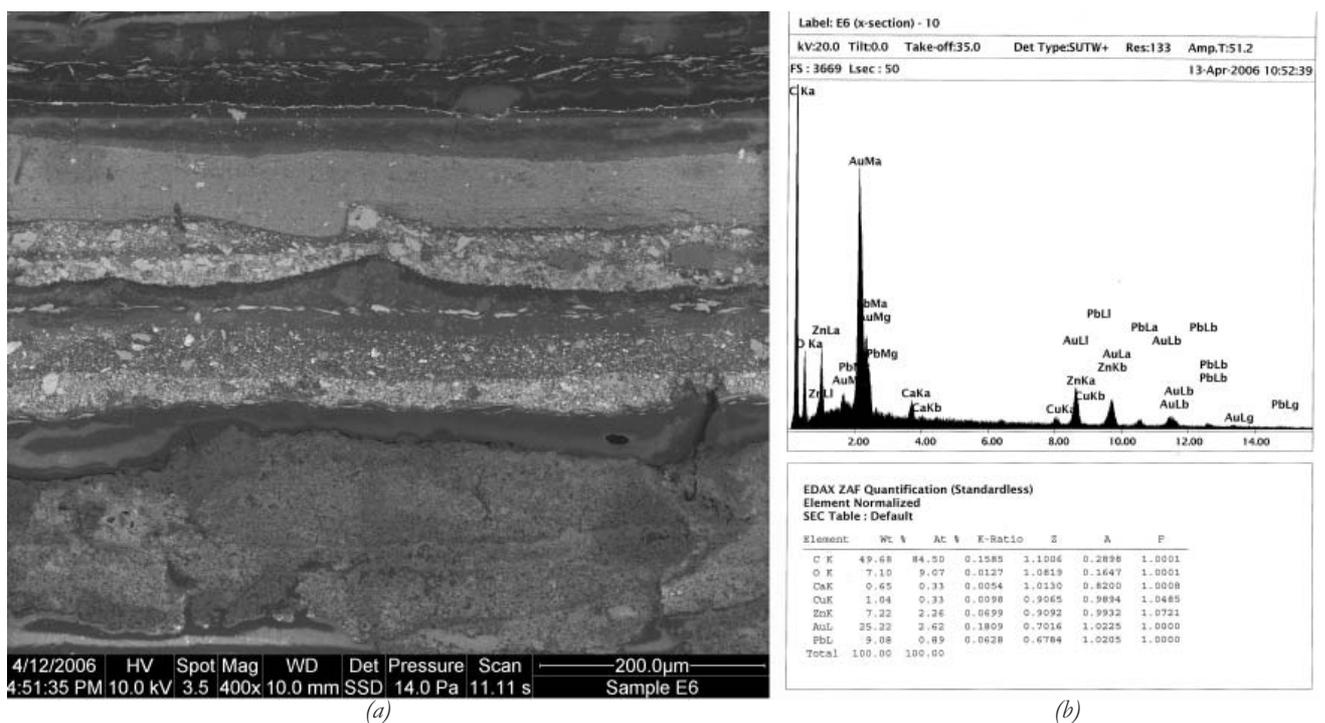


Figure 4a&b. SEM/EDS result for sample from moulding at the ceiling of the main hall at Kom Tong Hall

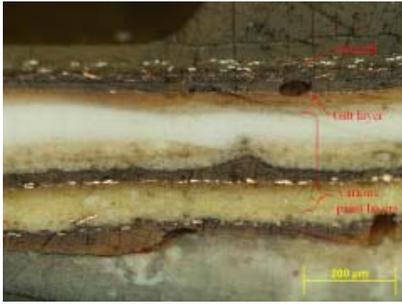


Figure 5. Cross section examination under Leica MZ6 reflective microscope (see the scale on figure for the magnification) for sample from moulding at the ceiling of the main hall at Kom Tong Hall

therefore agreed to re-gild the concerned areas in light of the guiding principle not to alter the historic condition of the built heritage. As a result, the original surface was reconstructed.

**Repair or replace?**

There are a total of 18 stained glass windows in Kom Tong Hall. After a span of some ninety years, a good number of the composite glasses were cracked with losses in some areas, the steel framework had generally corroded, and some of the lead came were damaged or deformed causing planar distortion to the window. Except for the four missing windows which had to be replaced with new replications, Figure 6a–d showed the extent of damages found in the rest of the 14 stained glass windows.

Analysis of the lead comes was carried out using Inductively Coupled Argon Plasma Spectrometer and the percentage composition of the major alloying components was determined (Table 1).

Table 1. Percent of major alloy components in the lead came

Element	Sample
Lead (Pb)	97.74%
Silver (Ag)	<0.005%
Copper (Cu)	0.016%

The current ASTM standard indicates that the amount of silver and copper present in the lead comes should be up to 0.02% w/w and at least 0.04% w/w respectively for the comes to have an expected lifetime of more than one hundred years (Talland and Mangum 1999). The findings showed that both the silver and copper contents in the original lead comes were far below the

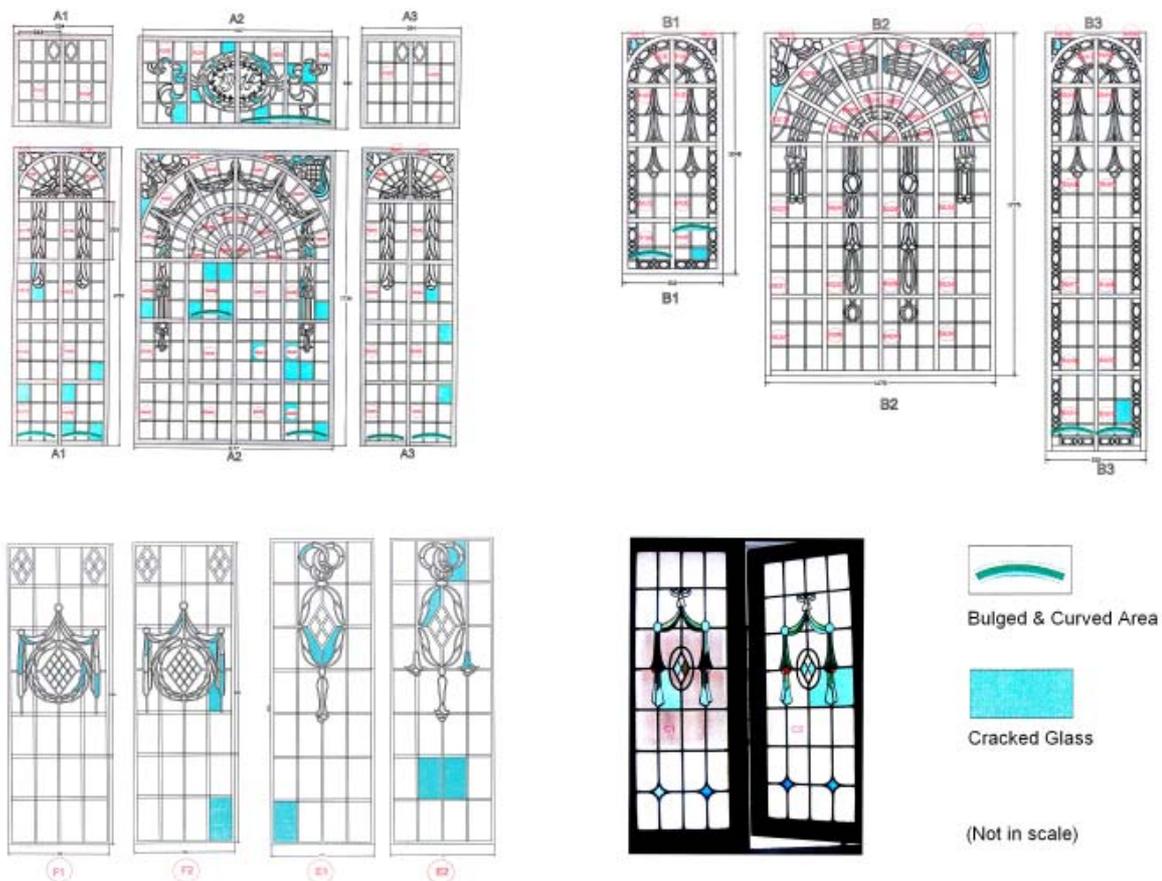


Figure 6a–d. Result of the condition survey on the stained glass windows in Kom Tong Hall conducted in August 2006

recommended levels, which would not be conducive to the strength and rigidity of the comes.

Given the inferior quality of the lead comes and the unsatisfactory condition of the glasses, the architect preferred to replace the windows with replicated ones for the sake of work convenience and public safety as, besides the aesthetic reason, the replacement windows should be strong enough to stand the wind and rain attacks. Nonetheless, the conservators did not agree with the idea of total replacement unless the glasses were missing or substantially damaged. In consideration that the stained glasses and the old lead comes were the original elements of the building and that the corrosion was merely localised on the surface of the comes as revealed by the examination of their cross-sections, the conservators were of the view that the original stained glass windows should be preserved as far as possible. The replacement windows made of new lead comes and modern glasses would not attain the same aesthetic quality as the works of an earlier century and the extra replacement would result in the loss of substantive evidence concerning the construction and fabrication technique of historic stained glass windows. In response to the concerns of the architect and the curator that consolidated or restored stained glass windows might not be strong enough to meet their functional role, it was agreed that the consolidation and repair work for the damaged stained glasses and lead comes would be performed by the conservators instead of the renovation contractors, but those seriously cracked glasses with considerable missing parts would be replaced by new replications.<sup>4</sup>

Literature (Davison 1998, Li et al. 2003, Li and Ghebreyesus 2006, Augerson and Messinger 1993, Messinger and Lansbury 1989) and market surveys were therefore conducted in order to identify a suitable and available adhesive for affixing the broken glass. The adhesive LocTite® 3051™ (acrylic acid mixed with polyurethane methacrylate resin) was found to be most suitable for the following reasons (LocTite® 2004):

- It has a refractive index of 1.5103 which is very close to that of glass.
- It has a good bond strength.
- It is fast curing (within 30 seconds by Hg Arc curing system) and was particularly suitable for this pressing project.

The windows were then taken down in sequence for treatment in the conservation laboratory and the broken comes were rejoined by soldering.

### **Traditional glazing putty versus modern silicon sealant**

A glazing putty<sup>5</sup> which comprised of lime and tung oil extracted from resins of the tung tree (*vernicia fordii*) was originally employed for affixing the stained glass panels to the metal frame. Though the putty was a traditional building material widely used in China and has been used for glass installation for a long time, its performance and properties have not been tested scientifically. Having doubts about the strength and permanence of the glazing putty, the architect preferred the use of silicone sealant for affixing the stained glass panels to the frames, as the technical information on the latter was available.

There was again a discussion on whether the traditional or modern materials and methods should be employed for repairing the stained glass windows. The conservators were inclined to use the traditional materials in the restoration work in order to retain the historic integrity of the building but considered the modern materials as a substitute (Park 1988) if warranted under the circumstances described below:

#### *Unavailability of Original Materials*

The original glazing putty is a natural mixture of lime and tung oil and was produced by the following process traditionally:

*The oyster shells collected from the seashore and rich in calcium carbonate were put into the kiln in layers and interleaved with coal cakes in between as fuel. The quicklime*

*(calcium oxide) produced as a result of calcinations was then 'slaked' by adding water to generate the hydrated form of calcium hydroxide. Once slaked, the putty was often left to age for a period of time and in effect, nanostructural colloids developed. Finally, the colloidal putty was thoroughly mixed with tung oil to produce the waterproof putty for gap-filling or window sealing application. Other than oyster shells, lime could be manufactured by heating limestone, coral or chalk which are mainly calcium carbonate (Sung 1637).*

While the earliest record of tung oil was found in the writings of Confucius dated to 400 BC and the technique of making lime from oyster shells or limestone was developed in the 17th century (Sung 1637), the materials are still commonly used in the construction industry in China nowadays. Therefore, there is no difficulty in acquiring the glazing putty produced in the traditional manner from the supplier for the window restoration work.

#### *Unavailability of the Necessary Craftsmanship*

Given that glazing putty is still commonly used in the construction industry nowadays, skilled workers are available for a range of its application work.

#### *Poor Quality of the Original Materials*

Glazing putty has been a reliable material and there has not been any reported failure due to its quality or inferiority throughout its long history of use. Besides, it is naturally compatible with other window construction materials used at the Kom Tong Hall and will not cause staining or galvanic corrosion to the metallic window frame or lead came.

#### *Violation of Codes*

The use of glazing putty for affixing stained glass windows in this case does not violate any building or safety codes, viz. Chapter 123B Building (Construction) Regulations, the laws of Hong Kong, and the Practice Note for Authorised Person and Registered Structural Engineers (PNAP) 172 – Energy Efficiency of Buildings – Building (Energy Efficiency) Regulation.

Though the widely available silicone sealant preferred by the architect would perform better than tung oil/lime glazing putty in terms of mechanical strength, adhesion property and durability, the meritorious properties of the latter were considered to be more suitable for the window restoration work in a historical building such as the Kom Tong Hall. Acting as a drying oil, tung oil will polymerise on long standing under the catalytic action of lime to a hard and waterproof gel that is highly resistant to acid and alkaline conditions and it will not darken noticeably with age (Tung 2007). With lime serving as a filler, the particle size of the individual grains of the slaked lime will shrink to less than 1  $\mu\text{m}$  when its morphology changes from prism to plate-like crystals on aging, rendering the slaked lime a higher plasticity and greater retention capacity for both water and tung oil. In effect, the morphological changes will result in a faster carbonation rate and stronger bonding in the matrix of the putty (Elert et al. 2002). Apart from these aspects, the putty is less vulnerable to mould growth in comparison with the silicone sealant because the lime component is more adaptable to moisture exchanges or to “breathing” (Sickels-Taves et al. 2005). Besides, the glazing putty has the edge of a lower cost and is more environmental friendly.

On the other hand, silicone sealant requires a clean surface for application, but the surfaces of the original lead comes and iron frames could never be made clean enough by mechanical means using scalpels or other abrasive tools for satisfactory application of the silicone sealant as trace amounts of the original glazing putty would still remain in the recess areas of these metal receivers and the lead comes were too soft to withstand the hard working. Also, the restored glass windows would be re-installed on site in the course of the renovation works by the contractor according to the work schedule,



Figure 7a&b. Stained glass window before and after conservation



Figure 8. Kom Tong Hall after restoration

and it was therefore not at all possible that the surfaces of the old lead came and the glass were perfectly clean for the application of silicone sealant. The fact that the contractor was more skilled at the application of the glazing putty rather than the silicone sealant had further prompted the use of glazing putty in this restoration project.

Having considered the aforesaid factors, the conservators managed to convince the architect and the curator to agree with the use of this traditional material for restoring the stained glass windows, and finally the effect of the treatment work was highly regarded by all the parties, including the previous owners of the building, the architect and the curator while maintaining traditional physical properties and techniques (Figure 7a and b).

### Conclusion

Dr Sun Yat-Sen Museum was opened for public viewing in December 2006 (Figure 8). The visitors now have not only access to a new thematic museum to learn about the life of the Chinese statesman and the history of modern China, but also can appreciate the original appearance and aesthetic quality of Kom Tong Hall. With the participation of the conservation scientists and conservators, difficulties in revealing the original materials in heritage conservation were overcome. A different approach and practice has been introduced to the preservation of Kom Tong Hall, which has indeed set a good example and standard for conservation of the local heritage. Through this restoration project, it is hoped that the existing practice in heritage preservation in Hong Kong will be gradually transformed so that not only the layout and settings of the buildings will be preserved, but also their original materials and traditional techniques. We are in deep appreciation for the collaboration with different professionals across the varied disciplines to make the project successful and would recommend that good practice and effective communication of this kind be continued in other heritage conservation projects to be carried out in future.

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### Notes

1. For the purpose of discussion in this paper, golden paint is defined as bronze flakes in a paint emulsion or binding medium, commonly known as 'bronze paint' while gold gilding is defined as the overlaying of the surface of a substrate with a layer of gold leaf.
2. Operating condition for the elemental analysis by a portable Seiko SII Sea 200 X-ray fluorescence spectrometer: 50 kV, 200  $\mu$ A for 100 seconds with a Rhodium target.
3. The EDS was operated at 30 kV for the paint analysis.
4. Except for the four missing stained glass windows which had to be replaced totally with new replications, the rest of the fourteen damaged windows were restored according to their original make though the extent of restoration treatment varied from one to another, as warranted by the condition of the individual windows. Of these 14 windows, 15% of the glass segments were missing or beyond repair and had to be replaced with replications.
5. In this paper, glazing putty means the traditional compound used in China for fixing and sealing panes of glass into frames. Being readily available in hardware shops, the putty is made by mixing lime with tung oil. Caulks and sealants are both generic compounds commercially available for filling the seams and joints. As a common practice, caulks are more preferable for work situation where no relative movement of the substrates is expected, while the sealants which are made of elastomeric materials will allow lateral movement of the substrates up to 25%–50% of the width of the joint. Caulks and sealants are considered as the same class of materials for the purpose of discussion in this paper.

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