

Bringing into the open: the study and use of architectural paint research information within the context of Singapore

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Abstract The increasing awareness of architectural heritage and history in the city-state of Singapore is an encouraging and undeniable trend. Public acceptance of urban conservation guidelines and the gazette of listed buildings as part and parcel of the cityscape development is gradually being translated into a greater, shared responsibility for the preservation of the urban fabric. It is within this context that a series of architectural paint research projects was commissioned and undertaken. The primary aim was to provide a snapshot of the use of architectural colour in various significant historic buildings, especially before the widespread use of colour photography.

The findings from the study were collated and shared with the owners and custodians of the historic buildings, in addition to being made available in various research libraries. A Creative Commons license was also applied to the publication of the results in order to encourage and facilitate future use and interpretation of the results in an open and transparent manner. With this initial glimpse into the (literally) colourful past of historic buildings, perhaps other like-minded professionals could also be encouraged to contribute towards an evolving understanding of the built heritage of Singapore.

Keywords architectural paint, heritage, Singapore, Southeast Asia

Singapore's architectural tradition

In 1819, Sir Stamford Raffles, the former governor of Java, acquired a new trading post and founded modern Singapore by establishing a theoretical sultanate under British sovereignty. After negotiations with the regent of Singapore, Temenggong Abdul Rahman, Tunku Hussein Long, the contender for the Johor-Riau throne was installed as sultan of Singapore (Pang 1983: 19–20).

Although 14th-century Chinese ceramic sherds and intact Yuan Dynasty 'mercury jars' found on archaeological sites in Singapore, evidence settlements and activities that predate 1819,¹ there were no remains of any vernacular architecture. This lack of physical evidence was probably due to the use of organic materials, such as timber, that does not preserve well.

All extant buildings post-1819 are the result of Raffles' intervention and the guidelines issued by the Town Planning Committee on 4 November 1822.² This set of guidelines is now commonly known as the *Raffles Ordinances* or *Raffles Regulations*. In the same year, Lieutenant Phillip Jackson, the garrison engineer, produced a master plan, which is commonly referred to as the 1822 Jackson's Plan. This was to have a profound influence on the future development of the colonial city (Fig. 1).

This famous layout of Singapore's settlement, which segregated the main ethnic groups into different districts (Cangi 1993), is evidenced on the map by different religious

buildings such as churches, Chinese and Indian temples and mosques. Also marked on the map are the Anglo-colonial government offices. Henceforth, the morphology and segregation of the population according to ethnicity followed these orderly grid-like lines as set down in the 1822 Jackson's Plan, the essence of which continues to exist today and is a visible link with the colonial past of Singapore.

Current overview of the built heritage of Singapore

Singapore is a small city-state with a land area of 716.1 km² and a population of 5.40 million.³ With limited land, the state's planning agency, the Urban Redevelopment Authority (URA), faces great challenges to cater to the needs of the nation in terms of land use. Limitations and restrictions on the way land can be utilised include that approximately 40% of the land must be reserved for water catchment and nature reserves, a height restriction is imposed on buildings near flight paths, and that some land is set aside for military use. There are inherent conflicts in situating the conservation authority within a planning body such as the URA, but it has been argued that for a small city-state such as Singapore, such an arrangement will be effective and efficient. Apart from the conservation authority, the Preservation of Sites and Monuments (PSM, formerly Preservation of Monuments

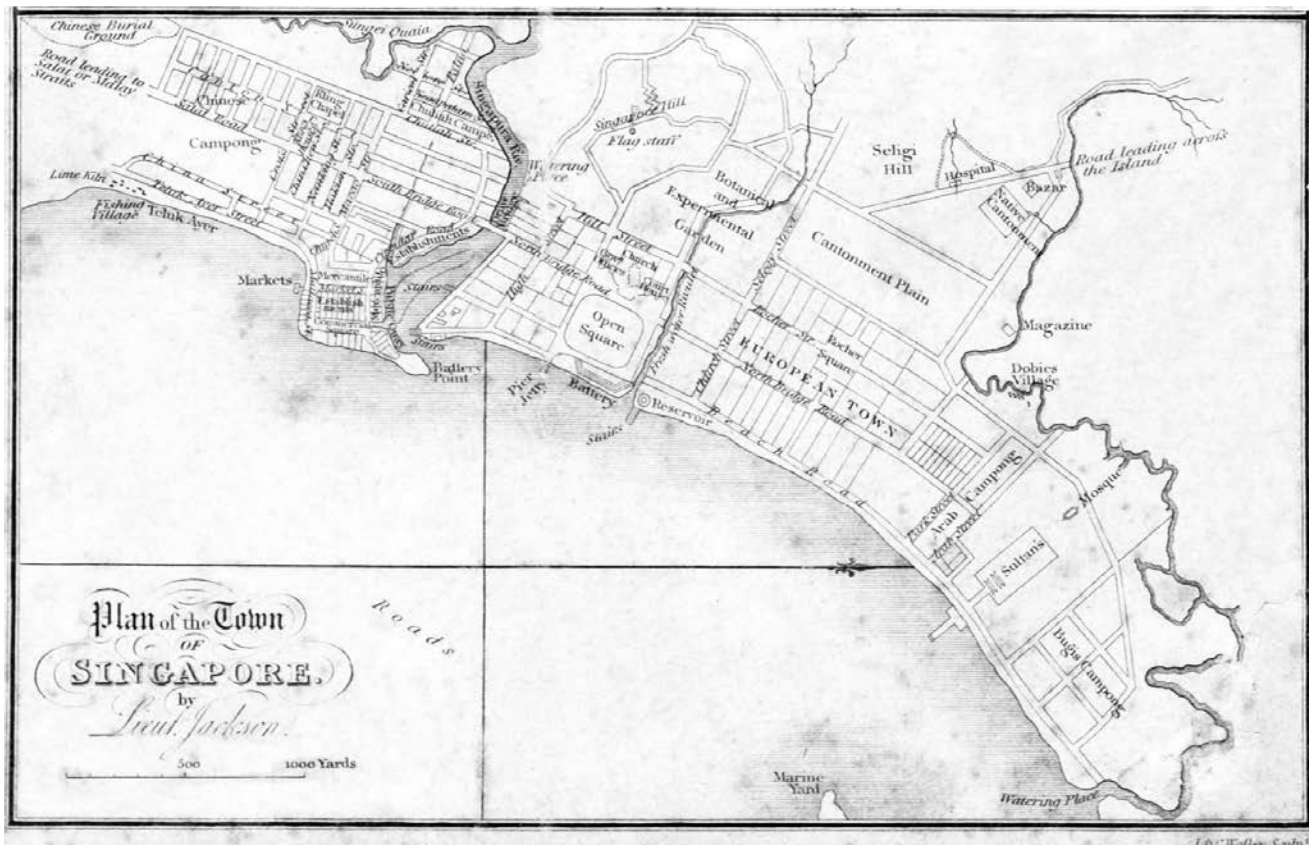


Figure 1 Plan of the town of Singapore by Lieutenant Jackson, 1822, commonly known as the 1822 Jackson's Plan. The plan shown here was published by Henry Colburn, London, June 1828. (Image: Lim Chen Sian)

Board or PMB) under the auspices of the National Heritage Board (NHB) also regulates national monuments that are of great significance to Singapore.

Despite Singapore's small size, the URA and the PSM have granted conservation status to more than 7,100 buildings in over 100 conservation areas,⁴ and national monument status to 65 structures since the 1970s.⁵

Moving towards conservation of material culture

The fundamental principles of conservation, as issued by the URA and applicable to all national monuments and conservation buildings, are based on 'maximum Retention, sensitive Restoration and careful Repair', or the '3R's'. The '3R's' is a simple reduction of international conservation standards, which the authorities hope will make it easier for the professionals (primarily architects) to adopt. Although in-depth research is encouraged, the preservation and conservation guidelines⁶ produced by the authorities predominantly regulate historic structures based on their physical appearance. Such an approach is not unlike the stylistic restoration movement that began in late 18th-century Europe.⁷ Notwithstanding current international practices, the general tendency in Singapore has been towards stylistic restoration, which is at odds with the complex concept of authenticity.⁸ In most cases, research is also limited by the lack of historic records, as well as an understanding of historic materials and construction methods.

Moving beyond pre-restoration photographic records, measured drawings, artefact inventories, historic documentary and photographic records, architectural research, dilapidation surveys as well as structural and geotechnical analyses, Singapore is gradually heading towards unravelling the knowledge of material culture within the built heritage from the bottom up, led mainly by academics and non-governmental organisations such as the Singapore Heritage Society.⁹ Despite a history of over 40 years in preservation/conservation since the establishment of the PMB in 1971, there remains a general lack of understanding of historic building methods and materials.

Historically, expertise within the built heritage was achieved through colonial India, with building practices that incorporated Indian plasterwork and masonry for both colonial buildings as well as early Hindu temples. The Chinese also introduced their building methods, especially with their mastery of carpentry. In addition, the style of the Anglo-Indian bungalow was influenced by the Malay kampong house. However, building materials and methods were not limited to each ethnic community. More importantly, these contributed to the Straits Eclectic Shophouse typology,¹⁰ with its 'five-foot way' that was principally the legacy of the *Raffles Ordinances*. As Wurtzburg (1984: 610) notes, 'All houses constructed of brick or tile should have a uniform type of front, each having a verandah of a certain depth, open at all times as a continuous and covered passage on each side of the street.'

Beginning in the mid-1990s, some projects have presented important questions on the knowledge gap in

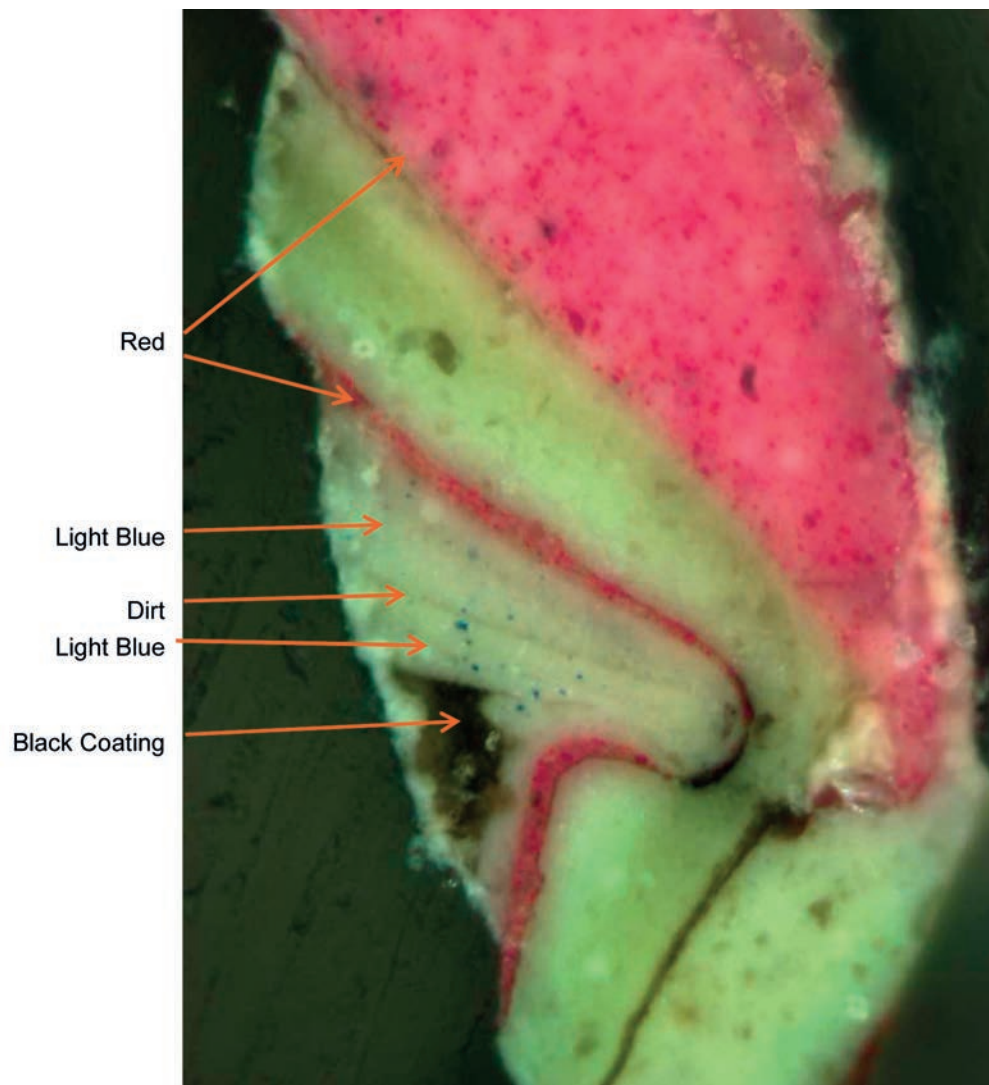


Figure 2 Paint sample cross-section microscopy of 157 Neil Road townhouse. (Photo: Lawrence Chin)

our understanding of built heritage. A series of small but important pre-development archaeological investigations was carried out by university academics to document the sites before major construction works took place.¹¹ In the late 1990s, major restoration projects¹² required analysis of historic pargetting (historic plasterwork) to aid restoration works in order to produce a modern cement mix that replicated the technical qualities and character of the original lime-based plaster.¹³ This is mainly out of practicality as builders have, over the years, lost the skills of historic construction, including the handling of lime plaster. In fact, there are few skilled local craftsmen dealing with materials that are not common in today's construction industry, such as *in-situ* terrazzo, Shanghai plaster¹⁴ and ornamental masonry. Consequently, Singapore has been increasingly reliant on foreign workers to engage in restoration work since the 1970s (Ofori 1994: 2). Timber craftsmen from China, for example, work on Chinese traditional buildings and Indian architectural sculptors work on Indian temples. The inability to retain skilled craftsmen to work on heritage structures is a major issue faced by conservation practitioners.

One project that stood out was the restoration of the townhouse at No. 157 Neil Road,¹⁵ and its adaptation to the Tun Tan Cheng Lock Baba House, owned by the National

University of Singapore. This townhouse (previously owned by a Peranakan family) is perhaps the most comprehensive restoration project, if not the first detailed cross-disciplinary study of a conserved building in Singapore, that was supported by research into architecture, archaeology and the building's history. Photography and measured drawings were undertaken between 2005 and 2006,¹⁶ and archaeological investigation in 2006, prior to the restoration (Lim and Wee 2007). The Baba House also had the honour of having been the focus of the first detailed material conservation condition assessment. This was undertaken in 2007 and was not limited to architectural components, but was extended to include immovable artefacts within the site (Chua and Chan 2007), the iconographic study of artefacts (Lim and Wee 2007) and the scientific analysis of architectural paint by colour scrape and cross-section analysis (Chin and Tee 2007) (Fig. 2). Some of the paint samples were also analysed for their chemical composition (Chin 2007, 2008).¹⁷ This is clearly an improvement in technique since the first known paint colour scrape test that was carried out in Singapore on the House of Tan Yeok Nee in 1999 (Chan et al. 2003: 69).¹⁸

Beyond restoration and conservation projects, community organisations, especially grassroots communities, have increasingly started to harness knowledge gleaned from

Table 1 Buildings for the study of the architectural paint layers are selected to represent a spectrum of architecture typologies (namely mosque, Chinese temple, church and colonial government building).

Type	Building
Mosque	Al-Abrar Mosque (c.1850–1855) Hajjah Fatimah Mosque (c.1845–1846) Jamae Mosque (c.1830–1835) Sultan Mosque (c.1924–1928)
Chinese temple	Tou Mu Kung Temple (c.1919–1921) Yueh Hai Ching Temple (c.1895) Former Keng Teck Whay (c.1859?)
Church	Armenian Church (c.1835–1836) Cathedral of the Good Shepherd (c.1846) St Andrew's Cathedral (c.1856–1864) Sts Peter and Paul Church (c.1869–1870) St Joseph Church (c.1906–1912) Telok Ayer Chinese Methodist Church (c.1924) Church of Our Lady of Lourdes (c.1888)
Colonial government building	Victoria Concert Hall and Theatre (Victoria Theatre: c.1856–1862) Victoria Concert Hall (1903–1905) Command House (c.1938)

Table 2 Buildings for the study of the architectural paint layers are also selected to represent various historic periods (10-year intervals).

Period (completion date)	Building
1830–1839	Jamae Mosque, Armenian Church
1840–1849	Hajjah Fatimah Mosque, Cathedral of the Good Shepherd
1850–1859	Al-Abrar Mosque, Former Keng Teck Whay
1860–1869	St Andrew's Cathedral, Victoria Theatre
1870–1879	Sts Peter and Paul Church
1880–1889	Church of Our Lady of Lourdes
1890–1899	Yueh Hai Ching Temple
1900–1909	Victoria Concert Hall
1910–1919	St Joseph Church
1920–1929	Tou Mu Kung Temple, Sultan Mosque, Telok Ayer Chinese Methodist Church
1930–1939	Command House

material studies. In 1989, and 2004–2005, the Tanjong Pagar and Mountbatten Citizens' Consultative Committee funded archaeological investigations in the back lanes of Duxton Hill shophouses and Fort Tanjong Katong, respectively. In 2005, a small milestone was achieved when the Hakka-based community brought together specialists from different disciplines to understand not only the social and cultural history, but also the material culture of their Foot Tet Soo Khek temple on Palmer Road (Ho 2006). From 2006 to 2007, another study on a larger scale was commissioned by the Sentosa Development Corporation. This was a heritage study of a British fortification, Fort Serapong, which brought together the disciplines of archaeology, architecture, engineering, military history, and more importantly for the first time as an integral part of the team, an artefact conservator (Lim et al. 2008).

All these cases demonstrate that there remains knowledge to be harnessed from Singapore's limited stock of built heritage with the assistance of scientific investigative techniques. With improvements in investigative techniques, it is increasingly possible to extract more information than before from historic buildings. In retrospect, there are varying levels of recording, carried out by the state, for example the *Preservation Guidelines of National Monuments*, periodic inspections by the PMB, mandatory periodic structural inspections required by the Building Control Authority,¹⁹ as well as those bottom-up examples cited in the cases above. A

point to note is that there are no national recording standards for the conservation and management of the historic environment for heritage practitioners and planners to use. Singapore needs to actively work on these critical gaps in recording.²⁰

Case study: architectural paint layers research of 16 historic buildings

The Monuments Inspectorate of the PMB commissioned a study of the architectural paint layers consisting of two phases:

- Phase 1: 10 buildings (January–May 2009)
- Phase 2: 6 additional buildings (August 2009–April 2011)

These covered a good spectrum of architecture typologies (Table 1) and periods (10-year intervals) (Table 2).

Challenges, constraints and approaches

The main reason why such a study was commissioned is that there is no historic architectural paint database available in



Figure 3 The production of the wax cubes used for embedding paint samples. (Photo: Claire Lim)

Singapore. To compound this issue, there is a recent trend for specifying silicate paint for use on historic buildings during their restoration or maintenance in order to counter the effects of trapped moisture. As such, historic paint layers are being scraped back to the substrate during such works in order to achieve successful silicate paint application. This threatens the loss of historic paint information if the historic paints have not been previously sampled and documented. Hence, there is a time constraint to build a database quickly before the information is lost. Additionally, in order to encourage other researchers to build upon the work, it is important that the eventual report is made available to all researchers through the Creative Commons and copies of the report were lodged with various research libraries in Singapore.

It was also decided that the focus should be placed on historic buildings that have yet to undergo full-scale restoration works. In addition, there should be at least one building sampled for each 10-year time period, based on the date of its completion and as far as possible, representing a diverse typology.

While there is a limited budget for the project, a total of S\$15,000 has been made available for each phase of the project. This budget covers the tests using scanning electron microscopy with energy dispersive X-ray (SEM-EDX) analysis, which account for a third of the budget. As a result, there is also limited manpower devoted to the project. In order to balance time, cost and coverage, we experimented with the use of wax as an alternative embedding resin to acrylic, epoxy or polyester resins (Figs 3–6). This formula consists of 1 part carnauba wax (a relatively hard wax with a higher melting point) to 4 parts beeswax.

The wax mixture does not pose any infiltration or dissolution problem to the samples. While samples embedded in wax are too soft to be polished, they can be easily cut using

a microtome. Other than time and budgetary constraints, the other important factor for using wax rather than other embedding resin for this particular project is that the wax mixture is opaque, enabling identification of the position of the paint sample within the wax cubes, which is critical before microtoming. As beeswax softens at about 49°C, there were initial concerns that the possible softening of the wax would result in a shift of the cross-section during area mapping using SEM-EDX. However, it was found that the use of wax did not impede subsequent elemental analysis.

In addition, bearing in mind the controversy surrounding the use of wax as an embedding medium, paint samples were also kept in plastic vials for embedding in polyester resin or other 'better' mediums, for comparative analysis in the future. Also, during on-site sampling, photographic documentation



Figure 4 Paint samples embedded in wax (in readiness for microtoming for microscope observations and SEM-EDX). These are kept in plastic vials for future embedding and analysis. (Photo: Lawrence Chin)

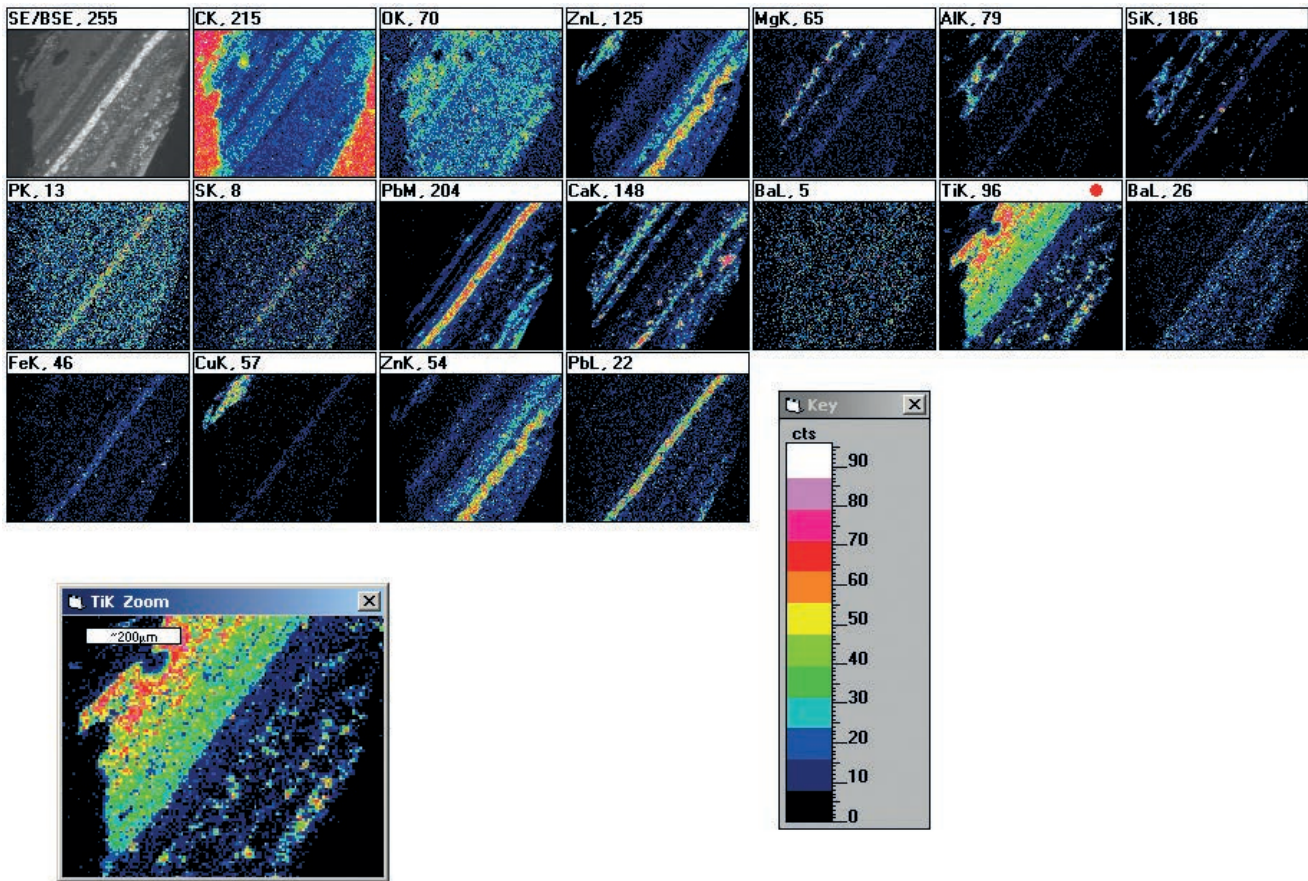


Figure 5 SEM-EDX image of a paint sample taken from Church of Our Lady of Lourdes. (Photo: Ding Jian of SETSCO)

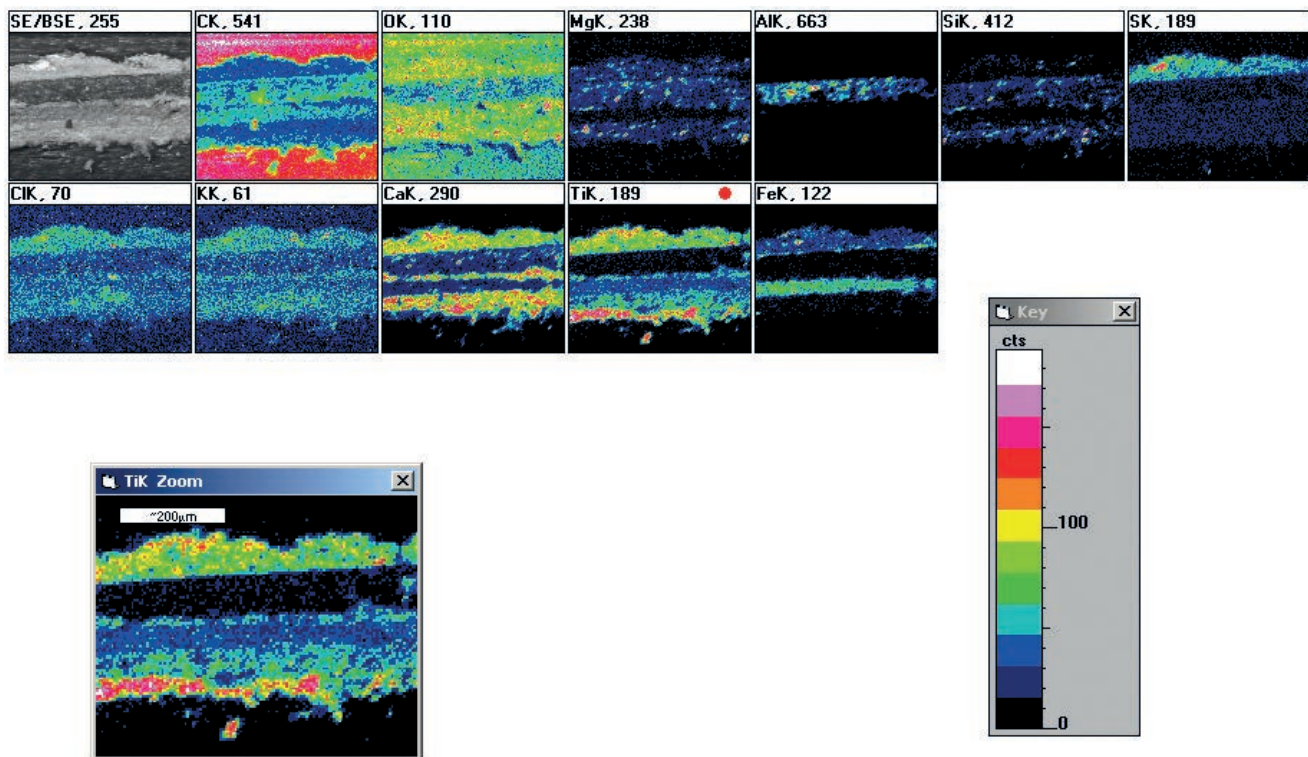


Figure 6 SEM-EDX image of a paint sample taken from Telok Ayer Chinese Methodist church. (Photo: Ding Jian of SETSCO)



Figure 7 Paint sampling at the Church of Our Lady of Lourdes, April 2009. (Photo: Claire Lim)

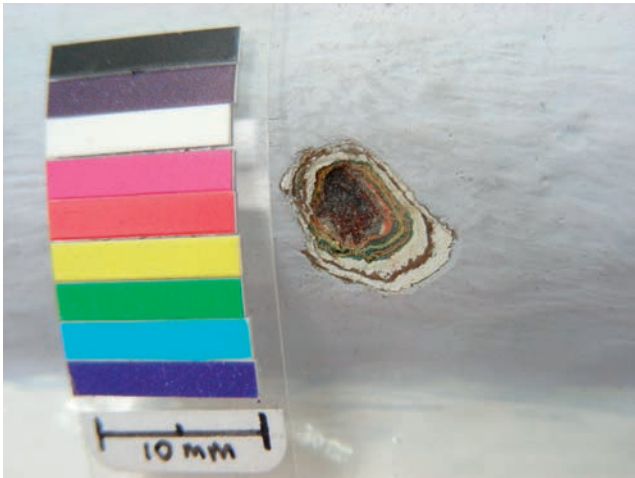


Figure 8 Cratering at the Church of Our Lady of Lourdes, April 2009. (Photo: Lawrence Chin)

was augmented by the use of a mini colour control chart, modified from KODAK colour control patches, to allow for better comparison of colour of the paint layers exposed by cratering (Figs 7 and 8).

Conclusions

Colours are everywhere. Colours identify, direct and decorate. Colours reflect the owner's tastes and personality. The use of colours on buildings became more widespread in the mid-20th century when paints, manufactured from petrochemical processes and their by-products started to appear on the market. Often associated with personal taste, paint schemes of historic buildings tend to be neglected by researchers. In addition, there are few archival and photographic records available to enable a better understanding of early paint schemes. Furthermore, colour photography only became widespread in Singapore after the late 1960s. The often transitory nature of building colours also makes their preservation fraught with questions and paradoxes. Since aesthetic values and tastes change over time, how does one determine which period of painting scheme should be kept

and how? These are rhetorical questions that require much consideration.

That said, this exercise has highlighted the importance of the collection, analysis and documentation of historic paint samples and in ensuring that information and resources are shared by all researchers, while the rhetorical questions are left to be answered.

Acknowledgements

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Notes

1. Although there have been archaeological interests and work since 1933, it was not until 1984 that the first systematic archaeological investigation in Singapore was carried out at Fort Canning Hill (Lim 2006). In 1949, there was an investigation on Pulau Ubin (an offshore island) but nothing of significance was found (Choo 1987). The Fort Canning Hill excavations led by John Miksic demonstrated that Singapore in the 14th century was the site of a complex urban society. Excavations at Fort Canning, the new Parliament House Complex, the old Parliament House, Colombo Court and Empress Place have yielded thousands of artefacts in undisturbed 14th-century contexts (Miksic 1985; Miksic and Low 2004).
2. The Town Planning Committee, the forerunner of the Municipal Council, was established on 29 October 1822 and comprised Captain C.E. Davis as chairman, George Bonham, a civil servant, and A.L. Johnston, a leading merchant. The second committee also included F.J. Bernard (Wurtzburg 1984: 610).
3. Key indicator data retrieved from the Department of Statistics, Singapore (2013); www.singstat.gov.sg/ (accessed March 2013).
4. Data retrieved from the Urban Redevelopment Authority (2013); www.ur.gov.sg/ (accessed March 2013).
5. Data retrieved from the Preservation of Sites and Monuments (2013); www.pmb.gov.sg/ (accessed May 2013).
6. 'Preservation' and 'conservation' are understood differently from international norms. In Singapore, the two terms are understood by their legal definition in the *Preservation of Monuments Act 2009* and *Planning Act* respectively (<http://statutes.agc.gov.sg/>). Preservation refers to the action of preserving, conserving, restoring, adapting etc. to structures that have been granted National Monument status by the state. Conservation refers to the similar actions to structures that have been granted Conserved status by the state.
7. Mérimée and Viollet-le-Duc systematically defined the restoration of the unity of style in the mid-19th century. The movement gained momentum by the pragmatic and positivistic attitude of architects who emphasised the need to make use of historic buildings rather than just preserving them as documents (Jokilehto 1999: 302–3). The movement essentially advocated the 'adaptive reuse' of built heritage.
8. The concept of authenticity was a consequence of modernisation whereby people became alienated from 'reality' (space and time). As a result, there is a quest for authenticity, especially

- in conservation. Cultural diversity means that authenticity can be interpreted and situated within regional, national and international contexts. Asian cultures, especially the Chinese and Japanese, tend to prioritise heritage as a continuum of form and essence and focus less on matter. The predominance of timber construction is also a contributing factor where it is relatively more difficult to preserve timber than materials such as masonry. See the *Nara Document on Authenticity* available from www.icomos.org/charters/nara-e.pdf.
9. Founded in 1987, the Singapore Heritage Society is a non-profit, non-government organisation and registered charity. The Society aims to promote active interest in the cultural life and history of Singapore and to initiate action on research, evaluation, documentation, publication, collection, display, and preservation and restoration of skills and items of historical interest. Over several years, the Society has been involved in many projects to raise awareness of the history and cultural heritage of Singapore by various means, such as publishing books, organising talks and forums as well as conducting heritage tours. The Society plays an advocacy role in advancing the general public's viewpoints on issues such as the remaking of Chinatown (1998) and the demolition of the National Library building at Stamford Road (2001). Both of these issues were in the media spotlight and the subsequent robust discussions and outpouring of public opinion did not go unnoticed.
 10. The origins and developments of the shophouse are attributed to Stamford Raffles (Lim 1993).
 11. After the first systematic archaeological investigation on Fort Canning Hill in 1984 and subsequently in 1987 and 1988, the second investigation at a different site was carried out five years later in 1989 in the back lanes of Duxton Hill shophouses. Between November 1988 and March 1989, archaeological investigation (limited to surface collection) was carried out on Pulau Saigon prior to the construction of the Central Expressway Tunnel (Low 1995; Barry 2000). Five years later, an archaeological investigation was carried out from 1994 to 1995 prior to the development of the Parliament House Complex. This was followed by excavations before the redevelopment of Empress Place (Asian Civilisations Museum) in 1998, Istana Kampong Glam in early 2000 (that continued sporadically until mid-2003), Colombo Court (New Supreme Court) in 2000 to 2001, Old Parliament House (The Arts House) in 2002, St Andrew's Cathedral (current 'Welcome Centre' with subterranean auditorium) in 2003 to 2004, the Baba House in 2006, the National Art Gallery (former Supreme Court and City Hall) in December 2009 to January 2010 and November 2010 as well as the Victoria Concert Hall in June 2010. Other excavation sites include the Singapore Cricket Club at the Padang in 2003, Fort Tanjong Katong in 2004 to 2005, Palmer Road Foot Tet Soo Khek temple in 2006 and Fort Serapong in 2006 to 2007. It is important to note that the bulk of archaeological investigations in Singapore were salvage in nature and conducted under limited time constraints (Lim 2006).
 12. Some noted projects include Sun Yat Sen Villa from 1997 to 2001 and the House of Tan Yeok Nee in 1999. Recent major restoration projects, such as the National Museum of Singapore from 2003 to 2006, also underwent analysis of the historic plaster (pargetting carried out by Indian plasterers).
 13. The modern cement mix must match or have a similar thermal expansion coefficient as that of the historic plaster in order to minimise cracks caused by thermal stress.
 14. This is an artificial stone that is also known as granolith and granolithic plaster that was popular in Singapore during the interwar period (1918–1939).
 15. This townhouse is gazetted as a conserved building on 25 October 1991 and is located within the Blair Plain Conservation Area.
 16. This study was undertaken by Associate Professor Chan Yew Lih from the Department of Architecture, National University of Singapore.
 17. Energy dispersive X-ray analysis was carried out.
 18. On-site paint scrapes and cross-section analysis were also carried out by conservators from the Heritage Conservation Centre at Clifford Pier in early 2008. No analysis was carried out to determine the constituent of pigments (Chin and Tee 2008).
 19. *Building Control Act*, Section 28; <http://statutes.agc.gov.sg/>.
 20. The Getty Conservation Institute has been working on a five-year initiative in partnership with other organisations and institutions entitled the RecorDIM initiative (Recording, Documentation and Information Management: An International Initiative for Historic Monuments and Sites). This is a good platform from which Singapore's built heritage decision makers could learn from or participate in. For examples of national standards, one example to consider is the UK where, since the 1990s and the onset of Planning Policy Guidance Notes, recording standards have continued to be modified. Of particular note are the *Planning Policy Guidance: Planning and the Historic Environment (PPG15)*, and *Planning Policy Guidance: Archaeology and Planning (PPG16)*. A manual on recording, entitled *Informing the Future of the Past: Guidelines for Historic Environment Records* is into its second edition.

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