Introduction

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It is always good to discuss the important subject of the cleaning of traditional building materials in an informed way. There is no better way of doing this than through practical projects which have been undertaken on the basis of sound understanding of the substrate to be cleaned, the soiling to be removed and the intimate relationship between the two. This issue of the *Journal of Architectural Conservation* does just that, in a series of intriguing articles from around the world, written by experienced practitioners. The issue treats you to an in depth discussion on the cleaning of an excellent diversity of subjects – the interior of St Paul's Cathedral, the concrete at Sydney Opera House, a portion of the *Titanic*, the world's largest French Gothic Cathedral (in Manhattan) and no fewer than two Saturn V rockets. Important balance is also provided in the principles of cleaning and the public perception of soiling.

Deborah Slaton and Kyle Normandin begin with a description of the techniques currently in use in North America. In the UK, we have seen all the techniques described; some are in common use, some remain in specialist niches, while others have never really 'taken off'. BS 8221: Part 1, 'Code of Practice for the Cleaning and Repair of Traditional Materials' should be read by UK readers alongside this paper for better understanding of the local situation. Slaton and Normandin also include a well presented section on applying conservation policy to cleaning, which flags up the important difference between soiling (extra, undesirable) and patina (inherent, desirable).

The White Tower at the Tower of London is the setting for Carlota Grossi and Peter Brimblecombe's paper on public perception of soiling. Constructed of Kentish Rag, a relatively light coloured stone, members of the public were canvassed about its very noticeable, streaky soiling. For most, their first impression of the White Tower was not of dirtiness, but rather grandeur of age.

Grossi and Brimblecombe's research on the White Tower and a selection of other European cathedrals has found it quite possible for the blackened surfaces of landmark historic buildings to have a level of social acceptability. This certainly contrasts with the perceptions of developer clients who see cleaning as fundamentally important to the presentation of a refurbished or redeveloped building. Cleaning has also played a key role in the urban regeneration of many UK cities. So, there are still many exciting debates to be had about how cleaning is perceived. I expect a different debate would be had depending on whether buildings are built of naturally light or naturally dark coloured stones.

Remaining in London, the article on cleaning the interior of St Paul's Cathedral reinforces the value of researching substrates, the history of the building, the history of previous cleaning and surface treatments, and the undertaking of independently commissioned *in situ* cleaning trials, and much more. To achieve the cleaning of such a significant interior, to achieve it well, on time and on budget, reflects highly on the 'homework' and preparation phase which Martin Stancliffe, Surveyor to the Fabric of St Paul's and the Doctors De Witte, share with us in their paper. The interior was cleaned using a latex film with bespoke ingredients, achieving a good level of clean whilst overcoming many of the logistical nightmares that often plague the cleaning of interiors.

The preparation phase undertaken by Akhurst, Macdonald and Waters as part of their development of a methodology of the cleaning of the folded concrete beams at Sydney Opera House is exemplary. Based on the building's *Conservation Plan* and *Design Principles* set by designer Jørn Utzon, it also included some very clearly defined and useful scientific analysis of surface characteristics, soiling and deposits, capped with interviews with labourers, supervisors and engineers involved the Opera House's construction in the 1960s. The authors' understanding of the surfaces to be cleaned and their context, on a building which will undoubtedly one day be made a World Heritage Site, is breathtaking, but so worthwhile.

The cleaning process selected (termed a 'conservation treatment'), involved steam cleaning followed by application of a thin wash of fresh calcium bicarbonate solution, left to dry slowly, precipitating calcium carbonate into the pores of the concrete. Gentle buffing during drying using methods of the original construction changed the surfaces into an opaque glaze. This recaptured the character of the concrete beams as they appeared after removal of the original formwork; a solution as unique as the building itself.

The paper on the use of high and ultra high pressure waterjetting techniques in the conservation of historic metals comes to life immediately when you find out that its case studies are based on a portion of the *Titanic* and two Saturn V rockets. The techniques discussed will be of greatest

interest to those involved in the cleaning of external ironwork and bronzework, either sculptural or architectural. Waterjetting technology which involves increasing the power of water, was reported on in the 1960's when Dr Norman Franz, a forestry engineer and professor at the University of British Columbia, was looking for a faster method of slicing large trees into 'lumber'. The article provides a very clear explanation of waterjetting, its many adjustable parameters and how these can be fine-tuned to the metal substrates and the cleaning result required. The selectivity and sensitivity of the process, designed by the right people, on the basis of well researched investigations, is impressive. Unfortunately waterjetting cannot be as predictably controllable on masonry because the characteristics of masonry and its joints are too variable. The article makes several memorable points. My favourite is: 'Dirt or unwanted material in crevices and cracks cannot be reached by a particle that is larger than the crevice opening, whereas water is not limited by the size of the pits or crevices.' We should remember this when considering abrasive cleaning on masonry.

Martin Cooper's article on laser cleaning clarifies what laser cleaning is and how it operates. He explains how laser cleaning is an extremely high quality method of cleaning which can be finely tuned to remove only the soiling from the finest and most delicate of surfaces. There is also a reassuring warning that, as with all cleaning techniques, damage to a surface will result if laser cleaning is carried out poorly.

At present, the bulk of laser cleaning undertaken in the UK takes place in museums or conservator workshops. In these contexts, the rate of cleaning can be as fast if not faster than other comparable techniques available in the conservator's toolbox.

Laser cleaning equipment which has been modified for building site conditions is also available and is being used primarily for cleaning monuments and sculptural and architectural detail on buildings. The logistical considerations of on-site laser cleaning are very clearly explained in this paper.

Most of us still consider laser cleaning as a relatively slow specialist process which is best suited to sculpture. However, in Europe whole façades have been cleaned by laser, e.g. the entire front façade of Rotterdam's City Hall. There, the laser unit remained on the ground linked by 45 metre long optical fibres to cleaning operatives in a 'cherry picker' personnel lift. This is an excellent example of thinking outside the box which should encourage us all to stretch our minds when designing any cleaning regime.

A fire in the Cathedral Church of Saint John the Divine in Manhattan, New York City, provided the material for the article by Kavenagh and Gembinski. During the fire, thick black smoke penetrated the entire building interior. The subsequent insurance claim required comprehensive and

irrefutable documentation that all internal surfaces required cleaning because products of the fire had deposited on every surface. Cost control provided the mechanism for an in-depth analysis of the materials deposited on the granite and limestone interior, and the distribution of this.

Once this was established, on-site trials eliminated both chemical and abrasive cleaning processes as none tested successfully, and none had operational logistics that could fit in the environment of a busy, operational church.

Latex, with a chemical additive, was tested and proved successful on light and moderately soiled stone, but not on the heavily soiled stone. No method was found that could clean these surfaces where bitumen globules were the prime deposit.

All the projects described in the papers are fascinating to read about and learn from. Even when simple and less prominent buildings are cleaned, many of the principles and procedures described here can be applied.

It is my experience when it comes to masonry cleaning that assumptions are never wise. This is certainly true in the field of traditional masonry cleaning where the temptation must be resisted. We are particularly prone to assumptions about soiling.

On three projects over the last two years I commissioned petrographic analysis to determine the nature of the soiling, the nature and condition of the stone substrate and the inter-relationship between the two. No one was more surprised with the results than I. A Portland stone building on one of London's most trafficked 6-lane roads exhibited a moderate level of black soiling in a disfiguring weathering pattern. It was assumed that the diesel vehicle particulate emissions would be a predominant ingredient of the soiling. However, the analysis proved there was no carbon at all.

A large garden structure of sandstone located in a part of Yorkshire, heavily polluted with industrial emissions in the nineteenth century, was assumed to have a largely carbon-based soiling. Analysis proved the assumption wrong as it identified the soiling as a finely textured mat of organic growth.

Analysis of 1 cm thick black crusts on a magnesium limestone railway viaduct in an area of Nottinghamshire that was heavily industrialized in the nineteenth century, confirmed the crust to have no carbon constituents. Instead, it was found to be a thick layer of gypsum, formed by the reaction of the stone with sulphur, probably generated by the burning of coal in the area. The calcium required for the gypsum had been leached from the stonework itself, creating a highly porous layer of stone just beneath the surface. This porous layer was, in turn, protected by a thin layer of gypsum. There was no 'clean break' between the stone and the soiling.

We need to go back to first principles on every cleaning project in which we become involved. We need to check that our assumptions are correct, that we really do know about the materials we are cleaning and the soiling we are removing from them. Carefully selected analytical procedures will provide this, often at minimal cost. And we need to understand in detail the actual effect of what our selected cleaning processes are doing, before we inflict them on a whole building.

We also need to remember that there is still a lot of merit in the more common water-based, chemical-based and abrasive cleaning processes that have been in use for the last twenty years. The increased sophistication of many of these is producing excellent results, especially in the hands of skilled specialist contractors, despite the fact that they do not have glossy brochures.

The advertising of cleaning materials and equipment has become more sophisticated with the result that certain processes are better known for their name than they are for what they do. In all areas of consumer life, we need to stay vigilant, and this includes the cleaning of traditional materials.

Any preference for describing cleaning systems by proprietary name is best avoided – it helps us forget the fundamentals on which a cleaning process operates, and to lapse into a false sense of security that, at last, the cleaning process suited to every substrate, substrate condition, and to every soiling type has been found. There is a wish in all of us that one day a miracle cure will be invented which means we no longer have to understand substrates and soiling. Several brochures for cleaning systems try to persuade us we are there, at least nearly. The reality is that we still have to be informed and experienced about cleaning and, if we are not, we need to find someone who is.

Not many of us have the luxury of cleaning external façades that have not been cleaned before. The effect of previous cleaning regimes must be understood before any further cleaning is undertaken as it can significantly alter the selection of an appropriate cleaning regime. It is always worth talking to the operatives who undertook the work as they will remember what was actually done rather than what was specified.

Each cleaning operation has an effect on the masonry substrate. While the best designed cleaning regimes keep this to a minimum, the incremental effect of repeated cleaning will have a significant impact. This is of particular concern when lease terms require façade cleaning at short and regular frequency. There is no better example of this than the repeated removal of graffiti, where the incremental effect of even careful use of chemical cleaners and pressure water can soon produce noticeable damage.

We need to use more descriptive terms for cleaning. The word cleaning is not sufficient for the separation and removal of a wide variety of soiling

types, from an even wider range of substrate types and substrate conditions to which they are bonded, in an equally complex range of ways.

We have come a long way in the field of masonry cleaning in the last 20 years. We also have much more to learn. The following papers are an excellent start in this education process.

Biography

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Nicola is an established specialist in the conservation and cleaning of historic buildings. She was formerly working for the Research and Technical Advisory Services of English Heritage and is now Principal of Adriel Consultancy, Melrose, Scotland. Nicola is author of *Cleaning Historic Buildings*, Volumes one and two.