



Figure 1 Image of Royal Crescent elevation

PROJECT DETAILS:

Client	Royal Crescent Society. (representing the 300+ residents of the Crescent)
Listing Status	Grade I group listing, World Heritage Site
Contract Values	£900,000.00 Individual units of £30,000 each
Funding	Individual households and Management companies
Contract details	RIBA Householders Contract
Contractors	Nimbus Conservation (Frome) Corbel Conservation (Taunton) Minerva Conservation (Bradford on Avon)
Type of work	Stonework Cleaning and repair.

PROJECT DESCRIPTION AND APPOINTMENT:

Designed by John Wood the younger circa 1767-74 the Royal Crescent is perhaps one of the most famous pieces of urban architecture in Britain. What makes it so remarkable is not simply the crescent building itself and the space enclosed in front of it, but its uniformity, rhythm and lack of substantive alteration from the time of its construction. This is in no short measure is down to John Wood himself who along with this developer brother in law, Thomas Brock, produced substantial restrictive covenants for the newly created crescent stating the means by which the primary elevations had to be maintained and cleaned as well as preventing any alteration without reference to the newly created management company. In essence John Wood wanted his creation to be maintained as closely as possible to its original form and condition.

Remarkably although the Crescent is grade I listed, forms a key feature in the World Heritage Site and sits in a conservation area as designated by the local authority, there is no conservation area appraisal and or management plan for the Crescent, or for that matter any other conservation area in Bath. In simple terms, what this means is that according to council policy the Crescent is no more or less distinct / remarkable than any other part of Bath covered by the 37 Conservation areas. Consequently there are no specific policies or measures in place, other than national legislation, which would affect how the area is developed or managed in future years. This is a truly remarkable situation and is almost unique to Bath.

Over the years since the crescent's construction the buildings themselves have changed hands, suffered from a degree of neglect, poor maintenance, bomb damage, and fire but on the whole have remained fairly intact. Over the course of its life the crescent has suffered significantly, like most other buildings, from the damaging effects of pollution from coal fires and vehicle emissions. Up until about 40 years ago a consistent patina of grime sulphation and general dirt covered the stonework, which whilst unsightly and damaging was generally evenly distributed. Ironically advances in conservation techniques and philosophy recommending the cleaning of buildings to remove damaging salts and dirt have made a greatest impact on the uniformity of the elevation since its creation. The once homogenous grime unifying the run of 30 houses has been broken by the ignorant and overzealous cleaning of a number of properties using a variety of methods including nebular cleaning, sandblasting, chemical stripping, JOS cleaning and even disc sanding of the elevation stonework.

As a result of the work carried out by Rhys Brookes (RB) of Harrison Brookes Architects (HBA) on the Royal Crescent Ha-ha, Royal Crescent Railings and associated footpath to the front of the property, RB was approached to put together a management plan for the entire Crescent by the Royal Crescent Society (RCS), a body that represents the owners of the individual properties. Very quickly RB in conjunction with the RCS identified that one of the major issues confronting the crescent was a lack of coherent approach to the cleaning, decoration and maintenance of the elevation with individual houses and sometimes flats in each house adopting a different timetables and approach to repair and maintenance often without consents. Once executed, these works had a significant impact on the entire elevation, causing friction within the community. It was clear to RB and the RCS that some mechanism needed to be introduced to control the method of cleaning of the buildings and quickly before more damage was done.

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HBA were appointed to prepare and implement a LBC application to clean & repair all 30 buildings in the Royal Crescent on behalf of all the residents of the Crescent in what has proved to be a very complex but ultimately successful venture.

As with all conservation projects key to moving forward is obtaining a thorough understanding of the structure & the nature of the problems associated with it. Only by understanding the building can a philosophy be developed & repairs specified. Usually this is fairly straight forward as the building effectively tells you what is required by way of intervention which is then communicated to the owner. However when dealing with a building of 30 dwellings most in multiple occupancy with up to 100 property owners with varying budgets, aspirations & with buildings in different conditions, the bigger problem is obtaining consensus as to how to move forward.

In the case of this project RB insisted on a single representative be appointed by the RCS who would act on behalf of the residents. The RCS would develop a legal agreement similar to the original covenants produced by Wood during the early days of the crescent. This agreement would ensure that the collection of owners acted as one entity thereby enabling efficiency and a consistent approach to be adopted.

INVESTIGATIONS:

The opportunity of working on an entire streetscape is extremely rare and offers great advantages. The biggest single advantage is that the street or building can be considered as a whole, rather than individual units and issues outside those effecting individual households can be looked into. There is also the benefit of economy of scale and consistency of approach which would be lacking if there were 30 different approaches for each house.

Investigations consisted of two main areas of work. The first was the physical recording of the entire front elevation of the crescent detailing each house in sufficient detail to allow identification of individual stones. This was a significant undertaking & required scaffold access at different ends of the crescent to determine consistency. This enabled base drawings to be produced which were then act as record drawings.

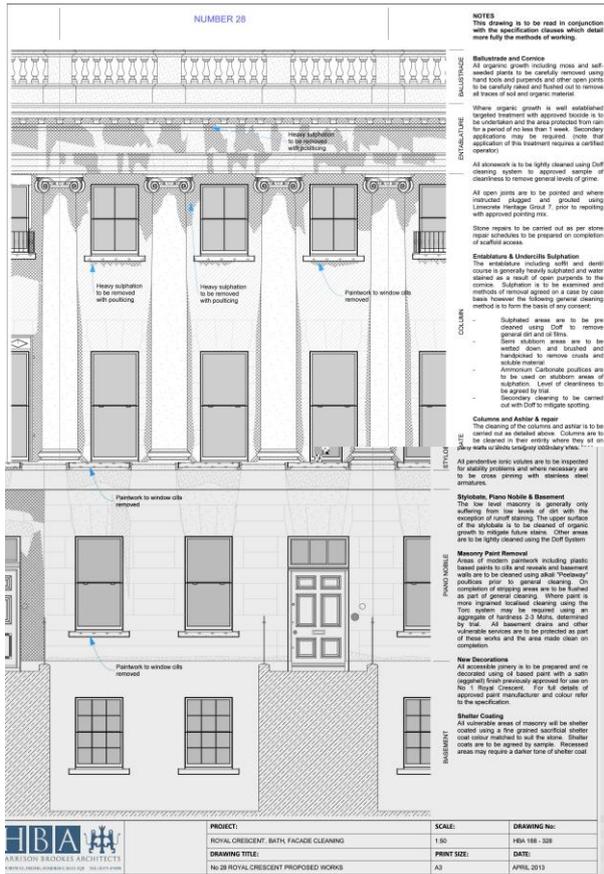


Figure 1 Typical Elevation of house (No 28)



Figure 2 Associated photographic record

The second area of investigation was a complete inspection of the stonework from the ground using telescopes and long focus lenses to determine the nature of the soiling and weathering. This was a laborious process but allowed a snapshot to be taken of the condition of the entire elevation which was then recorded on the drawings.



Figure 3 Detail of weathering pattern to elevation

RESEARCH FINDINGS:

Surveying the building enabled two different patterns of weathering to be observed; orientated weathering and architectural weathering;

Orientated weathering;

On the large or macro scale the shape and orientation of the crescent has affected its weathering. The prevailing winds and driving rain from the west and southwest has meant that the more southerly and westerly facing part of the crescent (Nos 1-10) shows markedly different patination to the easterly facing buildings (20-30) irrespective of cleaning history. This is very typical of large structures and affects both the runoff characteristics and the sulphation build-up. In its simplest and crudest terms the eastern side of the crescent will be more exposed and therefore less soiled than the western side of the crescent. This principle of orientated weathering, will affect moss, lichen and sulphate buildup, drying patterns, salt leaching and freeze thaw cycles. South westerly facing elements of the building although generally cleaner due to their exposure to the elements can also be more heavily eroded and the stone in a diminished condition. Orientated weathering will also affect individual elements such as columns, and balustrades which have more than one open side resulting in differing patination on the element.

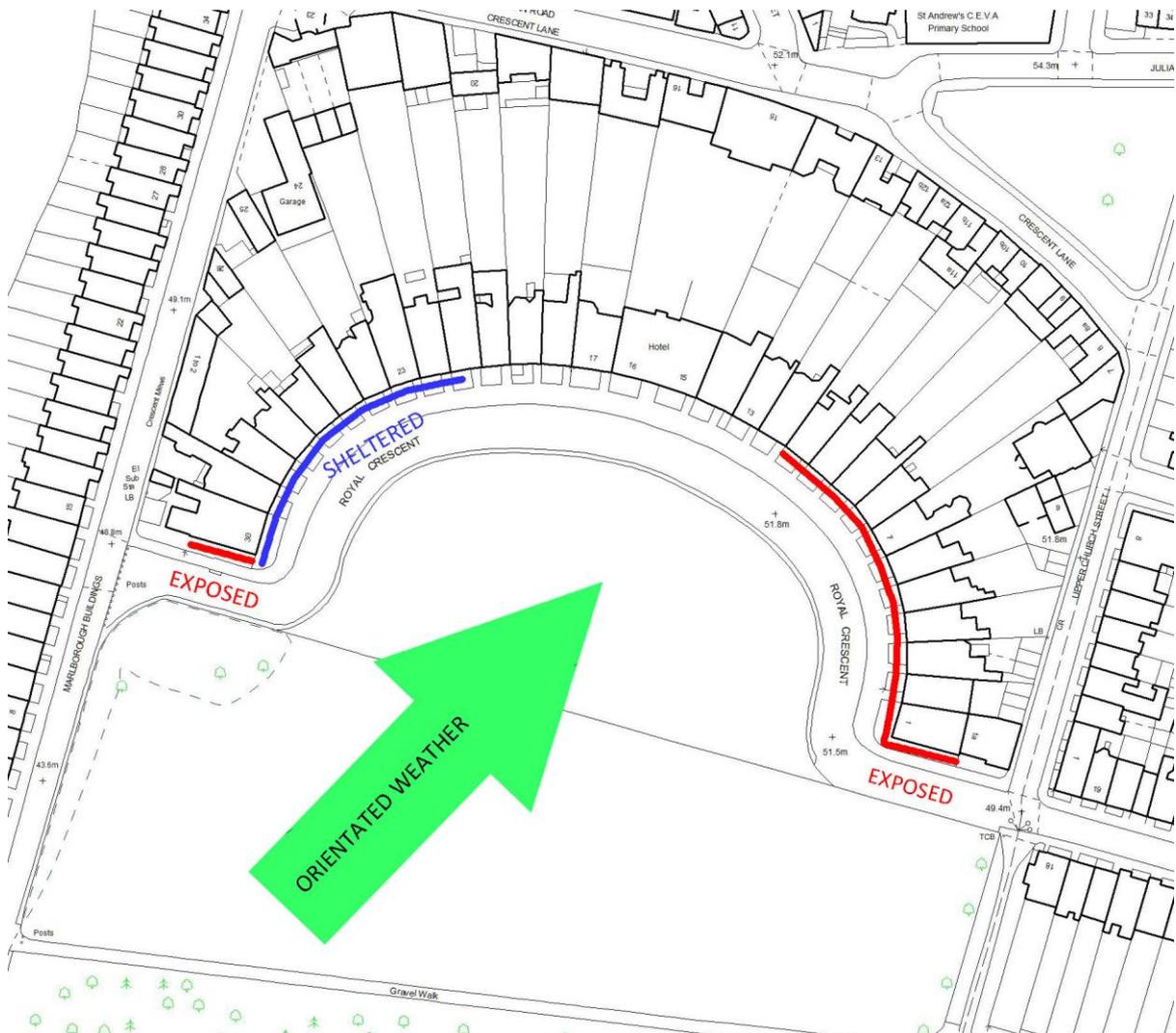


Figure 4 Plan showing orientated weathering

Architectural Weathering

On a smaller scale the second weathering pattern is associated directly with the architecture and its articulation. Historically it should be remembered that the design of building first and foremost is to provide shelter and shed water and even in its classical form the Crescent there are practical reasons why the elevations are configured the way that they are. A simple examination of a typical elevation shows several

distinct patterns of soiling. In developing a cleaning philosophy it is vital that these are accurately observed and interpreted.

In the case of the crescent there is a clear correlation between the architecture and the type of weathering. In essence the building resembles the form of a classical temple with the zone between the columns being in-filled. The balustrade the lower entablature the columns and the stylobate and below are all in the same vertical plane. As such they all receive similar degrees of weather and exposure to rain and generally speaking have weathered consistently. However the setback plane of the inter column ashlar is significantly more sheltered and has weathered differently as has the area under the cornice which has weathered most. This difference in weathering in some instances has helped with visual articulation by mimicking shadows, whereas in other areas it has reduced the legibility of the architectural detail.



Figure 5 Architectural Planes and Shadows



Figure 6 Typical weathering and soiling patterns

Types of weathering and soiling

In general there are four distinct types of soiling and weathering patterns on the building. The first and most obvious of these is the very dark discoloured areas of the stone. This is caused by sulphur dioxide and other gases mixed with soot particles reacting with the calcium carbonate of the oolitic limestone to produce calcium sulphate based compounds. When thick, this creates a crust or clinker which disfigures the stone and cause significant damage to the stone matrix and legibility of detail. This is generically known as sulphation and tends to form around sheltered or airless areas, especially on architectural details below overhangs and behind columns.

Sulphation can also occur without forming a crust. In this instance the surface of the stone will become “nicotined”. This can happen anywhere but as with the heavy sulphation tends to be in less exposed areas. On balance this type of sulphation is substantially less penetrative and does not disrupt the stone matrix leading to stone failure, although it can be unsightly.

The third distinct area of staining is general air borne grime and dirt. This can build up anywhere but tends to be concentrated in areas of high splashback, runoff, or areas which become disproportionately wet such as columns and balustrades. (The longer an element remains wet the more airborne particles cling to it) The presence of dirt can in turn provide nutrients for organic growth so it is not uncommon to see these areas with green algae bloom, moss, lichen etc.

In addition to the three main forms of weathering there are a group of stains associated with metals such as copper alloys and ferramenta. These are usually associated with fixings which will need to be assessed on an individual basis.

Conversely there may also be areas of leaching on the elevation. This is where runoff has been concentrated over other weathered areas leading to streaking. This is most notable at high level where perpendicular joints have been lost in the cornice or other weathering details.

LISTED BUILDING CONSENT AND THE CLEANING PHILOSOPHY

Given the unusual nature of this application and the buildings significance a high level of pre application collaboration was undertaken with the Senior Conservation officer Adrian Neilson of Bath and North East Somerset Council, Bath Preservation Trust and English Heritage. Key to moving forward was agreeing the objectives of the cleaning and the methods of controlling the nature of the end result. Set out below is an extract from the Listed Building Consent Application Design and Access statement relating to the agreed objectives of the cleaning;

REPAIR AND CLEANING PHILOSOPHY

¹ Weathering patterns leave distinct marks on buildings with some areas soiled more than others. A common problem with targeted cleaning is the inversion of the natural weathering pattern which can be visually discordant. This is particularly problematic on dirtier buildings where even the lightest of targeted cleaning can stand out if not blended in sympathetically.





Listed building consent was granted to the Royal Crescent Society for the entire crescent to be cleaned in line with the several conditions set out below;

THE SPECIFICATION AND TENDERING:

Although obtaining consent to clean an entire street was complex and fairly protracted it was recognised by all parties that consent in and of itself would not lead to a successful clean and conservation work. Critical to ensuring consistency was to have the same people involved throughout. This included conservation officers, architects, and most importantly contractors. However the nature of the multi headed client meant that there needed to be a degree of flexibility as to the use of various contractors. HBA and conservation officer working in collaboration with the RCS agreed that a shortlist of three contractors be formed each with similar skills. Each contractor then agreed to a set framework of costs for the cleaning and repairs. This ensured that the contractors were interchangeable in terms of costs and quality. The only factor in the selection of the contractors would therefore be availability.

With the consent in place and in the hands of the RCS each house owner wishing to clean their building would then purchase the rights to use the consent from the RCS on the proviso that they used the named contractors and HBA as the architects thereby ensuring the same set off eyes and hands were involved with every job. Whilst this is a logical approach what is clear is that it is dependent upon companies actually being around to execute the works to the same level which has proved to be more awkward than initially envisaged due to the natural rise and fall of personnel and companies.

In an attempt to control the variable nature of operatives a large amount of sampling and method sequences were placed in the specification clauses, this is fairly standard practice but essential in this instance.

C2 WORKMANSHIP & TECHNIQUES

Staff All cleaning is to be carried out by a competent person trained in the use of the agreed cleaning method (refer below for trials). As cleaning requires subjective assessment the Architect reserves the right to select individual operatives according to the desired result.

Timing Cleaning must not be commenced until all biocide and herbicide treatments have been completed and any objects fittings or fixtures scheduled for removal have been removed so as to provide the fullest possible access. Similarly cleaning must not commence if there is a significant likelihood of failure either due to excessively cold or hot weather which could adversely affect the cleaning process

Trials The degree of cleaning will need to be established by trial. Once the level of cleaning has been agreed with the Architect the contractor is to work from the top of the structure down. Care must be taken to lift scaffold boards and / or reconfigure the scaffold as necessary to enable a complete access.

Where and when necessary any scaffolding protection is to be temporarily removed to allow assessment from afar and in natural daylight. On completion of assessment the protections are to be replaced.

Where there are stubborn stains, graffiti, chewing gum, paint etc the general stone cleaning system is not to be used excessively in an attempt to remove these stains. Other more targeted methods may be required.

Feathering in is to be used at the junctions between areas of disparate cleaning / staining such as columns. The intention of feathering in is to minimise unnatural transitions in patination. Feathering in will need to be undertaken by skilled Doff operators. Feathering in using brushing techniques is not recommended. Revision A

Flushing Flushing down can be carried out using light water washing or Doff at low temperature and pressure. The objective of flushing down / off is to remove loose contaminants; particles, grime, oils and general dirt which if left in situ could affect the works. The process can occur at any time during the works but is usually carried out both prior to and post the works. Flushing down is executed from the top down to ensure that particles are fully removed. The act of flushing off / down also provides invaluable information about water shedding and runoff characteristics that can inform repair approaches. Flushing down is particularly important on high level complex masonry such as balusters and cornices which are not as easily flushed by natural processes and therefore tend to contain greater levels of contaminants.

On completion of the targeted cleaning it will be necessary to flush the cleaned masonry down to remove all dissolved salts and traces of ammonium carbonate to ensure that salts are not re-deposited elsewhere. Similarly on the removal of the scaffold it may be necessary to flush down to remove splashback strips at scaffold lifts.

Finishing The contractor is to re-inspect the building on striking of the scaffold to ensure that targeted areas are cleaned / flushed to the satisfaction of the architect. Where instructed to do so the contractor is to carryout any additional cleaning / flushing necessary to remove detritus. This is normally only the case when scaffolding or other temporary obstructions have prevented full access cleaning / flushing.

C3 TRIALS

C3.1 Background cleaning

The objective of the cleaning is not to remove every last trace of dirt staining and discolouration but is intended to remove the surface layer of grime and dirt. Levels of cleanliness are subjective and both English Heritage and B&NES will want to agree the individual level of work with the Architect and contractor. Wherever possible the cleaning should enhance the visual articulation of the elevation and certain architectural elements such as the columns, stylobate, entablature and piano nobile ashlar may have to be cleaned to a different level of cleanliness from the inter-column ashlar so that they visually stand out from the background.

The basic principle is to start with a light level of cleaning and then progressively increase the level of cleanliness as directed. Cleaning the stone to a uniform consistency is also not recommended and in some instances it may be that the cleaning is feathered in from clean areas to less clean areas.

Trials will need to confirm the following

- 1) Level of column cleaning
- 2) Level of Entablature cleaning
- 3) Level of Piano Nobile, Stylobate and basement ashlar cleaning
- 4) Level of inter column ashlar cleaning.

This work is to be carried out using the Doff system and will require the operator to understand the differing levels of cleanliness.

C3.2 Sulphate removal (Method Sequence)

The objective of the cleaning of sulphated areas is to remove damaging salts which lead to progressive decay of the stonework. It is not the intention of the Architect to get back to the base colour of the stone and shadow staining will be generally acceptable as part of the patina of the cleaned stone.

It has been observed that there are three distinct types of sulphation, crust deposits, oils deposits and soluble deposits, each of which requires a different treatment. To prevent over-cleaning, works are to commence with the least invasive techniques and increase in intensity as and where required / directed.

- a) All areas suffering from sulphation and heavy soiling are to be initially lightly cleaned using the Doff steam cleaning system to remove oils and dirt films and to allow a degree of pre-wetting of the affected areas. This action will quickly enable the contractor to identify the different sorts of sulphation and their location.
- b) Areas are then to be inspected by the Architect and the nature of the sulphation and treatment process agreed.
- c) Heavy sulphation crusts, presenting a viable edge are to be removed by hand picking using approved tools such as blades and small chisels. *(these deposits are generally on overhanging elements and require close access by operatives)
- d) Where sulphation is present but there are no crusts the area is to be thoroughly wetted down and poulticed with sepiolite covered with clingfilm. Once removed the areas are to be flushed and brushed down with soft bristle brushes. Judging the dwell time will remain the responsibility of the contractor and may vary from area to area. The contractor is then to allow the architect to reinspect.
- d) Where stubborn sulphation remains targeted poulticing using a weak ammonium carbonate mix in approved poultice matrix such as Arbocel BC 1000 is to be used. Concentration and dwell times are to be determined by trial and may vary. Initial trials are to assume weak concentrations applied over a long period rather than high concentrations over a short period. This is to ensure that more control can be exercised over the outcome.
- e) The contractor is to record on the drawings the application concentrations and dwell times and supply the architect with a copy of the record.
- f) On completion of the poultice work a final sweep of the cleaned stonework is to be made with the Doff system to help flush away traces of ammonium carbonate and even out the interfaces between poultice and un-poulticed areas.

THE WORKS:

Irrespective of how much preparation is carried out up to and including tendering, the success of any project is down to communication between the architect and the workforce. As a practice HBA take particular care to work with the craftsmen and push them to achieve the highest results possible. To do this we visit the works regularly and have detailed discussions to ensure that they have understood what is being asked of them and also to see if they have better solutions to problems that we may be unfamiliar with.



Figure 7 Pre works



Figure 8 Post works

To date four of the 30 houses have been cleaned in the last 18 months with a further group of 5 houses to be cleaned as a single entity next year. The success of the cleaning to a sensitive level is difficult to demonstrate through images as the major impact is in the distant appreciation of the elevation. On a detailed level the two images above showing a before and after cleaning and repair of a column capital, illustrate just how

understated the works have been. This is a typical example of cleaning the column shaft and capital details whilst maintaining an area of slightly soiled ashlar beyond so as not to flatten the elevation.

Repair works have proved more difficult to predict as some buildings, particularly those subject to the prevailing winds and rain have suffered much more than those in the more sheltered areas, and inspection from the ground is no substitute for sounding the stone. This is a direct result of orientated weathering. A key area of discussion on each building has concerned the pendentive scrolls and the balusters. Due to their relief carving these are very susceptible to salt damage and accelerated weathering and a large number have been historically lost and or replaced. Where they are lost this has left the column capitals and balusters often featureless and has significantly eroded the rhythm of the colonnade which is a point of discussion amongst the residents and the conservation officer. This is resulted in a secondary level of philosophy having to be adopted.



Figure 9 Typical Scroll condition

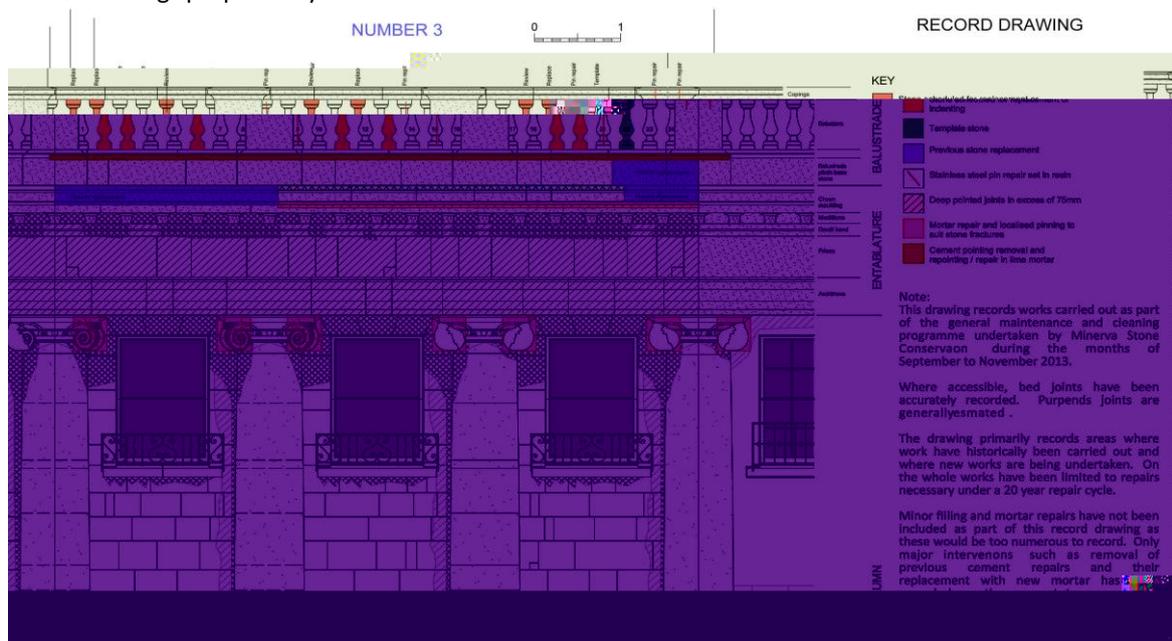


Figure 10 Typical Baluster condition

Given the classical nature of the building and the clear intention of John Wood, as set out in his lease, that the building is to be maintained to a similar standard across the entire elevation; it was felt that the preservation of the design intent in this instance is more important than the merit of individual stones which have clearly been mass produced. This is a markedly different approach than would be taken on an individual building or a building where records did not communicate the designers original intent.

RECORDING

A key component to the works has been recording the actual level of intervention. This was a listed building requirement but would have been done regardless for contractual issues. Below is a typical extract from HBA record drawings prepared by RB.



SUMMARY:

Hopefully by showing this project a range of conservation skills have been demonstrated. As the architect RB was involved with every aspect of the project from the surveying of a vast 300m long building through the negotiation of consents and the partial implementation of the works. What can not be easily communicated in this document is the huge amount of work carried out to bring this project to fruition. In addition to RB's work as the architect, he was involved in detailed negotiations and the setting up of a company to manage the consent with all 30 households. Works also involved preparing a character assessment of the Royal Crescent to enable key characteristics to be identified and the preparation of a management plan for the crescent itself.

On the face of it cleaning an elevation seems like an easy brief. However when you have 100 different household all with different agendas which often conflict, and doing this in possibly the most photographed street in Britain the issues become far more complex, and it is in no small measure the success of a team of people that have worked collectively and hopefully will continue to do so in future years so that the entire elevation is cleaned and repaired to a consistent level.

On a personal note the lessons learnt were as follows;

- 1) Architectural elements such as streets really need to be considered as single entities rather the groups of individual houses.
- 2) There is significant scope for saving individuals money if collaborative projects can be put together.
- 3) Where there is a body clients (in this case there were 300 individuals involved) always insist from the outset that there is one point of contact and that he or she is willing to champion the project and can take important decisions.
- 4) You can never do too much research. Every bit counts even though you may not realize at the time. The fact that we had original lease agreements from John Wood gave us an insight into what he was thinking and enabled us to form our philosophy around his desires.
- 5) The success of any project is down to consistency, whether this be consistency of materials, decisions or people making those decisions.
- 6) Working with the local authorities and consultees from the outset and making projects as much theirs as they are yours always gives better results.