Wells Cathedral West Front pilot study: Setting the tone for appraisal and repair strategies

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Berenice Humphreys *began her career with Cliveden Conservation working as an architectural conservator on numerous projects, varying from fixing plaster decorative ceilings in Northumberland, repairing a Tudor tiled floor in Cornwall, cleaning marble statues in Wales and refixing architectural ceramics in Northern Ireland. Since 2005 she has taken the lead on projects, and now works from the Bath workshop of Cliveden as a Senior Projects Manager. The projects remain varied both in materials and size. Recent projects include consulting on and overseeing the conservation needs during the Archway Project — a scheme to open up a new section of the Roman Baths Museum in Bath, lifting and setting a 5m x 8m Roman mosaic on the wall of Dorset Museum, and works to decorative plaster and timbers at St John's College, Oxford. Berenice also has been involved for many years with the Institute of Conservation, the professional body for practising conservators, and has for the last few years been Co-Chair of the Stone and Wallpaintings Group, organising conferences and lectures on a voluntary basis. With over 20 years' experience in the contracting field, she spends much of her time consulting, estimating, negotiating with clients, architects and her team, and looking after the logistics of projects which frequently require last-minute decision making, as conservation of historic buildings tends not to be predictable. She has delivered presentations to professionals on the repairs of ceramics on the Crown Bar in Belfast, local radio interviews on the repairs to both the Roman Baths and Fordington Mosaic in Dorset, and was part of a recent Discovery Channel* Heritage Rescue *documentary on a water-damaged plaster ceiling at Powderham Castle.*

Abstract

Simon Jenkins placed Wells Cathedral at the top of his list of Top Ten Cathedrals of England and it is easy to see why when the sun dances across the West Front. Adorned with 300-plus sculptures dating from the 13th century, the pattern of decay is somewhat to be expected, but it is perhaps the historic interventions that make the building of such interest to conservators and architects alike. This paper addresses the recent works carried out on the West Front between May and August 2021, which were put together as a pilot scheme of repairs, from which a much larger repair programme could be specified. On a building as significant as Wells Cathedral, repair programmes are proposed as centuries-only events, rather than five-year plans, the impact of a full scaffold being placed across the façade being both technically challenging and disruptive to a small city relying very much on the tourist and filming trade. The repair works carried out and proposed for the future include replacement of severely decayed stonework, 'plastic' repairs in lime mortar, removal of detritus and pigeon guano, and comprehensive recording to understand both the patterns of decay of the stone itself and any repair programme's longevity.

Keywords: conservation, repair mortars, sheltercoat, lime method, recording

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Figure 1: Wells Cathedral

INTRODUCTION

The Cathedral at Wells (see Figure 1) was begun at the east end in 1175, firmly in the Gothic tradition, with the West Front begun around 1230. The two squat towers dominating the skyline are of 14th and 15th-century origin. The cathedral looks out over the Cathedral Green, with an array of 17th–19th-century residential houses, and is accessed through the Chain Gate, a 15th-century arched covered walkway connecting the cathedral to the neighbouring Vicar's Close. Wells is the smallest city in England, and the environment is very much that of a small market town, albeit one with considerable draws for tourists, both the cathedral and the Bishop's Palace on the southern side being popular locations for tourists and film studios alike. There is no train station at Wells.

Visually the West Front takes the eye on both a vertical axis, with six prominent buttresses drawing the eye to God, and horizontally, where some 300-plus sculptural forms set in niches tell a narrative of Old Testament stories and the doctrines of the Christian faith. The figures range from seated and static to considerable movement in the Resurrection tier, naked figures stepping out of their tombs on the Day of Judgement, while the (replacement) figure of Christ sits at the uppermost gable. All of the stonework would originally have been painted, and some traces of this can still be seen today in more sheltered areas.

Deterioration of the stone on the West Front is ongoing, and programmes of repair have for the most part been prompted by falls of stone. Significant treatment programmes were carried out in the late 19th

century, 1903 and the early 1930s, but it is the repairs carried out in the 1974–87 phase that are generally recognised by modern conservators for the ground-breaking techniques developed that inform conservation treatment to this day.

THE MATERIALS

The majority of the stone used on the cathedral is Doulting, an inferior oolite, quarried locally and also used on Glastonbury Abbey. Blue lias is used to provide a striking grey contrasting band, but as a mudstone formation, this is very prone to delaminating, with obvious cleaved layers visible in the remaining lias capitals. Much of the blue lias was replaced in the 1870s with Kilkenny limestone.

The West Front is subject to weathering, and the thermal changes as the sun moves across the face of the building are significant. Early restoration treatments have used hard cementitious materials, and ferrous metal cramps will have led to corrosion, expansion and subsequent deterioration of the stone. Doulting stone is also vulnerable to freeze–thaw processes, and some of the gable stones and decorative carving (the drapery of the apostles) have a number of fissures and delaminations. This can also be attributable to salt efflorescence, but there is not the blistering and open surface seen on other major sites (Tewkesbury Abbey cloisters, for example) which may have been removed during previous repair schemes. The sculptures and niches also prove very popular roosting areas for pigeons and corvids, their guano contributing to both the disfigurement and changes to moisture permeability of the stone. Much of the upper gabling is seen to be replacement stone, and the central figure of Christ, originally flanked by the figures of the Virgin Mary and John the Baptist, was replaced by competition by David Wynne in 1985.

For modern-day stone conservators, the West Front of Wells Cathedral is most notable for being the birthplace of the lime method, a way of treating decaying stone using hot lime poultices followed by 30–50 applications of lime water, and the use of pozzolanic repair mortars developed by Professor Baker and his team in the 1970s. Professor Baker was not the first to have carried out a series of repairs, significant treatments having taken place in the mid- to late 19th century and also the 1930s, but the works in the 1970s–80s were probably the most comprehensive, not to mention using more sensitive materials than the cement and iron of previous phases. Smaller phases have been undertaken since then, with five-yearly inspections being carried out from mobile elevating work platforms (MEWP) access, although it is worth noting that the largest MEWP available does not reach the uppermost parts of the cathedral.

THE PROJECT

The aim of the 2021 phase of works was to act as a pilot study, not just to assess the current condition of the façade, but to develop an easily translatable methodology that could form the basis of a long-term specification for repairs across the whole of the West Front. Although not specifically part of the remit, it also was a good opportunity to review the successes and failures of the Baker and later repairs.

The tender documents were sent out in September 2020, with contractor interviews taking place in January 2021. The contract was formally awarded to Cliveden at the beginning of February.

The works were due to begin with the erection of scaffold on 12th April, 2021, but the clause ‘in the Event of a Royal Death access must be maintained through the West Door’ was hurled into being by the death of HRH the Duke of Edinburgh. Following some delicate negotiations and agreements,

the scaffold began the following week, and the first access to view the sculptures was made at the beginning of May. A strict deadline for completion had been imposed by the cathedral of August Bank Holiday, for the erection and unveiling of a temporary Gormley sculpture.

The pilot study was to focus on the sculptural pieces and architecture of all the levels above the West windows, and in between the two central buttresses. These are recorded as tiers: the Christ in Majesty, the Twelve Apostles, the Nine Orders of Angels and the Resurrection tier. The apostles and angels have been identified by name on the basis of their attributes; however, they were given numbers that related to a numbering scheme drawn up back in the 1900s, to ensure consistency for the archives.

Every process during the pilot study was approached as a trial. The original specification was used only as a guide, meaning close agreement needed to be made with the architect and client (represented by the Clerk of the Works), as all of the works needed to be re-measured and quantified on site throughout each stage (a project manager's worst nightmare).

Key processes needed to be followed to enable the pilot study to take form and be a success.

CLEANING

Cleaning of historic buildings can be controversial, and the desires of the client need to be weighed against the needs of the fabric. For the repair works proposed, it quickly became apparent that removal of biological growth within the open textured surface of decayed stone would be needed to ensure stability and adhesion of mortars and shelter-coats, algal growth being a known factor in failure of repair programmes.

Initially the guano and nesting debris was carefully removed and disposed of, then the stone was sprayed with Algo, a bio-inhibitor, and left to dwell for a period of three days. The surface was then gently cleaned with bristle brushes and water, mechanical/steam being rejected as more difficult to control. No wet cleaning was carried out on areas of polychrome — this includes most of the angels' wings and backs of their heads. There remain thick crusts of sulphate skins on the tops and backs of the angels' heads which were not treated by Professor Baker and his team, but the difficulties he encountered in not losing friable material beneath those skins warned us not to attempt to clean these at all.

Some areas were noted as retaining biological growth, and while ammonium carbonate and tri-ammonium citrate poultices were trialled to remove this further, the team settled simply on a further application of biocide and a brush-down.

RECORDING

Following cleaning, a two-stage recording process took place, using an agreed standard format that was hurriedly developed through a fair amount of brainstorming and meetings, categorising different elements. While documentary evidence of all of the historic treatments and condition surveys does exist in the form of detailed drawings and records, for a number of reasons these were not easily accessible to the team — a frustrating aspect of the project, as this information would have assisted greatly in assessing the condition and stability of the mortars.

The recording needed to be carried out with enough detail for any future analysis of patterns of decay, but equally be able to have the most important and relevant details plotted onto drawings (see Figure 2), which could be reproduced no larger than A3 in the final treatment report. The 'types' of decay were reduced to a maximum of six, and these could be marked up on the images the team had been provided with, along with additional commentary and notes.

The initial recording system needed to be simple for all of the team to understand and use, but also be able to be easy to digitise and share. There sometimes is no substitute for coloured pen on drawings, except in this case there were available high-resolution photogrammetry printouts for marking up, accompanied by an individual notebook for each sculpture within its niche. Working on historic buildings can be a challenge where old processes meet new, and practicalities of using tools on the 13th lift of a scaffold in a rainstorm means that pen and paper will usually win over digital tools. Once recorded by hand, the drawings were painstakingly digitised using Adobe Photoshop, and the RGB colour codes recorded for each annotation, to enable clear records to be transferred across platforms in the future.

Definitions of decay process were agreed with the team, so that they could be categorised between 'delaminating' and 'friable' stone, but also agreement could be made on how to restrict recording to those areas thought relevant to informing the treatment. A review of the success or failure of historic repair processes was not part of the project, but by recording the decay this could form part of a desk-based survey.

Some areas were simply recorded but not recommended for intervention. As an example, on the apostles, a notable feature was the copper pins protruding from the drapery. These pins had almost certainly been used to secure fine fissures to the drapery, but no further conservation works were proposed, as attempting to remove these pins and reset the sections of stone was considered too invasive. Copper also does not deteriorate in the same way as ferrous metals, although can leach copper sulphate, disfiguring the face of stone with verdigris. In the interests of providing a record for future interpretation, these were recorded, but it was thought important not to 'clutter'

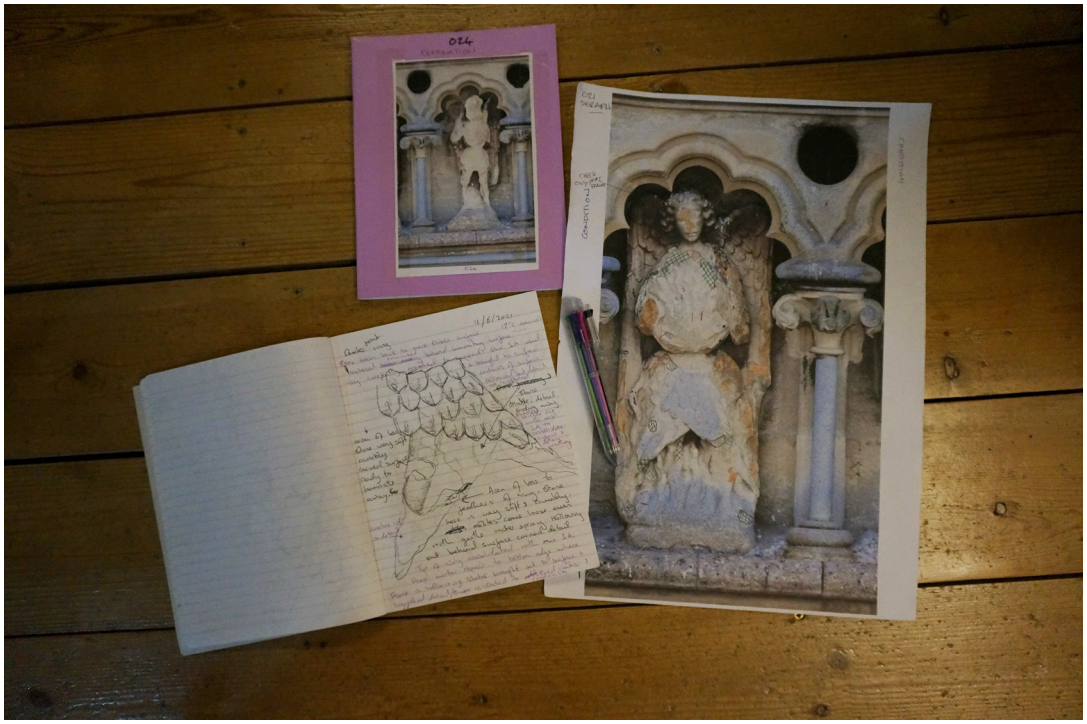

Figure 2: 'Old-school' on-site recording techniques

the drawings by defining each and every historic repair noted.

The condition of the fabric was assessed and areas of decay recorded, both of the stone and any historic interventions. From this, a treatment proposal could be drawn up, again with standard definitions for repairs. So for example, when approaching a historic mortar repair, a distinction was made between 'sound but edges need filleting to support' and 'delaminating — remove and replace'.

The team were lucky enough to be able to involve Nick Durnan, who had worked on the West Front during phases of repairs in the 1980s, and also David Odgers, who had carried out an assessment of the historic repairs elsewhere on the West Front and had also worked on the building during previous phases. This gave a key insight into how repairs were carried out, the processes, and even the failed techniques and methodologies, which would greatly enhance the treatment proposals.

Figure 3: Typical blistering patterns and loss of structure to form

Under a restricted timescale, many of the aspects of the project needed to run concurrently. So cleaning of the tiers was swiftly followed by condition assessment and mortar trials, while further cleaning took place below. The individual members of the team took on an area to work on; it was important to the project that continuity was maintained, so the same person cleaned and then followed up with the condition checking, as the closeness of cleaning an object would aid in identifying areas of concern and getting 'an eye in'. At the same time each team member needed to collaborate, ensuring consistency of recording, working together to spot things their colleagues may not have, and cross-referencing. For this reason the team was kept small, with no more than three to four conservators working, each taking a bit more of a 'lead' — as an example, one conservator took the lead on mortar repair trials, two collaborated on the condition checking and another looked after the sheltercoat trials.

This use of a small team of conservators working together is a reflection of the project during the Baker years, where the team was selected from those with a more sculptural background and days of study in sculpture were integrated into the programme. No such freedom of programme was possible during this pilot phase, but several trips to review the archive were sanctioned.

The intention of the pilot study is to inform any future specifications to the West Front, which places somewhat of a conundrum in the laps of the client. The most suitable team for putting together such a specification are those who have had the most recent and intimate knowledge of the building; however, as with all projects, the tender process means there are no guarantees for continuity of team. It was hoped that by developing a detailed but straightforward assessment process, there would be enough information for the development of this wider specification for works. Prior to this,

collation of the historic archives and review of the drawings showing historic interventions should be carried out as a separate project.

REPAIR MORTARS

A key facet of the works, once recording and cleaning was completed, was the repair mortars. Repair mortars differ from repointing mortars in that they are designed to protect a friable surface of the stone from water penetration and aid water shedding, but can also act in the same way a pieced stone repair may work — replacing missing detailing. Repair mortars are often finer in texture, with a greater use of stone dusts, as they need to accurately mimic the stone to which they are applied in colour, texture and moisture permeability.

It was noted that some of the earlier mortars had survived well, although without the treatment records of that period it could not be confirmed which mortars dated from that phase or which from the later 1990s works. Nick Durnan's input was very useful here, as he could identify individual sculptures he worked on, provide the baseline recipes from his notebook and describe the method of application — for example, the use of sections of Doulting stone being used to tamp down the surface and fine Doulting chippings used to dust the surface and provide an open texture.

Keeping accurate records is essential for any project such as this, but one of the difficulties faced when working in a historic building is the supply of the materials; with aged lime putty difficult to find older than three years, and even during the project, it was apparent that our fine yellow pit sand was no longer yellow. Experience had also showed that some stone dusts created staining; Hornton blue and Hornton brown were particular problems, with the blue being replaced by more stable slate dusts. It is likely that even in future works to the West Front, depending on the pilot study to inform the specification, the mortar mixes will only ever stand as a guide and new trials will need to be carried out. As it is, different base mortars were used in different locations — there is a distinct difference in visual appearance between the top half of the apostles, for example, and the Resurrection tier lower down the West Front.

In addition to designing mortars that were a suitable match for the stone itself, the method of application and also extent of repairs needed careful agreement with the cathedral team. Some of the figures (particularly the angels) are unidentifiable 'blobs' of stone, with blistering to their legs (see Figure 3) and lack of features to their bodies and faces. There are few photographs of the sculptures to aid in building up the shape of the figures, and care needed to be exercised not to be conjectural in the application or styling of repairs. Having said that, it was also important to ensure the figures could be 'read' in their sculptural form.

The focus of designing repair mortars was on the following:

- Mortars should not have feathering edges which would dry out and fail;
- Where blistering edges of the stone (generally on the front side of the angels) were noted, the mortars would carry *over* the blister, to act as a protective skin to prevent further blistering;
- Where historic mortars were sound to the touch but had lost their edges, they would be cut back to sound material and filleted;
- Where mortars sounded hollow to the tap, they would be gently removed and replaced;
- Sculptural form would only be attempted where there was a clear line to follow — legs, arms and in some cases wing tips. The front of the torso was increased on some of the more decayed figures of angels and resurrection tiers to give shape,

Figure 4: The head of St Peter before and after

but this was also in order to prevent water from sitting on the surface of the stone;

- Where the repair was intended to provide sculptural form, the aim was for a closed texture which would mimic the finish of newly carved stone (see Figure 4). Where the mortar was a cap to prevent water ingress, this would be left open to aid evaporation.

SHELTERCOATS

The final 'treatment' of the stonework was to apply sheltercoats. There are many arguments for and against sheltercoats; in some cases they are intended to form a 'sacrificial barrier' which will decay preferentially to the stone beneath, but in other cases they are used simply to unify the colouration of the surface of the treated area. It was agreed on the Wells project that with a history of using sheltercoats, the tradition would continue, and there was good evidence to show they would help to protect the new mortars and any cleaned stone surfaces (see Figures 5 and 6).

As with all the other elements of the project, extensive trials were carried out. Colour matching proved particularly difficult, and differential drying of the sheltercoats took place depending on where the sheltercoat was applied — those applied on mortar repaired surfaces absorbed water differently from those on stone surfaces, and where any small areas of biological growth remained, some white flecks appeared as the alkaline materials reacted with the lichens beneath.

As with the repair mortars, base mixes were agreed, and in some areas two different applications of mixes took place. These were applied to the sculptures, with only those

Figure 5: Angel 021 historical image (date unknown, pre-1930s)

areas of surrounded architecture taking a mortar repair needing treatment.

In addition to the repair mortars and shelltercoats, more structural repairs were needed to some elements. Stone replacements were considered only to areas where they were considered structurally unsound and likely to fail (and become a health and safety hazard) or where stone acts as a protective weathering feature, either to the building below or adjacent material.

STONE REPLACEMENTS

The following areas were replaced, cutting out the existing to as small an area as possible to provide adequate fixing, and new carved stone dowelled into position using a stainless steel dowel and epoxy acrylic resin. All joint beds had a lime mortar slurry.

- The right-hand quatrefoil to the upper gable (see Figures 7 and 8);

Figure 6: Angel 021 before and after works

Figure 7: Quatrefoil section before and during works

Figure 8: Completed stone repairs to quatrefoil

- A section of string course to below the apostles;
- The upper parts of the cross of St Andrew (possibly the third or fourth time this had been replaced);
- Individual foliate arms of stiff-leaf capitals;
- One half of a blue lias capital, replaced this time in blue lias, rather than the Kilkenny used elsewhere.

During high winds it was also noticed that two of the large finials on the upper gable had significant movement, and the scaffold was adapted to allow these to be dismantled and reset on stainless steel dowels.

Lime mortar was used throughout the project. For high-level work and more exposed elements an NHL 3.5 mortar was chosen; while NHL mortars have come under scrutiny over the last few years for their variability in hardness and impermeability, the harder mortar was appropriate as a known material, particularly where there would be a lack of access to monitor.

All repair mortars were carried out using a seven-year-old aged lime putty. Moreton Cullimore limestone sand was chosen for its colour and increased permeability and sieved

by hand. Stone dusts were collected from the Doulting quarry and also sieved by hand, and buff brick dust acted as a pozzolan.

Hand-made ceramic dowels were incorporated into the mortar repairs to act as armatures, and a small dowel of 'Rockbar' was used to bridge a gap when recreating a missing arm (see Figure 9).

Figure 9: 'Rockbar' dowel used as armature for figure

SUMMARY AND LEARNING

As a conservation project, the remit was relatively straightforward, but there were lessons to be learnt across all stages:

- Access to original records and historic reports is extremely important at an early stage;
- Quick learning and development of ideas is needed on a project with limited timescale. It took three on-site meetings with all of the conservation team and all of the client team to agree both the recording methodology, the definitions and the colour coding to be used;
- Small tight-knit teams are to be preferred on projects such as this (see Figure 10). Dissemination of the information gathered still needs to be very precise and clear, but having named individuals in reports allows future projects to make

Figure 10: The team at work

Figure 11: Before works

Figure 12: The completed works

contact and potentially gather additional information that may not make it into a report (this is especially true of things that 'did not' work on site);
- Continuity of the team is also important. There is a case in some trades for using different skill sets at different stages of a project; however, for the pilot study to work effectively, the conservators needed to be present from start (removing the pigeon guano from the figures) to finish (applying sheltercoats as protective coatings) (see Figures 11 and 12) ;
- Longevity of supply of materials cannot be guaranteed — the simpler the base recipes, the better;
- Tall buildings make great nests for pigeons and they will be unperturbed by your presence;
- Tall buildings with scaffold on are seen as a challenge for 'urban adventurers' and you never know when you might find a discarded beer bottle on the top lift of a scaffold.

It is not known when the pilot scheme will be translated to a wider scheme across the remainder of the West Front, but this is likely to begin sometime in the next few years. One of the biggest challenges of the project was the forward planning required, not just from the point of view of Cliveden as contractors, but also the cathedral and client team. Each stage of the project needed to be carefully thought through and recorded with a view to passing on information to future conservators likely to work on the project, and methodologies and materials are ever-changing. The digital recording also needs to be future-proof, and a central repository for the resultant documentation be easily accessible to future users.

The opportunity to examine well-designed repair mortars and see their success and survival, down to even the surface finish remaining, is an added benefit from the project. It was clear to the team that while repair mortars are often given a short life span of five years or so, when well applied and tended during the application process they can continue their function for 40 years or more. Regular review of conservation projects is important, but rarely able to be carried out except on some of the larger cathedral projects such as at Wells.