Bath Abbey Footprint Project: An architect’s view of the project objectives and the works

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ABSTRACT

Bath Abbey is the largest and arguably the most significant building in the World Heritage City of Bath, recognised by UNESCO as a site of international importance. The Footprint Project sought to prepare the Abbey and its associated buildings for the next century of occupation, to ensure that the fabric of the Abbey is properly looked after and appreciated, as well as providing the kind of facilities that a contemporary church and visitor attraction requires. The Footprint Project not only repaired a failing floor but has taken the opportunity to document and research the carved gravestones that made up the floor, record the archaeology beneath the stones and install an innovative sustainable heating system to provide comfort to parishioners. New spaces have been created in the adjacent buildings that will serve the Abbey and those who work in it, repairing the Georgian buildings, but also creating unexpected spaces within them for learning, administration and for the 60-strong Abbey choir. Over ten years in development, and now close to completion, the Footprint Project has tackled major historic damage to the Abbey floor, while also creating a range of new facilities. This paper discusses the Footprint Project, during which the Abbey sought to put its buildings in a condition that will enable them to serve the mission of the church for the next 100 years. It analyses how the removal of the nave pews at Bath Abbey and the repair of its historic floor enhances the significance of the Grade I Listed Building and the outstanding universal value of the city of Bath World Heritage Site.

Keywords: heritage architecture, conservation, ecclesiastical architecture, sustainability, creative reuse

INTRODUCTION AND PROJECT OBJECTIVES

Bath Abbey is the largest and arguably the most significant building in the World Heritage City of Bath. The Grade I listed building sits on a site with a recorded history of human occupation spanning nearly 2,000 years. Situated in the heart of modern Bath, next to the Roman Baths Museum and surrounded by buildings from the Georgian city, the site is recognised by United Nations Educational, Scientific and Cultural Organization (UNESCO) as of international significance.

The Bath Abbey Footprint Project has been in development for over ten years and
the current phase of work has been on site since May 2018. The project tackles major historic damage to the Abbey floor, while also creating a range of new facilities.

The primary purpose of the Footprint Project was to address the ongoing damage to the historic floor surface of the Abbey. This is made up of hundreds of carved floor stones, known as ledger stones, many of which had become damaged to the point where their suitability as a floor surface (and therefore their future) was threatened. This damage has been an ongoing problem that has been progressing for many decades.

The project developed to include three major elements. As well as the repair of the Abbey floor, the pavement vaults were to be reused to house new education facilities and a new interpretation space. The third part of the project required the repair and adaptation of a terrace of Georgian cottages. New spaces were planned for choir rehearsal and the Abbey archive, as well as office space for the clergy and administrative team.

The Abbey defined its project objectives in two documents: a statement of need and a vision statement. There were many aspects to the brief, which required changes to make the existing buildings more flexible, as well as creation of new facilities. The overarching objective, however, was to ‘ensure that the Abbey buildings are fit for purpose for Christian mission throughout the 21st century’.

Apart from Christian worship by an active congregation of around 60, who had a particular need for better facilities. They rehearsed in a semi-basement space, to the south of the Abbey. Built in the 1920s, the Jackson Extension provided space for the Abbey shop and adequate but rather cramped space for the choir to rehearse in. It had very limited daylight and lacked other basic facilities. In summary, there was an urgent need for improvements, to ensure the building would provide for contemporary needs and in so doing help to safeguard its future.

SITE HISTORY

There are three key aspects to the significance of the site. The Roman history of Bath is well known. In AD 60 the Romans established the settlement of Aqua Sulis, on the site of the only hot geothermal spring in the UK. The Abbey was later built on the site of this Roman town and the archaeological remains are one of the best examples of Roman building and engineering that can be seen in the UK today.

Christian history on the site extends back over 1,400 years. In the 7th and 8th centuries there are records of a convent and a monastery. In 973 AD Edgar was crowned King of all England in the Abbey, by Archbishop Dunstan of Canterbury. The ritual Dunstan devised contains features which have lasted to this day. After the Norman invasion, the construction of a great cathedral commenced in 1088. This cathedral fell into disrepair in the following centuries, leading to the construction of the building we see today.

As the Footprint Project utilises spaces outside the boundary of the current Abbey, the other key period of occupation of the site, not surprisingly, is from the Georgian era. The UNESCO statement of outstanding universal value (UNESCO World Heritage List, City of Bath) describes the significance of the city of Bath as follows:
"The Georgian city reflects the ambitions of John Wood Senior, Ralph Allen and Beau Nash to make Bath into one of the most beautiful cities in Europe, with architecture and landscape combined harmoniously for the enjoyment of the spa town’s cure takers."

The Abbey sits surrounded by the Georgian city and immediately adjacent to the Roman Baths Museum. These three aspects contribute to a site with internationally significant buildings and archaeology.

The Abbey we see today was started in 1502 under the order of Bishop Oliver King. It is a late gothic building in the perpendicular style. This is characterised by delicate stonework and a strong vertical emphasis. This is particularly evident in the stone tracery of the windows, with their tall vertical mullions, which give the style its name. It is important to recognise that, despite appearances, the building has gone through a complex series of repairs and alterations over 500 years (see Figure 1). Significantly, this has resulted in a building that the Pevsner guide to Bath describes as of 'exceptional uniformity'.

The fan vaulting of the east end was constructed in the 15th century, the vaults of the crossing from the 16th century. An ornate timber roof and plaster ceiling was constructed over the nave in the 17th century. During the 19th century, two major restorations were undertaken, the second by Sir George Gilbert Scott. The result of this second restoration largely leaves us the building we see today. The roof of the nave was rebuilt with fan vaulting (see Figure 2), to match those of the east end.
and the crossing, as well as extensive work externally. The ‘exceptional uniformity’ of the building can be seen both internally and externally, resulting in a rare stylistic integrity, which is astounding given the building’s long and complex history. The list description states that it is ‘among the most consistently uniform in design’ of the great gothic churches.9

**REPAIRS**

**Repair of the Abbey floor**

The key driver for the Footprint Project was the ongoing deterioration of the Abbey floor. Made up of approximately 2,400 floor stones, including 891 inscribed ledger stones, the Abbey floor has more memorial stones than any other church or cathedral in the UK.10 Many of these precious historic artefacts had already been severely damaged due to subsidence, which was ongoing prior to the start of the Footprint Project. The church burial registers between 1600 and 1845 provide a record of approximately 7,000 burials beneath the Abbey floor11 and the deterioration of these burials has been the cause of ongoing subsidence, which has led to the collapse of the sub-floor and the fracturing of many floor stones (see Figure 3).

The works to repair the Abbey floor have been undertaken in three phases, starting in 2018 and due to be completed in 2021. The process of repair for the floor required the individual assessment, lifting and repair of each floor stone. A trial was undertaken in 2013 to understand the works and to test strategies for repair and rebuilding of the Abbey floor. This work took place in the north aisle and allowed the first inspection of the floor stones, beneath the pews, for 150 years. The Victorian pews and plinths were removed, following which the stones were carefully cleaned and the inscriptions were recorded. This revealed the stone layout as recorded in the impressive floor survey, completed after the Scott works in the 1870s (see Figure 4). Excavations and archaeological investigations were then undertaken, after the floor stones had been carefully lifted and the lime-based floor slab had been removed.

During the restoration works undertaken by Scott (1860–73),12 the whole of the floor had been lifted and rebuilt, incorporating a new heating system. This consisted of a series of trenches with cast iron grilles and heating pipes, common for the period.

![Figure 2: Bath Abbey west end vaults](image)
Archaeological investigations revealed that these works had only disturbed the ground 1m beneath the Abbey floor. The planned floor works for the Footprint Project restricted activity to the zone of previously disturbed soil, thus allowing the undisturbed archaeology beneath to be protected.

Inspection of the floor stones during the trial was encouraging, in that they remained largely untouched since the Scott works (see Figure 4). It also, however, revealed evidence of decay and the need for significant repairs. These repairs would be required to create a floor surface that would be fit for purpose for the next 100 years. As elsewhere in the floor, very serious fracturing was evident in some of the floor stones. Heavy surface deterioration was also evident with the resultant loss of inscriptions on carved stones. This was a particular problem with the Welsh blue pennant floor stones. Some of these had delaminated to a point where their integrity was compromised, making them unfit for use in the Abbey floor. There was also heavy staining to some of the stones caused by tannins from the timber pew supports. This was particularly evident on the white marble stones that are a notable and striking feature of the Abbey floor (see Figures 22 and 23).

The trial works also provided the
opportunity to establish a suite of repair techniques to deal with the various types of floor stone defects. The first type of repair was identified for large fractured stones. These were reassembled by using a range of stainless steel rods or bars, selected to suit each stone. The stones were either drilled or carefully cut on the back to allow the reinforcement elements to be fixed in place using resin (see Figure 5).13

The second type of repair was identified for fractured marble stone inlays. These were reassembled and consolidated using a modern textile backing (aramid fibre) and resin. This was bonded to the back of the stone fragments to hold them together. Plaster of Paris was then used to neatly point up the matrix of cracks, to consolidate and represent the stone. The newly assembled marble was then either reset into its original backing stone, or set into a new backing stone. Many of the marble backing stones were made from Welsh blue pennant, many
which had suffered from heavy delamination, due to damp and the cycling of moisture movement in the floor. Where absolutely necessary, these were remade from new stone, to provide a durable new floor stone which was intended to support and protect the marble inlays (see Figure 6).14

Discoveries during excavations in the Abbey
The site of Bath Abbey has a long history, with the current building built on the foundations of the earlier Norman cathedral. This was an immense building — the current Abbey would almost fit into just the nave and side aisles of its Norman predecessor. The works revealed some spectacular glimpses of the earlier buildings from the site. Ornate plaster fragments from a timber and plaster ceiling built over the nave of the Abbey during Tudor times were uncovered.

The mighty stonework of the Norman cathedral column bases were also revealed during excavations, as well as various fragments of carved figures from the same period (see Figure 7).15 These discoveries were an extremely exciting part of the project, as the finds provided new evidence that testified to the history of the building.

During the floor works, several lead-lined coffins were also uncovered (see Figure 7). These must have been placed into the subfloor during the Victorian reordering, prior to the reconstruction of the floor during that period. The coffins needed to be reinterred and the preference was for them to remain within the Abbey. During the excavation of a pit into which the burials could be placed, one of the most startling finds of the project was uncovered. It was known that the floor of the Norman cathedral was approximately 2m below the current Abbey

Figure 6: A new backing stone and marble inlay, which also required consolidation repairs
floor level; however, it was not known quite how intact the floor was. The excavation revealed a complete historic floor surface (see Figure 8), suggesting that the floor may be largely intact. The medieval floor tiles were a combination of stone and encaustic clay tiles, the surface of which had been decorated with various crests and medieval iconography. The striking graphic pattern of the floor tiles revealed that the 900-year-old floor must have been a spectacular feature of the building.

One of the most distinctive and impressive features of Bath Abbey is the fan vaulting (see Figure 2). This extends throughout the building, providing a delicate and daring ceiling, which brings together the columns and walls of the building beneath. The consistent treatment of the fan vaulting belies the history of the building, which has developed over five centuries.

In the listing description, the building

Figure 7: Archaeological excavations during the first phase of floor works at the east end

Figure 8: The stone and tile floor of the Norman cathedral uncovered in 2018 during works to reinter burials uncovered during the works
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(largely of 1499–1533)\(^{16}\) is attributed to the master masons Robert and William Vertue, who were also masons to King Henry VIII. They were well known at the time for their stone vaulting and are thought to have undertaken the fan vaulting of the crossing of St George’s Chapel, Windsor, as well as the vaulting of the Henry VII Chapel at Westminster Abbey.\(^{17}\)

During the summer of 2020, a remarkable discovery was made. As archaeological works proceeded, the distinctive mason’s mark of William Vertue was discovered on stonework (see Figure 9). This was revealed during excavations for the new interpretation space beneath the Jackson Extension. The discovery of this physical evidence of Vertue’s hand on the building was a hugely exciting moment, which again provides new evidence that testifies to the building’s history.

**Removal of the nave pews**

A controversial aspect of the Footprint Project was the proposed removal of the nave pews, which date from the major phase of refurbishment work undertaken by Sir George Gilbert Scott in the late 19th century. The Scott works were extensive, including the completion of the nave vaulting and opening up of the Abbey interior, as well as improved means of lighting, ventilation and heating. Externally these works included significant restorations to the east and west transept windows. In addition, extensive works were undertaken to the external pinnacles, parapets and flying buttress structures, undoing some of the earlier 19th-century work undertaken by G. P. Manners. In addition to the major works to the structure of the exterior and interior of the Abbey, Scott also undertook work to the Abbey furnishings, removing

![Image of mason's mark](image_url)

**Figure 9:** The mason’s mark of William Vertue attributed to the Abbey building started in 1502, uncovered during excavations in the summer of 2020
many early 19th-century elements, replacing them with new oak seating, an oak pulpit, a reredos and altar, a communion rail, a brass eagle lectern, porches, light fittings and a sanctuary screen.18

The Abbey wished to remove the nave pews to improve the flexibility of the building for worship and other community events. In addition, removal of the pews also allowed the Abbey to pursue its desire to ensure that ‘hospitality and justice’ are extended to all visitors by allowing wheelchair users to be offered access anywhere in the building. There were strong objections to the proposed removal of the nave pews, which were considered carefully through the Faculty Approval process.

A consistory court hearing was granted to the Victorian Society, to allow the case for and against removal of the nave pews to be heard and considered properly. This took place in 2017 in the Abbey itself. Barristers for the Abbey and the Victorian Society brought their cases in written statements and witness testimony. The witnesses were also cross-examined as part of the court hearing overseen by the Chancellor.

The Abbey’s case was based on an assessment of the harm to the significance of Bath Abbey caused by removal of the nave pews, which it was argued was outweighed by the heritage benefits of the proposals.

It was contested that the nave pews represented only a minor element of the Abbey’s development and therefore their removal would cause little harm to the overall significance of the building. It was established through evidence brought before the court that the pews were products of a standard process with nothing unusual about their form, material or method of manufacture. Their layout was standard and the concept of applying variation in carving was also not unusual. The nave pews, although highly visible, were considered to be a relatively unimportant part of one phase of the extensive Scott works. As such, the harm caused by their removal, to the architectural and historic interest of the Abbey as a whole, was very limited. This harm, it was argued, would be outweighed by the heritage benefits that flowed from the removal of the pews.

The heritage benefits were expressed as follows. First, the ability to appreciate the medieval architecture in the manner that it was originally intended — in particular, a better appreciation of the base of the pillars where they meet the Abbey floor. Secondly, the ability to observe and appreciate the floor stones that are uncovered by removal of the pews and plinths. These stones tell the stories of the lives lived in historic Bath, largely from the Georgian period. The ability to appreciate the many wall memorials would also be improved by the proposals, as the pews impeded access to view the internal walls. By making visible and re-presenting the Georgian floor and wall memorials, the removal of the pews enhances both the significance of the Grade 1 listed church and the World Heritage Site, by revealing the Georgian history which is key to the outstanding universal value of the city of Bath.19

ADAPTIONS

In addition to the floor repair work that has been undertaken during the Footprint Project, significant adaptions of the existing buildings have also taken place to create new facilities, the purpose of which is to allow the Abbey to provide the welcome and hospitality referred to in its vision statement. The Abbey emphasised the need to ensure that everyone should benefit from this welcome, whether young or old, able-bodied or otherwise.

In order to create these new facilities, a wide range of options was considered, with the design proposals going through a lengthy development process, over several years, with many stakeholders. The ambition
was to find an approach that would minimise interventions to the historic buildings and archaeology, while providing spaces that were fit for purpose. The public benefit, gained by provision of new and improved facilities, was the major justification for interventions and adaptions of the historic structures. The objective was always to minimise interventions to maximum effect, while preserving the character of the existing buildings. The interventions also sought to enhance the reading of the various periods of development and sometimes required the removal of contemporary layers to reveal the principal elements. In particular, the new education space benefited from this approach, with many layers of masonry additions removed to reveal the distinctive profile of the Abbey walls (see Figure 12).

THE NEW INTERPRETATION AND EDUCATION FACILITIES

Over half a million people visit the Abbey in a typical year. A key objective of the project was to provide better interpretation of the Abbey buildings and their history for visitors to the city and local people. To achieve this, a new space has been created beneath the Jackson Extension: a single-storey addition, south of the Abbey. This also creates a new entrance into the vaults spaces and was achieved by excavating 2.6m beneath the existing floor level and inserting a new stair for public use.

Prior to commencing the excavations, the archaeological risks were assessed across the whole site and formation levels defined to limit excavation depths. The excavations were overseen by the expert archaeological team, who also undertook excavations themselves, where artefacts and structures were required to be carefully exposed and recorded. A written scheme of investigation was prepared by the Abbey’s archaeological adviser to define this process.

During the excavations in the Jackson Extension, basement walls of dwellings built in the 18th century were uncovered to reveal a striking scene (see Figure 10). The plastered walls and fireplaces of the basement interiors bore evidence of domestic habitation from the Georgian period, standing among the walls of the current Abbey and

Figure 10: Archaeological excavations undertaken in summer 2020 for the new interpretation space
the older stonework of the Norman foundations. The walls were all exposed prior to detailed recording and removal. Excavations ceased in order to avoid damaging what was thought to be a historic pavement surface from the Norman cloisters. Stonework of the Norman cloister walls was also uncovered, which will remain exposed once the works are complete, to allow this aspect of the building’s history to be appreciated.

Within the space formed by these excavations a new interpretation space is being created (see Figure 11). This long, low space will create a dramatic setting for the interpretation of the Abbey’s history. The buttress stonework of the Abbey walls has been left exposed, forming a strong rhythm of bays, which frames the exhibition material. Into one of the bays a new stair is being formed, with a large rooflight above, which will provide a glimpse of the Abbey tower. This stair is a pivotal feature of the works, as it provides a new link between the Abbey and the vaults spaces. It is also the first step on the new route between what will be the new choir rehearsal spaces and the interior of the Abbey.

The new route aims to improve the legibility of the vaults level, from what was previously a disorientating labyrinthine arrangement of interconnected vaults. Connecting all the spaces with a clear circulation arrangement aims to achieve this objective. This aspect of the project was very important, as without identifying a simple set of interventions that would create a clear arrangement, the vaults would remain intimidating to visitors (most of whom would not know the building and would be put off using the new facilities).

In the 18th century pavement vaults (once used by Isaac Pitman, famous for his system of shorthand writing) the second major new space has been created. The education space has been created to provide a base for the Abbey to host school groups. One of the challenges with reusing the stone vaults was their scale; although extensive, each of the

Figure 11: Visualisation by FCB Studios of the new interpretation space being created following excavations as part of the Footprint Project
vaults spaces was relatively small. To create a single space to host a class group of around 30, it was necessary to link together more than one vault.

Two of the vaults were larger than the others and were orientated to allow them to be linked together, using a new concrete frame. Construction of these frames required the propping of the vaults to support their weight, which allowed the new openings to be formed. The formwork for the new concrete was then constructed to allow the concrete to be cast. Only after this process was completed could the propping be removed, ensuring that the loads were taken by the concrete frames first. This was repeated to construct nine new openings in the vaults, the largest of which is the new education space (see Figure 12). Additional opening up of more recent structures allowed daylight to be brought into the education space via an external lightwell beneath the vestry. A new rooflight beneath the south transept provides more daylight as well as unique perspective of the south transept window, looking up to the perpendicular mullions and complex stained glass towards the sky.

Full disabled access to the entire vaults level has been created by inclusion of a new platform lift to serve the exhibition space. A ramp then makes the transition down into the pavement vaults level. This provides

Figure 12: Site progress in summer 2020 and a visualisation of the new education space
access to the new education space as well as fully equipped disabled changing facilities (only the second in Bath). From the vaults spaces, level access is provided to the other facilities. These include the new archive room as well as the new choir rehearsal spaces and the Abbey administration offices (via a new lift in the adjacent Georgian terrace).

ARCHAEOLOGICAL FINDS IN THE VAULTS

Before moving on to describe the other aspects of the project, it is worth mentioning a couple of significant archaeological finds uncovered in the vaults. Among the foundations of the 18th-century pavement vaults and the stonework of the foundations of the Norman cathedral, the archaeological team uncovered more evidence of the Roman period. This included a 1,700-year-old Roman coin, which was minted during the period of Emperor Constantine I. This was a nice coincidence, as Constantine I was the first Roman Emperor to convert to Christianity.22

It was known that the areas south of the Abbey, occupied by pavement vaults, had been used for burials during the medieval period.23 The excavations revealed many burials, notably including a burial technique whereby the body was laid onto a surface of charcoal, which is thought to indicate a higher-status burial.24 All the burials were expertly exposed and recorded in accordance with the written scheme of investigation.

Lastly, a remarkable discovery was made beneath the footings of the Georgian terrace of Kingston Buildings. While constructing the foundations for the new structural work, a section of intact Roman mosaic floor was uncovered (see Figure 13).25 Previously fragments of mosaic had been uncovered in the excavations, but the discovery of an intact portion of mosaic floor surface was very impressive. This feature was recorded and left intact before being carefully covered over to remain beneath the new construction.

THE NEW CHOIR REHEARSAL SPACES AND ADMINISTRATIVE OFFICES

A terrace of Georgian cottages south of the Abbey, known as Kingston Buildings, had previously been used as accommodation for members of the clergy and the Abbey administration staff. The buildings, while remaining in use, were in a poor state of repair. Many minor defects were gradually causing damage to the building fabric and had created an environment that was unappealing and difficult to manage. A number of minor alterations had been undertaken in the past in order to link together the cottages, but this had resulted in a strange arrangement of interconnected rooms without a clear circulation system. The basement spaces had suffered from unsuccessful attempts to prevent damp, with the
result that many of these spaces had become uninhabited. Due to these many defects, a comprehensive repair strategy was prepared.

The basements were known to be at risk from radon gas, a naturally occurring radioactive gas that can cause lung cancer. It can infiltrate buildings in areas of high risk and requires very specific protection measures to prevent this. This risk precluded the use of traditional vapour-permeable floor construction techniques in Kingston Buildings and the pavement vaults as they are not designed to prevent radon ingress. This problem had to be taken with the utmost seriousness because of the risk posed to health.

The presence of radon can be monitored simply, and levels above permissible standards would prevent the new spaces being used, without highly disruptive and intrusive retrofit of protection measures. To avoid this, a system of below-floor chambers and vent pipework was installed. This provides a route out for any radon present in the ground, rather than entering the interior spaces. A radon-proof barrier membrane was also incorporated beneath the floor slabs. A specialist positive air pressure system was also installed around the new archive room, to allow drainage in case of flooding, while also providing radon protection.

The roof coverings of Kingston Buildings were removed to allow repairs, including to the chimneys and leadwork. A new eaves detail was also added to the rear of the terrace, to improve the weather protection to the top of the south façade. Lack of regular maintenance, inappropriate interventions and historic application of paint finishes had caused significant stonework deterioration of the exterior façade. The paint was carefully removed with a low-pressure water and inert granulate system, following which all loose and friable stone was also removed with hand tools. After this, careful mortar repairs and new stone indents were undertaken to consolidate the wall surface.

The walls of a Georgian house in Bath consist of only 150mm of Bath stone ashlar walling, with a lime plaster interior finish. This means that the condition of the exterior face is critical to avoiding water ingress and damp on the interior surfaces. Windows and other external joinery were also removed for repair. Original materials were retained generally, with repairs using like-for-like materials where required. External paint finishes were retained and repaired on the front elevation following a cleaning trial. This revealed the masonry to be generally sound and a paint surface that proved very difficult to remove successfully. Loose paint finishes were removed, and a breathable mineral paint system was applied to at least provide moisture movement in the walls where the modern coating had broken down.

Internally there were very significant alterations made to the Georgian terrace to allow the new choir rehearsal spaces to be created. Two of the terraced houses were joined together over two floors, to create a large rehearsal space for up to 60 choristers. This was a radical intervention into the small-scale cellular structure of the Georgian terrace of houses. As well as providing much-needed facilities for the Abbey choir, this intervention was justified by the public benefits that arose from using the previous choir rehearsal space to create a new historic interpretation space, as well as an entrance for the new education space. Both these new facilities are provided as a facility for the general public and visiting school groups.

The large size of the new choir rehearsal space was achieved by insertion of a new steel structure of beams and columns. This was configured to support internal walls that previously created subdivision between rooms, but also the thicker wall and chimneys that previously separated the cottages. Pairs of large steel beams and columns were used to achieve this with a concrete ground beam to distribute loads into the ground. This was clearly a very intrusive process, which was justified by the very significant
benefits of the overall scheme. In addition, the reconfiguration allowed the spaces of the Georgian basements to be brought back into useful occupation, fulfilling the imperative to safeguard the future of the buildings.

Entering this large double-height volume, after approaching what appears to be a modest series of cottages, is impressive. With a variety of timber linings, integral music storage and ceiling reflectors, the acoustic character of the space is designed specifically for choir rehearsal (see Figure 14).

Adjacent spaces have been created in existing rooms for a second, smaller rehearsal vestry, an office for the choirmaster as well as a small robing room and toilets. All these spaces are connected by a new below-ground gallery space, created after the removal of the series of small pavement vaults in front of each cottage. This space terminates the new below-ground route which passes through the vaults to the Abbey. The choir will be able to move from the rehearsal space into the Abbey without going outside. It is

Figure 14: New choir rehearsal space, visualisation by FCB Studios
envisaged that this route will allow the choir spaces to also be used as green room facilities for performances in the Abbey.

A new reception for the Abbey offices is located on the ground floor of Kingston Buildings to provide a public entrance. Along with this, a new restroom and kitchenette has been created for use by the team of volunteers, who assist with the day-to-day running of the Abbey. The upper floors are dedicated to offices for the clergy and administrative staff. At first-floor level, a new connecting route has been created through the centre of the cottages, replacing a haphazard arrangement of stairs, doors and connecting rooms. This was previously very inconvenient and created barriers to natural communication within the organisation.

Within the taller of the cottages, a new lift provides disabled access to all floors of the building, as well as connecting Kingston Buildings to the facilities in the vaults.

THE SUSTAINABLE HEATING SYSTEM
The need to reduce the environmental impact of the Abbey buildings was understood from the inception of the project, as was the unique opportunity to use the nearby hot spring waters, after which the city is named.

The hot spring waters rise from the ground via a series of pools within the Roman Baths complex and its adjacent buildings. Having travelled beneath the Mendip Hills, over the course of 10,000 years, the waters emerge from the ground at a temperature of more than 40 degrees Celsius. Approximately 1 million litres of water each day are discharged into the various pools, from which it makes its way to the River Avon, via an underground culvert called the Great Drain. This represents a huge untapped energy source.

As the Great Drain passes 7m beneath York Street, it runs adjacent to the basement of Abbey Chambers, one of the buildings occupied by the Abbey. This created the opportunity to connect into this valuable heat source. During late 2020 and progressing into early 2021, works to construct the heat extraction system in the Great Drain have been taking place.

A series of ten pairs of stainless steel heat exchange plates are being assembled in the water of the Great Drain, connected by insulated flow-and-return pipework, which allows water to be circulated through the plates. This water is then pumped through the adjacent buildings and beneath the pavement, 80m back to the Abbey plant room.

Heat exchangers within the plant room are used to extract the heat from this ‘closed loop’ system for use within the Abbey and all the other spaces occupied by the Footprint Project. The term ‘closed loop’ refers to the heat exchange pipework being closed to the hot spring water, which merely passes by the heat exchangers without entering a pipework system. This arrangement was chosen due to the highly aggressive nature of the hot spring water and the impact this would otherwise have on pipework, pumps and heat exchange equipment.

REBUILDING THE ABBEY FLOOR
The process of repair for the Abbey floor stones, described earlier, was only part of the challenge in repairing the Abbey floor. A new floor structure was also required.

Gradual subsidence of the floor and subsequent damage to the floor stones had been taking place. This was due to the deterioration of more than 7,000 burials, leading to the collapse of the primitive lime-based floor slab that supported the floor stone surface.

After consideration of many options and consultation with Historic England, the Society for the Protection of Ancient Buildings (SPAB) and the Diocese, the structural engineers developed a design for a new concrete floor slab. This new floor slab was to be constructed within the 1m
zone that had been previously disturbed during the Scott works, thus allowing the undisturbed archaeology beneath to remain untouched. It was also designed in a way that accepts the inevitable further collapse of the subsoil beneath, without affecting the new floor, which spans over localised voids or soft spots.

**The modified Scott approach**

This approach was characterised as ‘the modified Scott approach’ because during the Scott works, similar problems of subfloor stabilisation had to be addressed. This was done by excavation and construction of a new lime-based floor slab, on which the stone floor surface was then constructed. The subsequent problems of damage to the Abbey floor stones, and as a result the long-term viability of the floor, were caused by the inability of the lime-based slab to cope with extensive collapse of the soil beneath.

The new proposals sought to deal with this problem by the design of a new floor slab that would provide a sound background and support for the stone floor surface, and also have the ability to bridge over soft spots and voids that are likely to occur in the future. There are several features of the new structure that assist with this objective. The new fill material, imported to provide a base for the new slab, is reinforced with a tensile mesh. This is designed to help the fill material provide support, despite ongoing movement in the soil beneath. Secondly the reinforced concrete floor slab has the ability to self-span over areas of the floor where sub-floor collapse may cause the fill material to locally subside. The stainless steel reinforced concrete floor also has the ability to deflect (within limits) to spread floor loads over the sub-floor material. This is important to help avoid localised loading of the sub-floor, following movement, which would accelerate further collapse.

The use of concrete itself for the new floor construction is also contentious, as careful management of the sub-floor moisture is important to avoid causing damp on the masonry of the existing columns and walls. Installing new concrete floors with damp-proof membranes, which trap moisture, is well known to be the cause of damp, because the adjacent vertical masonry elements become a path for moisture to escape, causing damp and masonry decay.

The question of moisture movement beneath the Abbey floor was considered carefully prior to finalising proposals for Faculty Approval. A hygrometric study was commissioned by an academic at the University of Bath. The conclusions of this study were that the floor stones of the Abbey floor were relatively impervious to moisture movement and that the majority of moisture transfer from the existing sub-floor to the atmosphere in the Abbey was via the floor trenches, which were constructed of Bath stone. Proposals were also assessed, and it was concluded that breather holes located along the services trenches would not adversely affect the moisture movement under the Abbey floor. This approach was developed to include a clean stone ventilation layer beneath the concrete slabs which were vented into the service trenches with breather holes. This formed the final proposals that gained Faculty Approval and have been constructed.

Having decided to lift the Abbey floor, this created the opportunity to enhance the way that the Abbey is heated. The Victorian heating system consisted of heating pipes set beneath cast iron floor grilles, as was common for the period. The problem with using this type of system in large-volume buildings is well known. It results in uneven heating at low level as well as cold downdrafts from the large areas of glazing, which contributes to uncomfortable conditions in cold weather and inefficient use of energy. To combat these effects, a new underfloor heating system has been incorporated in the design of the Abbey floor, powered by the
hot spring water. This is supplemented by fin tube heaters, located in new trenches, beneath the reused Victorian cast iron floor grilles.

The main floor works were undertaken in three phases, to allow the Abbey to continue to function on a day-to-day basis. During each phase of work, an evaluation process was undertaken which summarised the results of the individual stone assessments. Any stones that were irreparable or otherwise unfit for reuse were identified and the remaining stones were then used to create a new floor stone layout.

The objective of the new floor layout was to place the floor stones as close as possible to their original position. This would minimise changes in the floor pattern and avoid cutting stones unnecessarily, as despite appearances, they do not fit together in a regular pattern. There were, however, a number of reasons why floor stones could not be relaid in their original position.

First, the arrangement of floor trenches was altered in the nave to counteract the strong downdrafts from the large clerestory windows. In the central quire aisle the floor grilles were not reinstated, as floor trench heaters were no longer required in this area. This gave the opportunity to re-present the stones of the entire central aisle, which could be aligned. Previously they had been

Figure 15: Plan by FCB Studios of the new floor relay plan for Bath Abbey, completed in autumn 2020
Figure 16: Floor relay works being undertaken in 2019, including an area of oval wall memorials, previously utilised as floor stones.

Figure 17: View of the east end following completion of the first phase of works in 2019.

Figure 18: Mortar samples — trial mixes to achieve a range of tones.

Figure 19: Care was taken with the pointing to retain the shape of the stones, to avoid adverse impact on the appearance of the floor.
staggered between two lines of floor grilles, which did not acknowledge the importance of the central east–west axis of the building.

To minimise the visual impact of cabling in the Abbey, electrical trunking was incorporated in the floor, around the base of each column. This trunking was concealed by new, removable stone covers. Other smaller changes to the earlier floor layout were made to avoid the adverse visual impact of floor grilles and to incorporate new floor access panels, notably in the crossing and transepts.

The resolution of these issues, along with new stone where absolutely necessary, resulted in the new floor layout. This was prepared first for the east end to allow the initial phase of work to be completed. Latterly, the final phase of the Abbey floor works was undertaken in late 2020 and the new floor layout completed. The resulting drawing (see Figure 15) is the culmination of thousands of individual stone assessments and many years of technical work by the project team to allow the floor to be represented. It is a contemporary version of the beautiful floor survey plan prepared after the Scott works 1863–75.27

After the new floor layout was prepared, the floor stones could be carefully relaid (see Figure 16). As with all the works to the Abbey floor stones, this was expertly done by the specialist conservation team. The stones were laid onto a bed of lime mortar, which varied in depth due to great differences in floor stone thickness. Some of the larger stones are nearly 2m in length and over 120mm thick. After the stones had been set in place, the careful process of pointing and mortar repair followed. The objective is the careful re-presentation of the floor, to create a useable and safe floor surface. The challenge has been to achieve this objective while protecting vulnerable features of the stones and not distorting the geometric pattern, which careless application of mortar would cause (see Figure 17).

A palette of lime mortar types was created to allow a simple mix of common constituents to be used to create a variety of mortar colours (see Figure 18). These could then be used as necessary over the floor, also being simple to replicate for future repairs. Pointing was undertaken in a consistent mid-grey colour, with darker or lighter mortars used to match the colour of stones that required plastic repairs (see Figure 19). Trial areas were undertaken to establish agreed standards, which were discussed with representatives of Historic England. The results of the first phases of work on the Abbey have been well received and the moment when the complete floor has been represented in its entirety is now eagerly awaited.

CONCLUSIONS

The removal of the nave pews at Bath Abbey and the repair of its historic floor enhances the significance of the Grade I Listed Building and the outstanding universal value of the city of Bath World Heritage Site. The fine work of the Victorian period remains a strong feature of Bath Abbey; however, the 500-year-old building benefits from a powerful re-presentation that provides an opportunity to appreciate it in a new way. This is created by the open floor within the nave, reminiscent of its pre–Victorian days (see Figure 20).

During the Footprint Project, the Abbey has sought to put its buildings in a condition that will enable them to serve the mission of the church for the next 100 years (see Figures 21–23). It is imperative that this is successful for the ongoing relevance of the Abbey to the community of Bath and also for the protection of its buildings. In a similar way, the new uses identified for Abbey Chambers, the vaults and Kingston Buildings will also help to ensure the ongoing survival of these precious heritage assets for future generations.

The Abbey’s objective to enhance the significance of its buildings and the city
Figure 20: Visualisation by FCB Studios of Bath Abbey nave depicting the relaid floor
Figure 21: Bath Abbey nave, March 2021. (Photography by James Newton)

Figure 22: Bath Abbey north side aisle, March 2021. (Photography by James Newton)
Figure 23: Bath Abbey, March 2021
of Bath, along with the heartfelt desire to offer hospitality and justice to all, make this project both unique and exemplary.

APPENDIX
Approvals

Faculty Approval: Programme of works forming part of the Bath Abbey Footprint Project (Items a to m). Granted 30th November, 2015.

- **Further Order**: Floor repair methodology in accordance with the application from the parish dated 15th June, 2016. Granted 30th November, 2016.
- **Further Order**: Treatment of coffins and human remains displaced in the course of the Footprint Project. Granted 1st October, 2018.
- **Further Order**: Recording of the nave pews, a scheme for display/redeployment of a proportion of the pews, disposal of pews, replacement with new chairs following approval of a specimen. Granted 18th December, 2018.
- **Faculty List B Application**: Application for new floor coverings for entrance mats in the Abbey. Granted 2nd December, 2019.

Bath Abbey Footprint Project planning and Listed Building Approvals: Provision of improved public and ancillary support facilities to Bath Abbey, alterations to 8–13 Kingston Buildings, basement of Abbey Chambers, the 1920s Jackson Extension to Bath Abbey, the Clergy Vestry and adjoining vaults and cellars south of the Abbey, creation of newly excavated below ground spaces north of Kingston Buildings and below the Jackson Extension, associated landscape improvement works to the public realm and to the garden north of the Seventh Day Adventist chapel.

- **Full Planning Consents**: Application Nos: 12/03335/FUL, 16/02022/VAR, 17/04173/NMA, 18/02289/VAR, 18/00295/VAR.
- **Listed Building Consents**: Application Nos: 12/03336/LBA, 16/02439/VAR, 17/04168/VAR, 18/02291/VAR, 18/00296/VAR.
- **Scheduled Monument Consent No**: S00180869.

Great Drain works: Proposed amendments to York Street hot water drain, Abbey Chambers vaults (Gd II), the rear yard of Kingston Buildings (adjacent to the Gd II listed terrace), and the existing plant room for Bath Abbey (adjacent to the Gd I listed Abbey church). To accommodate new pipe-work and equipment, to serve the new hot water heating system for Bath Abbey.

- **Listed Building Consent, application No**: 16/02447/LBA.

Approvals for works to Bath Abbey plant room: Modifications to the existing Bath Abbey plant room vaults to accommodate a new sustainable heating system.

- **Listed Building Consent, application No**: 17/04451/LBA.
- **Full Planning Consent. Application No**: 17/04769/FUL.

Approvals for works to the gate post adjacent to the Adventist Church: External work including dismantling and storage of gates, prior to repair and reinstatement to match existing to allow works to proceed under Applications 18/00295/VAR and 18/00296/VAR and to maintain access to properties 4 and 5 Terrace Walk and 18 York Street.
• Listed Building Consent, application No: 19/00734/LBA.

*Approvals for works to form the Roman Baths escape link:* Internal work to facilitate the adaption of the existing Roman Baths Museum storage vaults to form a new fire escape.

• Listed Building Consent, application No: 20/00343/LBA.
• Scheduled Monument Consent No: S00236369.

*Approval for Abbey Chambers electrical relocation works:* Internal alterations to relocate the existing electrical equipment in the basement of Abbey Chambers to the upper floors.

• Listed Building Consent, application No: 20/01283/LBA.

*Approval for Abbey Chambers floor works:* Internal alterations for the temporary removal of existing floorboards and full reinstatement following works to the space below.

• Listed Building Consent, application No: 20/00767/LBA.

*Approval for a new external door to Abbey Chambers:* Proposed new opening to rear yard of Abbey Chambers.

• Full Planning Consents. Application Nos: 15/03883/FUL, 18/02602/NMA.
• Listed Building Consents. Application Nos: 15/03884/LBA, 18/02603/VAR.

**Supporting documents and reports**

**Key project briefing information**

Bath Abbey Briefing — Vision Statement, 2012
Bath Abbey Briefing — Statement of Need, November 2015
Bath Abbey — Interpretation Plan, November 2015

**Key significance and archaeological reports**

Archaeological Report — Cotswold Archaeology, April 2011
Archaeological Report — Kim Watkins, October 2015
Archaeological Report — Cambrian Archaeology, November 2015
Architectural History Practice — Abbey Furnishings Significance Assessment, May 2015
Architectural History Practice — Kingston Buildings Significance Assessment, December 2011
Architectural History Practice — The Floor of Bath Abbey Report, 2011
Rowena Tulloch — Significance of Bath Abbey Floor Report, May 2015
Heritage Statement — FCB Studios, July 2012

**Key technical reports**

Faculty M&E Services Report — Buro Happold, May 2015
Faculty Technical Design Report — Mann Williams, 2015
Faculty Architect’s Report — FCB Studios, May 2015
Abbey Floor Hygric Flow Report — Mike Lawrence, May 2015
Trial Floor Repairs Report — David Odgers, November 2015
Floor Trial Report — FCB Studios, November 2013
Methodology for Lifting of Ledger Stones — FCB Studios, 2015
Fleming and Baron — Acoustic Statement, December 2012
Acoustic report (Song School) — Fleming and Baron, June 2012
Disability Access Audit — Jayne Topliss, July 2012
Abbey Access Audit — Jayne Topliss, March 2012
Planning Design and Access Statement — FCB Studios, July 2012
Management and Maintenance Plan — FCB Studios, November 2015

Protect team
Client — Bath Abbey
Architect — FCB Studios
Project management and cost advisers — Synergy
Building services engineering — Buro Happold
Structural engineering — Mann Williams
Lighting — Michael Grubb Studios
Landscape architect — LT Studios
Archaeological adviser — Cambrian Archaeology
Archaeological contractor — Wessex Archaeology
Acoustic adviser — Fleming & Barron
Main contractor — Emery

REFERENCES


(8) Ibid., ref. 7.

(9) Ibid., ref. 3.

(10) Dr Oliver Taylor, Bath Abbey, Head of Interpretation, Learning and Engagement (personal statement).

(11) Ibid., ref. 10.

(12) Ibid., ref. 7.


(14) Ibid., ref. 13.


(16) Ibid., ref. 3.

(17) Ibid., ref. 7.


(19) In the consistory court of the Diocese of Bath and Wells, Re: The church of St Peter and St Paul, Bath (Bath Abbey), closing submission on behalf of the petitioners [2017] ECC B&W1.

(20) Cotswold Archaeology Bath Abbey Archaeological Evaluation April 2011.

(21) The Architectural History Practice, Development History and Significance Assessment, 8–13 Kingston Buildings, 11a York Street, Abbey Chambers,1 Church Street and 6 and 7 Kingston Buildings with the vaults and cellars south of Bath Abbey.

(22) Wessex Archaeology, Twitter, 27th June, 2018.


(25) Wessex Archaeology (July 2019), ‘East of...

