SUSTAINABLE PAST AND FUTURE GUIDE

November 2021

RIBA
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CONTENTS

FOREWORD

For far too long we have failed to take a holistic approach to our built environment, with dire consequences. In 2021, scientists issued some of their starkest warnings yet about the unprecedented rate at which our climate is warming (IPCC 2021). The built environment is identified as one of the main culprits in the UK (CCC 2021). Buildings contribute to global warming over their whole lives: when we build, maintain, use and demolish or re-purpose them. But to date our focus has been largely on the in use carbon emissions of buildings, thus ignoring some of the unsustainable practices we commit to when we build and demolish buildings. This new guide from RIBA forges a new pathway towards holistic and more sustainable practices for the existing built environment.

We cannot new build our way to a sustainable, low carbon future. Our existing buildings including our historic buildings are a critical part of the solution and the journey. It is estimated that 80% of the UKs buildings in 2050 have already been built (UKGBC). Historic buildings are part of the fabric of our local communities, they provide unique and distinctive place identities, telling the stories of generations past. Our historic assets are durable and adaptable as demonstrated by the very existence of the 5.1million homes in England today that are more than a century old. They are the legacy of the past but more importantly they are brimming with opportunities for the future. If only we enable them.

This report provides a refreshing and much needed practical guide on how we can move towards a sustainable, low carbon future for the built environment. Using case studies, the guide demonstrates the importance of a broad, multidimensional understanding of our existing buildings and how important it is to balance the needs of the individual building, the users and the place. The guide demonstrates the multiplicity of factors that need careful consideration, to ensure that our low carbon building strategies do not in fact result unintended consequences that harm our health, our natural resources and our building stock.

To be truly sustainable we need to care for and maintain our existing buildings and we need to re-use and recycle our buildings. By doing so we avoid waste, we avoid unnecessary new carbon emissions and we reduce the pressures on our finite natural resources. Maintaining and repairing, re-using and recycling is climate action. This guide is an important tool in our armoury that will help us reduce carbon emissions from buildings as well as continuing to provide healthy living and work spaces for our growing local and national populations.

Adala Leeson,
Head of Socio-Economic Analysis and
Evaluation at Historic England

INTRODUCTION

This document aims to help both architects and their clients to take an informed approach to sustainability-focussed interventions in existing buildings. The Case Studies discuss a range of typologies and building forms.

At its heart is the premise that the notion of custodianship of buildings is not simply relevant to listed buildings, where we safeguard a monument for future generations, but that the idea of long term building value and stewardship applies equally to all buildings. The inherent carbon generation and storage within every building, new or old needs to be valued, with ever more efficient heating, ventilation and management technologies being only part of the solution to long term climate change mitigation. The fabric of every building costs the earth, and it is now understood that the capital cycle of 'demolish and renew' is a broken model.

This publication stems from a rewarding collaboration between the RIBA Conservation Register Steering Group and the RIBA Sustainable Futures Group. The title makes clear that all architectural practice involves securing what we have, with the implication that we ensure that new buildings are equally secure for the future.

Understanding that every building matters is both a challenge and a liberation. The buildings we currently designate as heritage assets were historically not always considered as as monuments. However, their locally sourced materials that are easily recycled, and longevity, is a paradigm that all new buildings need to address.

We hope that presenting a spectrum of retrofit projects, each one pushing the boundaries of sustainability within its own set of constraints and contexts, allows the reader to envisage what the possibilities are within their own commissions, and to consider options maximise the sustainable potential of the project at the strategic stages of the brief-making process.

BIOGRAPHIES

ALAN CHANDLER AA DIP. RIBA, SCA, FHEA

Alan Chandler gained parts 1,2 and 3 at the Architectural Association and is a founding director of the architectural practice Arts Lettres Techniques with Luisa Auletta. He has worked consistently on the interface between contemporary design and conservation since 1993, when as a student fabric formed concrete weighing several tonnes was poured into hessian, bitumen and papier mache casts taken directly from the portico of Hawksmoor's St George's Church in Bloomsbury to create a site-specific installation. This early engagement with questioning material and heritage value has persisted, alongside gaining expertise in conservation accreditation and working on award-winning heritage based projects in the UK and Chile, maintaining a focus on how politics and cultural perception connect with material and philosophical conservation.

Examining for the RIBA Conservation Register began at its inception in 2011, followed by membership of the RIBA Conservation Committee and Steering Group, which has allowed Alan to form a distinct perspective on the culture of professionalism within conservation practice. Alan is the Dean or Research at the University of East London and pursues distinct but in his mind complimentary fields of study – material and construction innovation, engagement based pedagogy and the politics of heritage. His recent book with Michela Pace – The Production of Heritage (Routledge 2020) brings these strands together.

MINA HASMAN RIBA, ARB, LEED AP BD+C, WELL AP, BREEAM AP

Mina Hasman leads SOM's sustainability and wellbeing daily operations and long-term vision for achieving excellence in practice. She has experience in a wide variety of projects in Europe, UK, Middle East, and Asia, bringing a greater understanding of the implications for sustainable and equitable design in different climatic, social, and regulatory contexts.

As a recognised expert in her field, Mina has been elected to, and is actively involved in the UKGBC's Board of Trustees, the RIBA Ethics & Sustainable Development Executive Leadership Group, UNEP/GlobalABC's COP26 Task Force (as the Commonwealth Association of Architects' Focal Point), Construction Industry Council's Climate Change Committee, WorldGBC's Whole Life Carbon Committee, CIBSE Intelligent Buildings Group as Vice Chair, and IWBI's Health Equity Advisory Group.

Mina regularly contributes to the wider climate change, sustainability, and wellbeing debate in her role as tutor at various academic institutions, as well as regular speaking appearances at many international events.

AIMS

The aim of the guide is:

- to bring together the approaches and principles underpinning both sustainability and conservation in architecture;
- to improve the knowledge of all architects in respect of sustainability and conservation, and to improve their skillset when approaching existing buildings;
- to support architects to identify relevant and effective strategies for retrofit that take into account historic significance as well as carbon significance;
- to identify gaps in knowledge and training where further RIBA CPD would be useful to help upskill individual architects.
- Bringing together the conservation and sustainability approaches to different types of existing buildings through a series of scenarios
- Speaking with the project architect to discuss approach, engagement, forensics and specification
- Drawing out principles which can be applied to different types and scales of projects
- Exploring the relative importance of the principles through case studies

With buildings being the third largest carbon emission producers in the UK, and with the UK government setting more ambitious climate change targets as part of their leadership of the Conference of the Parties (COP26), architects and clients clearly need to urgently explore how to improve the performance of our existing buildings – especially our homes.

New buildings need to be built more sustainably than before, but existing buildings also need to be sensitively adapted and improved. Sustaining the use of traditional and historic buildings, given the sheer number of them, creates a significant impact on our ability to address the climate emergency through architecture. Understanding the twin benefits of technical and social sustainability requires careful evaluation of the pathology of the building and the cultural value it holds. Enabling beneficial use and re-use brings a 'carbon responsibility' that requires specialists in conservation and sustainability develop a shared approach and tools to define how both are optimised.

This document explores how different types of existing buildings can be approached so as to improve performance, while also responding appropriately and considerately to the building's fabric, social setting, physical history and context.

To understand how different interventions can affect a range of buildings, the case studies have been arranged on a spectrum; from highly sensitive listed buildings to compromised buildings of some architectural or historic significance, and finally to unprotected buildings within a historic setting or conservation area. In each scenario, sustainability-focussed interventions will be explored in the context of the relevant conservation and heritage considerations and principles to see which interventions are possible and impactful. Options aimed at improving the performance of the building in question – for example, thermal efficiency – will be considered and weighed in the balance with relevant heritage issues – such as the historic significance of the windows or roofing materials.

One aspect of dealing with Carbon emissions is embodied carbon – this is currently under discussed when evaluating sustainability of buildings, however re-use of both buildings and building materials, minimising excess production, processing and distribution adds significantly to the overall picture of carbon production, and forms an important part of this guide.

Exploring a wide range of options, and considering the aims and principles of sustainability and conservation, this document provides an idea of how existing buildings can be approached and adapted to improve their performance (without causing any unintended consequences on health, nature, etc.), in line with the Sustainable Development Goals and the RIBA Sustainable Outcomes.

© Matt Chisnall
Domed glass skylights on the second floor of DEP W

WHY SUSTAINABILITY MATTERS?

Intrinsic to working on heritage buildings is the definition of their 'significance'. The history of a building and its context is both social and physical, and understanding this is a formal part of RIBA Workstage 0. Arguably, the detailed understanding of an existing building in technical and social terms is a requirement that should apply not only to listed structures, but all buildings, in order to develop the most appropriate scheme and the most relevant project possible.

The appraisal of a building before its development is also an opportunity to understand the building in terms of carbon – both its potential around emissions in use through the introduction of a viable energy strategy, but also in terms of the carbon content of its existing materials and those that will be introduced as part of enacting the design proposal.

The RIBA Climate Literacy agenda asks architects to assess historic significance in parallel to the sustainability appraisal of the building – effectively combining these two sets of principles and language into one comprehensive whole, including:

- Human Factors → built environment's impact on people's wellbeing, behaviour and lifestyle, Placemaking/ Community including community engagement, Social Value/History
- Circular Economy → preservation of resources and building fabric, reuse of existing materials and promoting recycling, repurposing of building components as well as understanding of and accounting for embodied carbon
- Energy and Carbon → conservation considerations of interference with building fabric and systems to improve operational energy and reduce carbon emissions
- Considering both historic significance and also the technical properties of the building's fabric (issues re moisture, response to heat etc)
- Water → management and use, as well as harvesting and recycling/reuse, particularly in large scale buildings with intensive use patterns
- Ecology and Biodiversity → how the building and its activity compliments or pressurises its immediate environment, how nature based solutions can form part of that strategy for integration, and also promote human interaction with nature

The conservation and adaptation of historic buildings is a process of prioritisation, justification and appropriate response, and is a structure shared between environmental protection and built heritage preservation. This overlay is fascinating because it dispels the myth that preserving the past is an impediment to attaining a future. Conserving historic buildings is an act of cultural sustainability, but the way in which we do that can always be allied to our obligations towards environmental sustainability.

This guide signposts some of the complexities that come with working with buildings from the past in a 'future conscious' way. Detailed support is available in the form of expert guidance form bodies such as Historic Scotland and Historic England, however an overarching standard that attempts to navigate not only conservation philosophy but frequently problematic modern building regulation is BS 7913. This well-crafted attempt to help building professionals deal with an often unsympathetic legislative and funding context for heritage buildings is always a good reference point for heritage professionals.

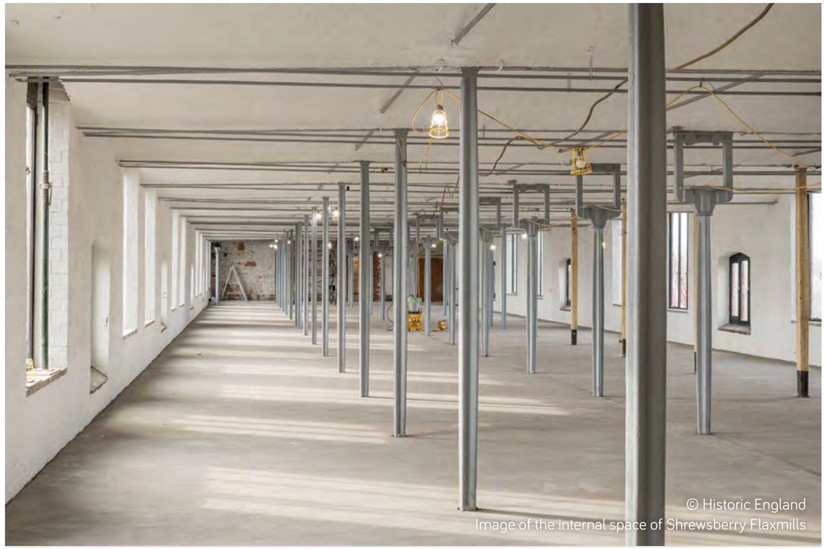
Through this suite of ‘Sustainable past, sustainable future’ case studies we aim to demonstrate how the approach to conservation dovetails into responsible low energy and low carbon design principles, and highlights the complementary nature of sustainability and conservation practice.

Claiming a building to be sustainable too often means that that building has low energy use, and emits low carbon. Nonetheless, holistic sustainability is beyond just conserving energy and emitting less carbon – it is about safeguarding long-term health and wellbeing, promoting community cohesion, minimising impact on natural ecosystems, and ensuring economic prosperity. It is also about building accountability for a building’s whole life.

Sustainable conservation/retrofit of existing buildings, therefore, needs to address a multitude of criteria. These may include indoor comfort, air quality, materials and waste, operational energy costs and maintenance, or accessibility and safety. These elements collectively add to buildings’ long-term value: value to people, planet and economy – with increased durability, adaptability and resilience.

Underpinning conservation philosophy is the practical working knowledge of the fourteen *ICOMOS Education and Training* guidelines, which form a set of competencies that, in a wider sense, are applicable common sense for how to understand a building or place before alterations are made. Education and training should produce conservationists who are able to:

a. Read a monument, ensemble or site and identify its emotional, cultural and use significance
b. Understand the history and technology of monuments, ensembles and sites in order to define their identity, plan for their conservation, and interpret the results of this research
c. Understand the setting of a monument, ensemble or site, their content and surroundings, in relation to other buildings, gardens or landscapes
d. Find and absorb all available sources of information relevant to the monument, ensemble or site being studied
e. Understand and analyse the behaviour of monuments, ensembles or sites as complex systems
f. Diagnose intrinsic and extrinsic causes of decay as a basis for appropriate action
g. Inspect and make reports intelligible to non-specialist readers of monuments, ensembles and sites illustrated by graphic means such as sketches and photographs
h. Know, understand and apply UNESCO conventions and recommendations, ICOMOS and other recognized Charters, regulations and guidelines
i. Make balanced judgments based on shared ethical principles, and accept responsibility for the long term welfare of cultural heritage
j. Recognize when advice must be sought and define the areas of need of study by different specialists, e.g. wall paintings, sculptures, and objects of artistic and cultural value, and/or studies of materials and systems
k. Give expert advice on maintenance strategies, management policies and the policy framework for environmental protection and the preservation of monuments and their contents and sites
l. Document works executed and make them accessible



© Historic England
Image of the internal space of Shrewsberry Flaxmills

m. Work in multi-disciplinary groups using sound methods
n. Be able to work with inhabitants, administrators and planners to resolve conflicts, and to develop conservation strategies appropriate to local needs, abilities and resources

Becoming accredited in conservation means understanding how to apply these guidelines in given circumstances, so this set of case studies are mapped against them, with each project clearly addressing some aspects of the guidelines.

It is instructive to map the ICOMOS guidelines against some of the key questions to be addressed when considering retrofit of an existing building, which includes:

a. Does the building have any hazardous materials such as asbestos, PCB or lead paint that need removal and/or containment? → Human Factors
b. What are the occupancy patterns and behaviours? What are the key concerns occupants raise? → Human Factors
c. Can any of the existing materials/ building components (internal and external) that need to be removed be repurposed and/or recycled (either to be used in the retrofit scheme or elsewhere)? → Circular Economy
d. Are there limitations to specifying low carbon materials of timber for instance, for any reason? → Circular Economy
e. Which building systems (of energy and water) are at a critical replacement cycle?

   How efficient are those that do not yet need replacement work? → Energy and Carbon
f. Is there an opportunity to integrate renewable energy generation technologies (such as PVs) on-site? → Energy and Carbon
g. Is there an opportunity to integrate vegetated areas (a green roof or wall or active landscapes for ‘food’ production) in/on the building?

@Carrig Conservation International Ltd
Front (west) elevation of the Rubrics Building. The curvilinear roofscape of the 3rd floor and new facing in Portmarnock brick was added c.1894-7.

→ Ecology and Biodiversity

h. Does the building have external lighting that contributes to light pollution impacting nearby habitats and nocturnal species?
→ Ecology and Biodiversity

i. Does the building have rainwater collection and storage facilities?
→ Water

j. Does the building recycle and reuse grey and/or black water? → Water

k. How accessible is the building from major, public transportation hubs/nodes? → Connectivity and Transport

l. Can the building accommodate low carbon travel (with bicycle storage, electric vehicle parking and charging stations, etc.)?
→ Connectivity and Transport

Very few of the ICOMOS guidelines would not apply to the implementation of a responsible and effective retrofit programme on an existing building. This correspondence is instructive, and forms the basis for '*Sustainable past, sustainable future'*. Knowing the levels of protection offered to a project is critical – is external insulation a viable option within a conservation area? Evaluating historic information on construction and materials in order to determine technical and chemical compatibility with high performing insulation is a necessity. Issues surrounding this compatibility may include:

- Diagnosing inherent decay issues to ensure the intervention addresses and does not exacerbate the situation;
- Knowing how moisture pathways through the fabric are opened or impeded through thermal upgrade;
- Knowing how new technologies are installed so they can be maintained or replaced without damage to surrounding building fabric;
- Understanding the value of other specialists in multi-disciplinary teams for integrated outcomes;
- Communicating operational aspects for secure long-term viability of the design.

All of these aspects of responsible retrofit map directly onto the fundamentals of conservation practice. Our collective challenge is to sustain cultural value whilst achieving the lowest carbon cost for that continuity without causing any unintended consequences in the process.

Part of our obligation involves understanding the parameters of what is possible, culturally and technically, in any given retrofit scheme. Adopting the notion that every single building is unique – even in an apparently uniform Victorian terrace this is actually true – requires us to gauge what, based on the technology and status of the building and the available budget, is possible. We have selected a range of historic projects which demonstrate a spectrum of possibilities and have articulated how each project's potential for low carbon technology was evaluated and put into place. *Across the spectrum of retrofit there are key issues that demand our research and our innovation:*

- Moisture and vapour open construction – this aspect is a key function of all traditionally constructed buildings and most directly drives the project to conserve the 'Writer's house', where the specification of vapour open materials and insulation became part of an overall fabric first approach, which limited the scope and specification of the insulation itself, but also revealed innovative original details for moisture management that informed new and sympathetic solutions.
- Embodied carbon versus carbon production – research into the inherent value of fabric first reveals in new detail the positive role that fabric retention can play in carbon reduction with 'Dept W' providing a compelling case for retention and re-use. Fabric retention is not the same as façade retention, which elevates the reality of a building to a billboard and effectively 'borrows' historic significance for otherwise insignificant buildings, undermining the social value of heritage and wasting carbon in elaborate retention structures.

© Featherstone Young Architects
Jack Windmills after completion.

- Energy generation and energy optimisation in use. Positioned 9 and 10 on the spectrum are two Victorian buildings that demonstrate how load bearing masonry construction can accommodate and enable Passivhaus standard energy performance.
- Airtight versus 'breathability'- how buildings conceived of as 'leaky' to manage internal pollution and ventilation can be adapted to contain heat loss and deal with thermal bridging through the façade, in particular through windows which need to negotiate appearance and performance.
- Communication and significance – the statutory protection of listed buildings require compelling narratives to justify where change can be considered appropriate – such conversations require both strategic and specific understanding of the building and the new technology that it will contain.
- Fire safety in public buildings – the implications for planning and materiality in retrofitting public buildings impacts on more than simply safety provision. Part B and Part M can radically influence original planforms as well as original fabric.

Each project demonstrates what can be achieved in a given context for an optimum retrofit within the constraints in place, and where possible give an indication of the budget envelopes required for the projects. This negotiation between performance potential, cost envelope and historic fabric requirements presents challenges, but for architects it creates opportunities to deploy our awareness of how material performance and user needs are brought together. With historic buildings we have two clients – the owner and the building itself.

THE WRITERS HOUSE

© Alan Chandler

CASE STUDY SPECTRUM 1

THE WRITERS HOUSE

Project Description

The project is a highly sensitive project – the former house of a renowned author and the setting for a major film. A mix of original late Georgian fabric and late 1960's interventions by the author owner, retaining plasterboard was subject for debate and negotiation, thus limiting the options for energy efficient measures. Moisture management to stabilise the fabric was a major aspect of the project, so material specification and the use of ventilation to sustain a dry habitable space became a priority within the largely retained building.

Typical values of embodied green house gas emissions per square metre of floor area for new buildings are commonly between 250 and 400 kilograms of carbon dioxide equivalent per square metre (kg CO_2eq./m^2). The operating GHG emissions from existing buildings are typically between 30 and 50 kg CO_2eq./m^2 per year* Odyssee-Mure studies reveal that the addition of embodied emissions caused by the renovation of an existing building, (subject to its scope and materials used) is typically less than 50% of the embodied emissions for a new building (i.e. less than 125–200 kg CO^2eq./m^2). These emissions can be much lower if the renovation avoids major structural change and utilises reclaimed or retained materials. The Writers House retained all joinery and glass, lime plaster and utilised reclaimed historic timber for minimal structural alterations.

The removal of the 1969 inset roof terrace opened the potential to insulate the interior of the double-pitched roof. Bio-based insulation materials such as cellulosic fibres (e.g. wood fibre board), sheep's wool or cork typically have much lower levels of embodied GHG emissions than conventional insulation, and offer the added advantage that they can contribute to the temporary storage of carbon, it is important to ensure that they have been treated to give adequate moisture and fire resistance. The roof build up uses Pavatextil recycled cotton insulation between the shallow original rafters, with 40mm Warmshell interlocking wood fibre panels to form a ceiling suitable for a lime-based plaster finish. The roof membrane is ProClima Solitex, which offers an enhanced vapour open capability below the reinstated original slates.

Externally the modern paint finishes to the original roman cement stucco was removed using the Thermatec steam/solvent process, with a mineral paint reapplied to maintain the ability for moisture evaporation through the wall to the exterior.

*Odyssee-Mure 2018 – https://www.odyssee-mure.eu/


© Alan Chandler

Discoveries that caused the initial design to be revised

Original Floor, Structural Elements, Openings /Accessways.

A unique external vented cavity to isolate the structural walls from raised ground levels was found, prompting us to revise our water management design. The original option to provide a vented membrane system to the internal wall face was revised – the cavity means that no penetrating water needed to be accommodated within a land drain, and its ventilation reinstated demonstrated distinct air movement through the void. The internal walls were re-plastered in lime based roman cement with a distemper finish, its micro structure providing a capillary active route for any moisture through the fabric rather than trapping moisture within the wall. Internally the floor slab stops short of the wall foundations, with a new internal ventilated void connecting to the external cavity through two original openings found below floor level. This airflow, augmented through a mechanical ventilation/heat recovery strategy to enhance air changes, accommodated vapour management using the physics of water movement through traditional materials.

The digging of a trial pit to investigate the vented cavity discovered the original flagstone floor of the scullery, each flag set not on earth or blinding, but on short brick blocks and slate damp proof courses creating a sub-floor cavity. The covering screed was removed and the flags allowed to dry out naturally.

Location

London

Building Use

Residential dwelling

Status

Under construction

Project and Construction Budget

£300K

Project representative

Alan Chandler, RIBA SCA 'Arts Lettres Techniques'

Post Occupancy evaluation results

The project is due for completion in December 2021, the energy strategy is very simple, however the water management strategy and associated vapour open detailing will be monitored long term.

Reasons for Retrofit

- Water Ingress
- Structural Instability
- Fire Safety
- Decay

Scale of retrofit (from light to deep 1-10)

1 This case study is a minimal retrofit with an emphasis on vapour open design for sensitive traditional buildings – with an emphasis on working with the building to minimise synthetic, carbon-heavy materials.

ICOMOS guidelines used

- [x] Read a monument, ensemble or site and identify its emotional, cultural and use significance
- [x] Understand the history and technology of monuments, ensembles and sites in order to define their identity,plan for their conservation, and interpret the results of this research
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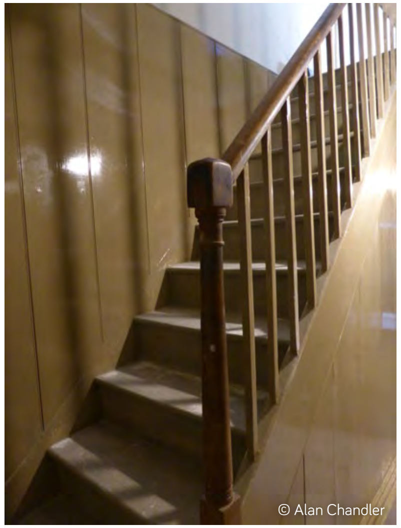
- [x] Make balanced judgments based on shared ethical principles , and accept responsibility for the long-term welfare of cultural heritage
- [x] Recognise when advice must be sought and define the areas of need of study by different specialists, e.g. wall paintings, sculptures,and objects of artistic and cultural value, and/ or studies of materials and systems
- [ ] Give expert advice on maintenance strategies, management policies and the policy framework for environmental protection, and the preservation of monuments as well as their contents and sites
- [x] Document works executed and make them accessible
- [ ] Work in multi-disciplinary groups using sound methods
- [x] Be able to work with inhabitants, administrators and planners to resolve conflicts, and to develop conservation strategies appropriate to local needs, abilities and resources



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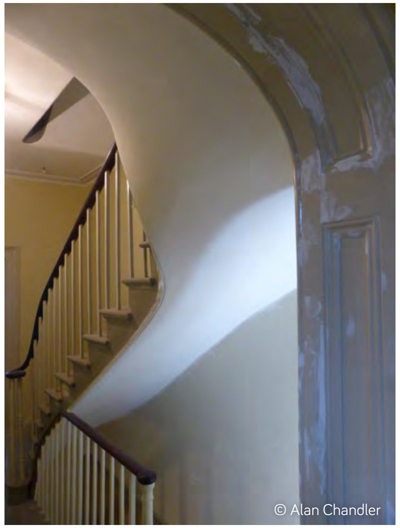

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Guidance consulted when approaching the retrofit design

Historic England, Sustainable Traditional Building Alliance (STBA), The Society for the Protection of Ancient Buildings (SPAB)

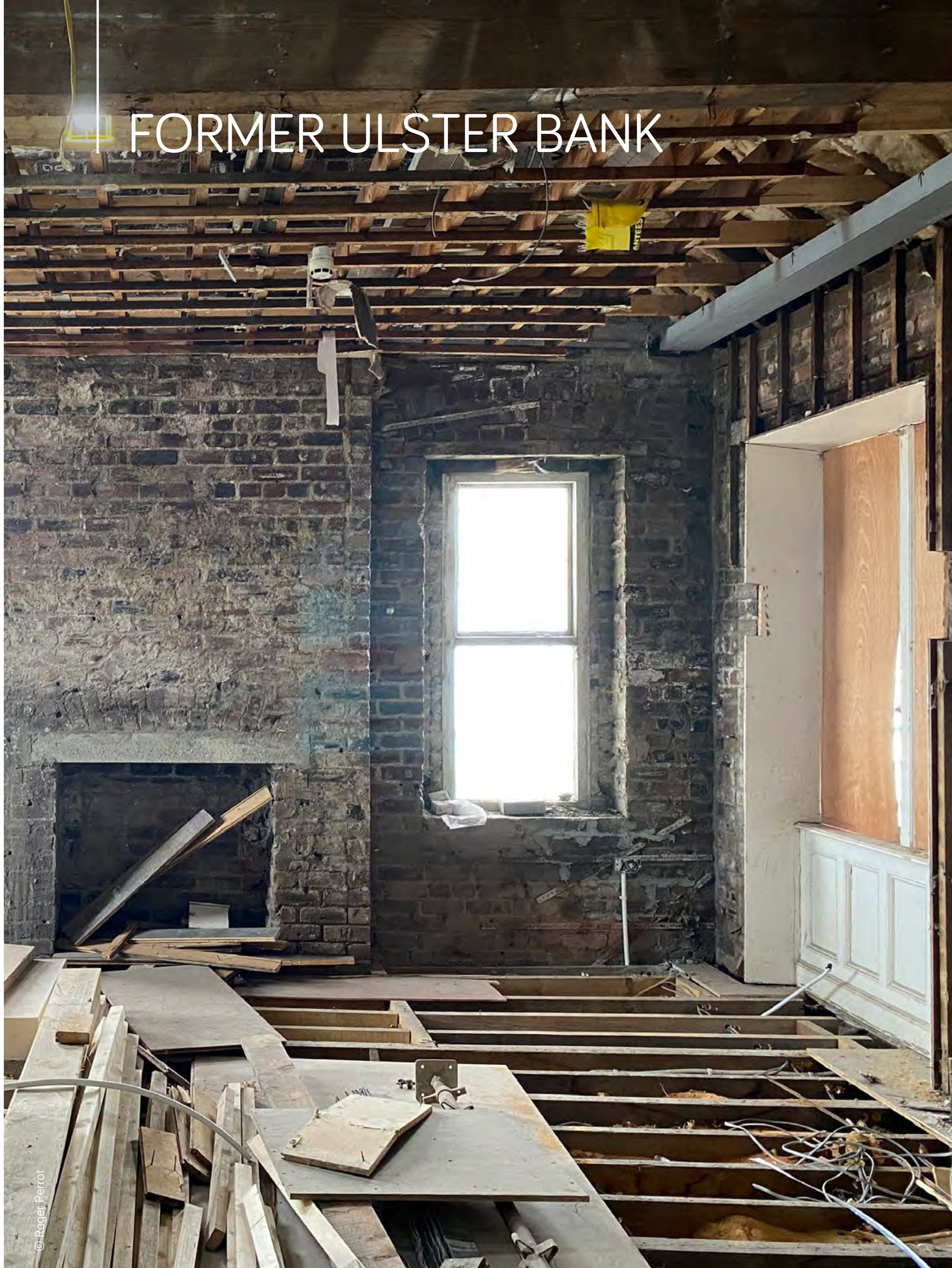
Project Evaluation Criteria

(from most important to least important)

1. Heritage Priorities
2. Project Budget
3. Operational Priorities
4. Construction Budget
5. Energy/Carbon Performance Targets
6. Procurement Route

The building was unoccupied for many years, two overlaid tanking systems in the basement had failed, the roof had failed both in terms of water management and structure, services completely dilapidated.

FORMER ULSTER BANK



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CASE STUDY SPECTRUM 2

FORMER BANK

Project Description

Built in around 1920 the Grade B2 Listed, Former Ulster Bank is one of the town's most dominant buildings, with its gables and chimneys appearing prominently on the town's skyline. The Bank's height results in spectacular views of the harbour, Lighthouse, Nearby Motte and Copeland islands from the top floor, which was originally set out as the managers residence.

A victim of the decline in Highstreet banking, the branch was closed in about 2015, and was subsequently acquired by a private client with a view to change of use to a dwelling.

The practice worked closely with the client to develop proposals which included the insertion of a mezzanine bar into the main living space and reconfiguration of the garage roof to introduce a private sun terrace. The main focus of the design was retention of historic character which required the thermal performance of the existing fabric to be carefully considered.

Early in the design process it was decided that the existing solid brass windows would be retained. Specialist fabricators were engaged at an early stage and trial sections were tested to develop an appropriate repair methodology. The original pivot hinge design of the windows prevented introduction of simple draft stripping, resulting in an evolving design which is continuing into the post completion evaluation stage as options are tested through the coming months.

Due to the need to preserve detailing, it was not possible to enhance insulation in some areas. A balanced approach was therefore adopted with some of the most exposed walls being lined internally with Saint-Gobain Isover insulation between existing studs, and other walls being left unlined. Analysis was carried out to verify that there was no risk of interstitial condensation. Budgetary constraint prevented rebuilding of the chimneys (which were extremely tall to the rear of the property); as they had no lead trays, additional ventilation was fitted to the ceiling voids to reduce the risk of moisture penetration and damage. This is also to be monitored through the practice's post completion evaluation to ensure that the measures employed are adequate to prevent moisture building up.

By retaining almost all of the original fabric of the building, the embodied carbon has been preserved in the completed scheme. All existing timber stripped out during alterations has been reused within the fitted joinery, which has also helped ensure that historic character and appearance has been preserved.

The heating strategy is based on low temperature operation over longer periods to utilise thermal mass and work with the existing fabric. This is being monitored through post occupation and will be adjusted as necessary to cope with seasonal variation.

Externally, there is little visual evidence of any change, save the removal of the ATM machine. The existing Portland stone required routine maintenance. Several of stones worst eroded by the driving Northly gales which batter the town in winter, were replaced. Lead capping was added to improve shedding of rainwater, and better protect the retained historic stonework.

© Roger Perrot

© Roger Perrot

Discoveries that caused the initial design to be revised

Original floor tiling and wood block flooring were uncovered, restored and integrated into the design

A 'night lock' mechanism from second floor linking to the ground floor vault was discovered behind wall cladding and found to be still working. Its location required designs to be revised to avoid its control mechanism which has been integrated into the final design.

Metal windows believed to be aluminium turned out to be solid brass. These were extensively restored, including several with stained glass panels which had been boarded over previously.

Location

Donaghadee, Northern Ireland

Building Use

Residential dwelling

Status

Post-Completion Evaluation

Construction Budget

£750k

Project team

Roger Perrott RIBA CA, C60 Architects, the designer of a Historic Property that is being retrofitted

Post Occupancy evaluation results

Post completion evaluation will be carried out through the next 12 months by C60 Architects including monitoring of ventilation and damp proofing, draft proofing of windows and efficiency of heating system.

Reasons for Retrofit

- Water Ingress
- Structural Instability
- Fire Safety
- Decay

Scale of retrofit

(from light to deep 1-10)

2 Interventions associated with the change to residential use were carefully controlled by the practice's Conservation team to preserve historic fabric and character.

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Guidance consulted when approaching the retrofit design

RIBA Sustainable Outcomes Guide, Historic England, Historic Scotland, Historic Environment Northern Ireland, UK Green Building Council's 'The Retrofit Playbook'

Project Evaluation Criteria

(from most important to least important)

1. Heritage Priorities
2. Construction Budget
3. Operational Priorities
4. Energy/Carbon Performance Targets
5. Project Budget
6. Procurement Route

SHREWSBURY FLAXMILL MALTINGS

© Credit required

CASE STUDY SPECTRUM 3

SHREWSBURY FLAXMILL MALTINGS

Project Description

Shrewsbury Flaxmill Maltings is a Historic England Flagship regeneration project, the £25m adaptive re-use of a Grade I listed redundant mill building into a vibrant centre for creative industries, social enterprise, heritage and leisure as part of a wider mixed-use development for the 2.1 hectare site and the economic regeneration of this area of the town.

The Flaxmill was built in 1797 during the reign of George III. It must have been a terrifying sight; a five-storey behemoth looming over the medieval streets of Shrewsbury. Its internal gas lighting, giant smoking chimneys and sawtooth roof earned it the nickname 'the dragon on the hill'. Beyond its simple brick elevations lies a revolutionary piece of structural engineering. It was the first building constructed using a structural system of cast-iron beams, posts with wrought iron tie rods and masonry jack arches, making it a fireproof construction. It was highly praised at the time of construction and now, 220 years on, it is considered one of the most important buildings of the industrial revolution, dubbed 'the great, great grandparent of the modern skyscraper'.

By 1896, due to the popularity of cotton, the flax industry had collapsed, and the building was up for sale. It was skillfully converted into a maltings through the blocking of windows and the addition of the pyramidal malt kiln. The maltings remained in use until 1986 when the buildings were once more put up for sale. A succession of failed attempts by the private sector led to a gradual decline in the condition of the buildings.

In 2005 Historic England stepped in to put heritage at the heart of efforts to regenerate local area. In partnership with the local authority and friends group they secured one of the largest National Lottery Heritage Fund grants to be awarded outside of London.

The innovative design of the Flaxmill may have set the trajectory for modern high-rise construction, but as with many pioneering projects, there were flaws that soon became evident and had to be ironed out in later buildings on the site. The Flaxmill's Achilles' heel lies deep within its walls and foundations. Extensive embedded timber had rotted over time, causing the walls to split in two, whilst settlement has led to tensile cracking in the tops of the brittle cast-iron beams.

These hidden defects were carefully surveyed by specialists under the direction of FCBStudios' conservation accredited architects and engineers. The structural repair strategy focused on reinforcing the existing masonry to retain both the special character and re-utilise the embodied energy in the 200-year-old bricks and iron frame. The interventions put the historic structure 'back to work' providing alternative load paths and additional structural capacity for the new uses.

The environmental strategy followed the 'whole building approach' championed by Historic England. Former windows were reopened to provide natural light and ventilation across floor plates, whilst a 114kw ground source heat pump and woodfibre insulation will provide and conserve space heating. The dramatic entrance space in the malt kiln is to be

© FCBS

© Historic England

© FCBS

unheated whilst the accommodation in the Flaxmill utilises exposed masonry structure for cooling. The strategy revolves around doing more with less, a continuation of the original innovative design.

When complete, the resurrected buildings will provide a creative hub for businesses of all sizes and sectors, with the aim of fostering a community where SMEs can gather and share knowledge with more mature businesses all inspired by the building's history of pioneering innovation. On the ground floor a heritage destination will be run by the Friends group who have supported the project from its inception.

With modern technology and engineering innovation applied, these heritage buildings will be equipped to for their third century of service. Another chapter in the story of the evolution of the world's first iron-framed building.

Discoveries that caused the initial design to be revised

Original Floor, Original Wall Surfaces, Structural Elements, Decorative Finishes, Evidence of Social History/Patterns of Use, Openings or Accessways.

Industrial archaeologists identified evidence of infrastructure lost 100 years ago that caused designs to change and to conserve finds.

Location

Shrewsbury

Building Use

Mixed use: residential dwellings, leisure and social enterprise

Status

Under construction

Project and Construction Budget

£25 million

Project representative

Tim Greensmith, RIBA SCA, Associate, Feilden Clegg Bradley Studios, design team leader of a Historic Property that is being retrofitted

Post Occupancy evaluation results

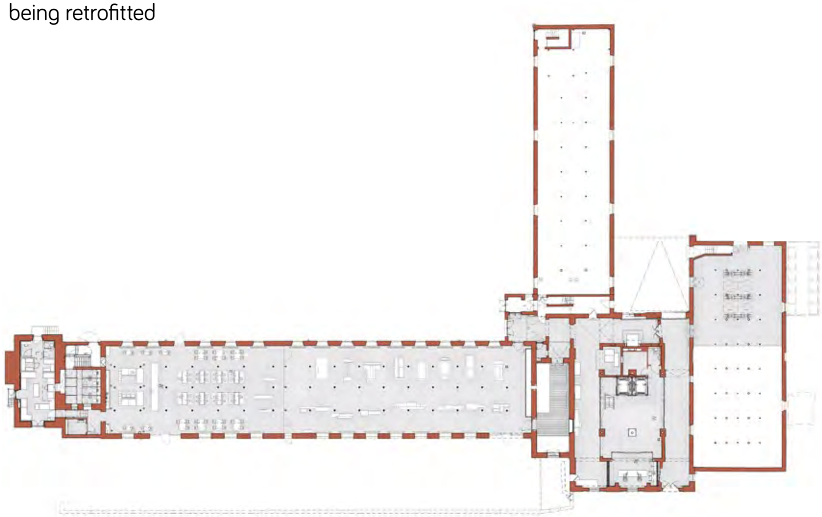
The project is 6 months from completion. It is planned to carry out soft landings and POE which will be made available for academic purposes. The project has been guided by One Planet Living principles and has been assessed at various stages using the FCBS Carbon Calculator

Reasons for Retrofit

- Water Ingress
- Structural Instability
- Fire Safety
- Pollutants (geoenvironmental, asbestos and guano)
- Decay

Scale of retrofit (from light to deep 1-10)

3 Deep in terms of structural strengthening, Light in terms of new finishes and servicing



Caption required © FCBS

ICOMOS guidelines used

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- [x] Document works executed and make them accessible
- [x] Work in multi-disciplinary groups using sound methods
- [x] Be able to work with inhabitants, administrators and planners to resolve conflicts, and to develop conservation strategies appropriate to local needs, abilities and resources

Guidance consulted when approaching the retrofit design

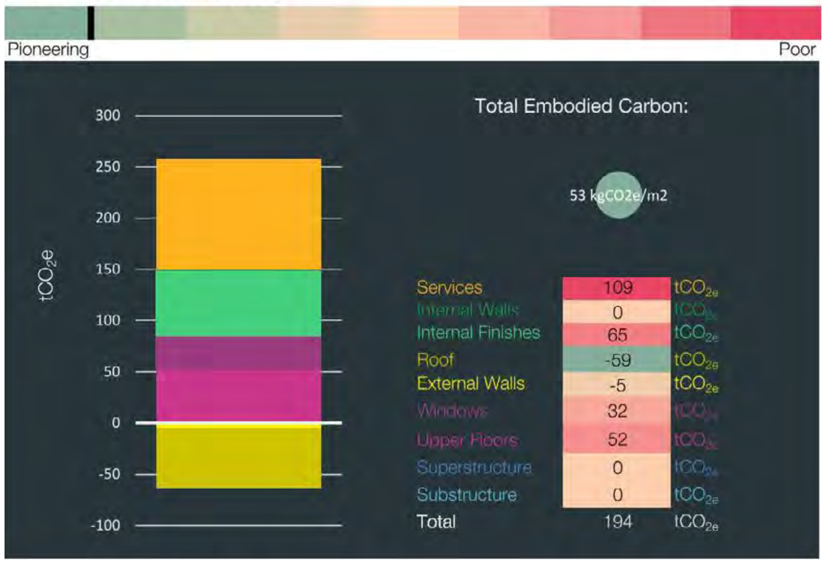
RIBA Sustainable Outcomes Guide, Historic England, Sustainable Traditional Building Alliance (STBA), The Society for the Protection of Ancient Buildings (SPAB), LETI Climate Emergency Design Guide, LETI Embodied Carbon Primer, UK Green Building Council's 'The Retrofit Playbook', [UK] Department for Business, Energy & Industrial Strategy's Guide to Making Retrofit Work

Project Evaluation Criteria

(from most important to least important)

1. Heritage Priorities
2. Energy/Carbon Performance Targets
3. Project Budget
4. Construction Budget
5. Operational Priorities
6. Procurement Route

EMBODIED CARBON



Sustainability stats for Shrewsbury Flaxmill Maltings produced by our FCBS carbon calculator tool.
Embodied carbon 53 $kgCO_2e/m^2$
Operational energy use (regulated plus an assumption for unregulated) 91.47 kWh/m2/yr
Re-using the existing building saved 80% of the carbon that would have been required for a new building.)
FCBS

JACK MILL HOUSE

CASE STUDY SPECTRUM 4

JACK MILL HOUSE

Project Description

Jack Mill House is a unique home bringing together a converted 19th-century mill house and granary, positioned between the well-loved local landmarks Jack and Jill windmills. The practice worked closely with a team of heritage consultants and millwrights to understand the historical progression and significance of the buildings on the site. The design refurbishes the 1960's house and creates a new protective timber structure around the original Granary building fabric. New roof top extensions open up important views between Jack and Jill and make better connections between the house and Granary.

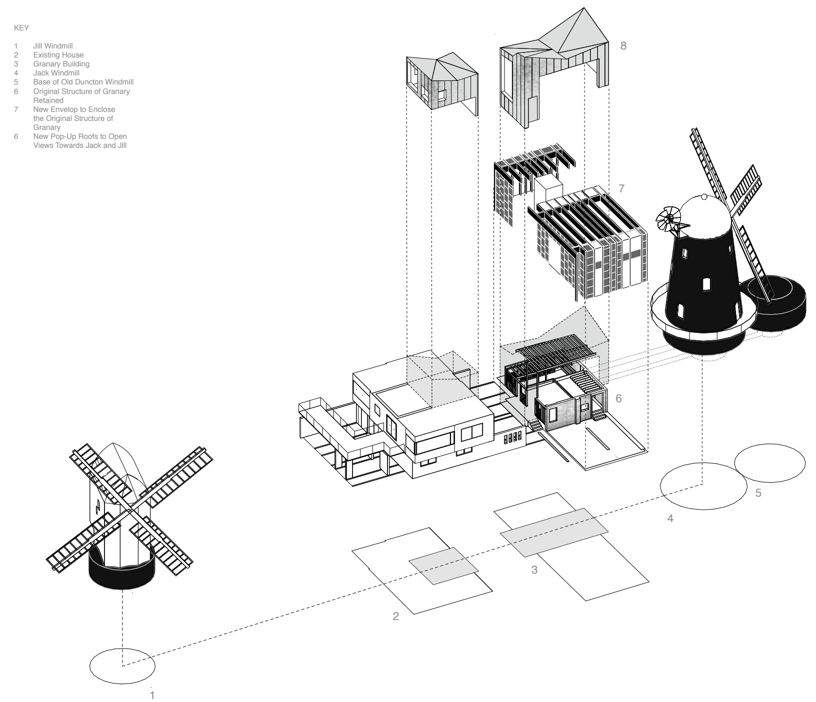
The design followed two key moves: 1) the pop-up roof extensions which open up the main view between Jack and Jill allowing them to be seen together from within the buildings; and 2) stripping back the Granary to reveal its historical layering and create a new structure that shrouds and protects the remaining fabric. It's a modern interpretation of the original timber shed and is constructed from structural glulams with ply sheathing.

Working with the existing building fabric, the practice concentrated on the following key aspects which we ensured were driven through the detailing and construction stages, and were integral to both the design of the building and the way it operates:

- Addition of much increased levels of thermal insulation to walls, windows, roof and floors of the existing buildings.
- Using a timber and steel structure with low embodied energy for new structures and extensions.
- Use of aluminum windows and wall cladding which has high recycled content and consequently relatively low embodied energy
- Selection of materials that are readily recyclable, nontoxic and with low global warming potential and low volatile organic content

Importance was also placed on passively sustainable features which were integral from the outset of the design maximising the potential for energy efficiency whilst also helping the design to knit into the context and take spatial benefits from it:

- New large, glazed areas orientated to maximise daylighting and winter solar gain.
- The triple aspect afforded to both the opened-up rooms in the existing house and the new living spaces in the Granary, allow for good cross-ventilation aided by ventilation flaps integrated in the external cladding and encouraged by the provision of private external balconies and spill-out spaces.



Proposed Axonometric © Featherstone Young Architects

Discoveries that caused the initial design to be revised

n/a

Location

Clayton

Building Use

domestic

Status

Completed

Project and Construction Budget

n/a

Project representative

Jeremy Young, Featherstone Young Architects, the designer of a Historic Property that is being/has been retrofitted

Post Occupancy evaluation results

n/a

Reasons for Retrofit

- Water Ingress
- Structural Instability
- Decay

Scale of retrofit (from light to deep 1-10)

4

*The Granary, however, is an excellent example of a major retro fit, as it had an almost archeological level of attention paid to it. The parts that were historic were retained and preserved and those that weren't were removed. The whole structure is now encased in a new contemporary structure to preserve it for (relative) perpetuity.

© Featherstone Young Architects

ICOMOS guidelines used

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© Featherstone Young Architects

Guidance consulted when approaching the retrofit design

Historic England

Project Evaluation Criteria

(from most important to least important)

1. Heritage Priorities
2. Energy/Carbon Performance Targets
3. Construction Budget
4. Project Budget
5. Procurement Route
6. Operational Priorities

DEPT W

© Matt Chisnall

CASE STUDY SPECTRUM 5

DEPT W

Project Description

The Beaux-Arts façade of Wickham's department store on Mile End Road was missing a tooth for almost a century: a jeweler named Spiegelhalter refused to move when the store was planned, so the department was built around his shop.

The remodelling turned the holdout unit into the heart and soul of the building rather than the thorn in its side. The Spiegelhalter void has become the main entrance, effectively a piece of the public realm where the threshold between outside and in is blurred.

The domed glass skylights on the second floor were repaired and restored, exposing the steel structure to create a spectacular lightweight pavilion at the top of the building.

The overall aim of the project was to retain and reveal as much of the historic fabric as possible, removing elements added over time to restore the building back to its original glory, adding as little as possible back. This provides the tenants a blank canvas onto which new tenants can project their own identities.

Community consultation was used to inform the design, and retail units retained at ground floor, to ensure the building continues to function as a vital part of the street and community

© Matt Chisnall

Proposed South Elevation - Mile End Road © Buckley Gray Yeoman

View of Mile End Road facade. © Matt Chisnall

Discoveries that caused the initial design to be revised

Original Floor; Structural Elements.

Location

London

Building Use

Workspace

Status

Completed

Project and Construction Budget

n/a

Project representative

Rachael Owens, Buckley Gray Yeoman, the designer of a Historic Property that is being/has been retrofitted.

Post Occupancy evaluation results

n/a

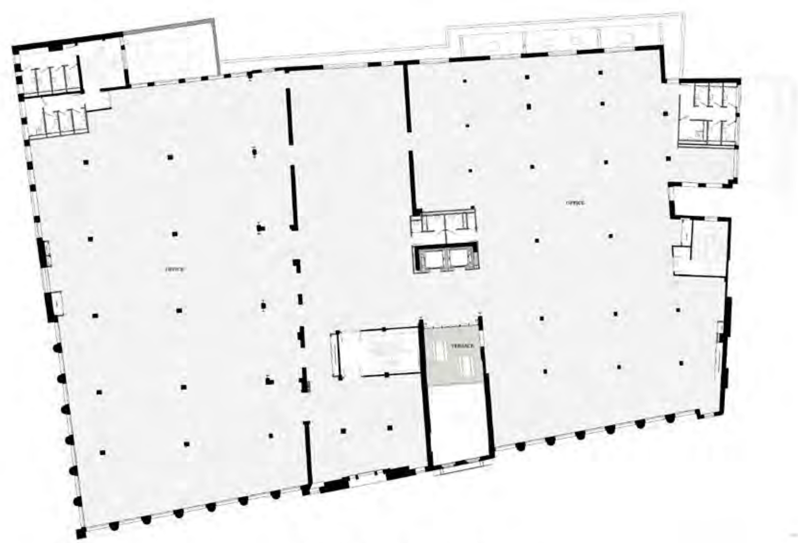
Reasons for Retrofit

- Water Ingress
- Fire Safety
- Decay

The existing and deteriorated structure meant that the original facade was badly in need of refurbishment. The original stonework facade has been repaired, removing pipework and other services that have been added over time. Repaired and restored domed glass skylight, while revealing the steel structure around this

Scale of retrofit (from light to deep 1-10)

5 New servicing, upgraded windows, repair and refurbishment of existing facades, flooring, balustrades and domed glass roof light.



TYPICAL FLOOR PLAN

BuckleyGrayYeoman

ICOMOS guidelines used

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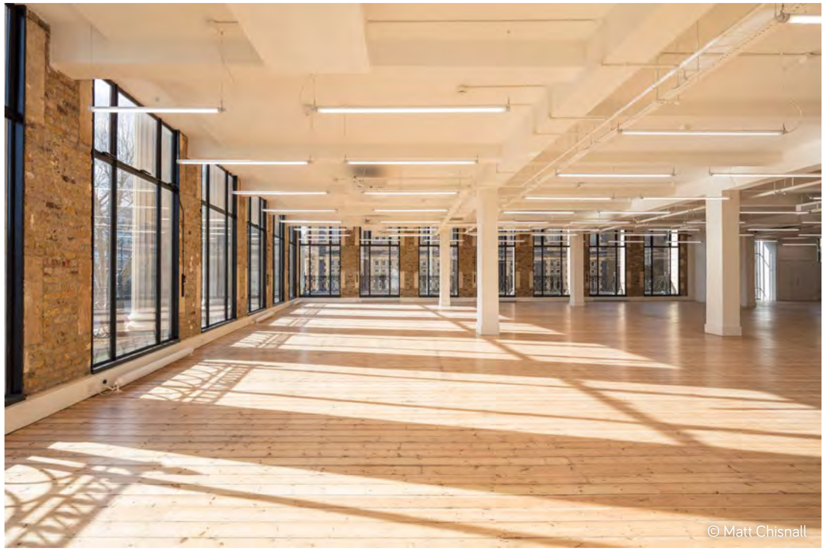


© Matt Chisnall

Guidance consulted when approaching the retrofit design

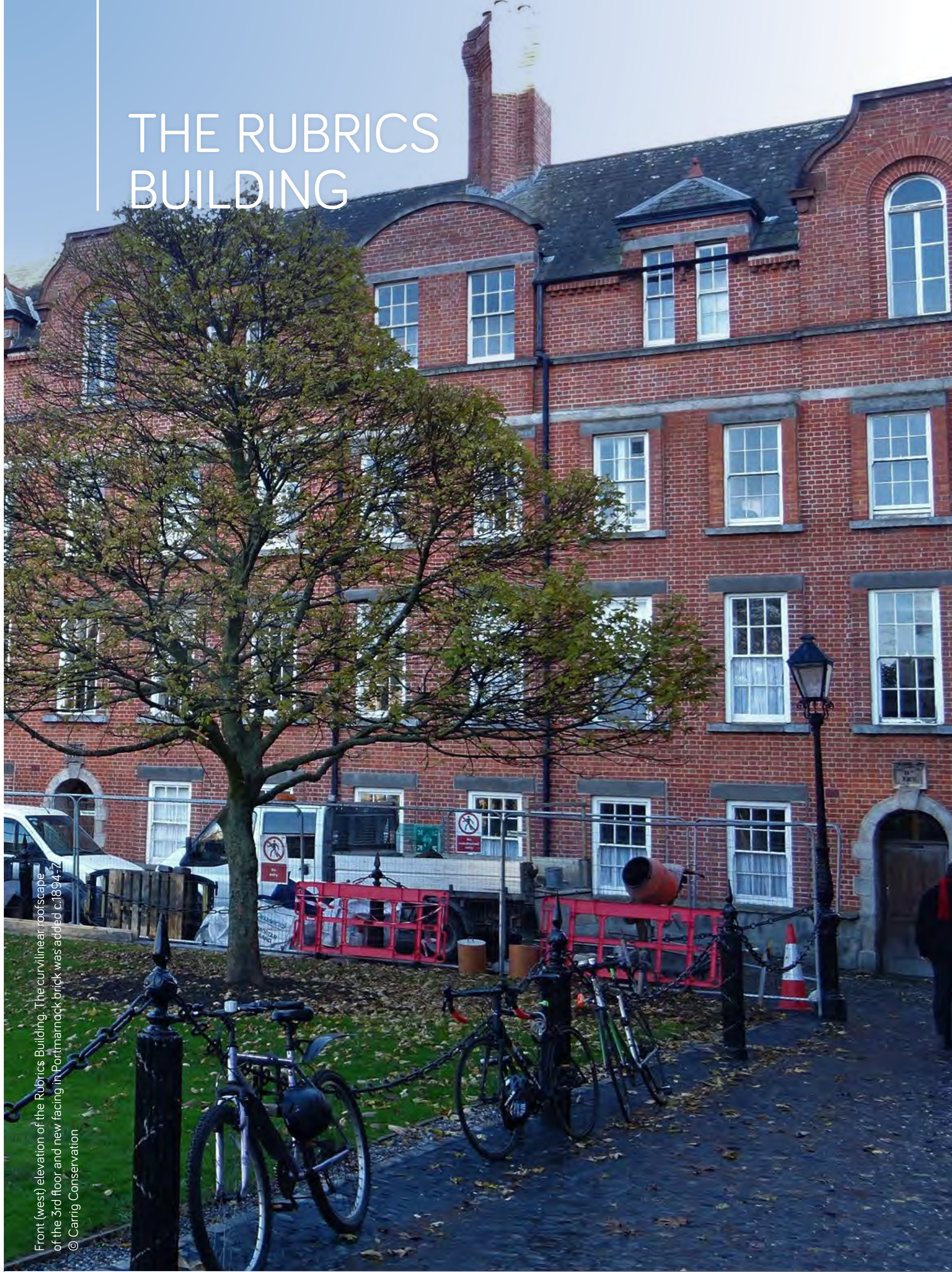
Historic England, Sustainable Traditional Building Alliance (STBA)

Project Evaluation Criteria
(from most important to least important)

1. Heritage Priorities
2. Energy/Carbon Performance Targets
3. Project Budget
4. Construction Budget
5. Operational Priorities
6. Procurement Route

© Matt Chisnall

THE RUBRICS BUILDING



Front (west) elevation of the Rubrics Building. The curvilinear roofscape of the 3rd floor and new facing in Portmarnock brick was added c.1894-7.
© Carrig Conservation

CASE STUDY SPECTRUM 6

THE RUBRICS BUILDING

Project Description

The Rubrics Building was constructed between 1699 and 1702 and is both a Protected Structure (Planning and Development Act 2000) and a Recorded Monument (National Monuments Act 1930-2004). Trinity College Dublin (TCD) has commissioned multidisciplinary team including Pascall + Watson Architects, Carrig Conservation International Ltd., Passivate Building Energy Consultants and AECOM Engineers to design an exemplar conservation and retrofit strategy that honours the historic value of the building, minimises both embodied and operational carbon in the short and long term and creates a comfortable and healthy indoor environment for future occupants.

The project scope includes but is not limited to:

- conservation of historic fabric;
- localised structural stabilisation where required;
- reversal of previous inappropriate interventions;
- upgrading of mechanical and electrical services;
- replacement of gas fired boilers and fireplaces with a geothermal heat pump;
- upgrading of internal spaces to provide high quality accommodation for staff and students;
- pre-retrofit in-situ U-value measurements and indoor air quality (IAQ) monitoring;
- hygrothermal risk assessment and thermal bridge modelling of any potentially risky retrofit measures;
- bespoke low-risk high-impact retrofit measures;
- post-installation fabric and IAQ monitoring.

Much of the project is focused on the repair and making good of existing building fabric, externally and internally. Where historic fabric remains internally, this will be preserved, however much has been lost over the years which has allowed for the alteration and improvement of these spaces to meet modern standards of comfort.

A contemporary view of the eastern elevation which shows how the building has changed over the years. The third floor was added in 1894-7 along with the present gabled arrangement. A coat of cement-based pebbledash was added to the elevation's Calp stone in the mid-20th century. © Carrig Conservation

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e-mail andrew@passivate.ie

Project Rubrics Building, Trinity College, Dublin 2
Client Carrig Conservation ltd
Date 26.06.20
Purpose Project U-values

Item description	Notes	Measurement period	Method	Calculated U-value
EXISTING CONDITION				
West elevation (solid brick)		24.05.20 - 27.05.20	In-situ measurement	0.836
East elevation (stone ground/first/second, brick third)		14.03.20 - 17.03.20	In-situ measurement	1.131
Gable walls			Calculation to IS EN ISO 6946	1.210
Suspended timber ground floor				0.470
Roof	Roof area is currently uninsulated			3.860
Windows				4.500
POST-RETROFIT CONDITIONS				
West elevation (solid brick)				0.836
East elevation (stone ground/first/second, brick third)				0.572
Gable walls				0.250
Suspended timber ground floor				0.330
Roof				0.330
Windows				4.500

A series of in-situ and calculated U-value assessments were carried out on the building to determine how well the building was currently performing before specifying any thermal upgrades. The front (west) façade is solid brick and an in-situ U-value measurement showed it has a U-value of 0.836 W/(m^{2}K). Given the historic significance of the external façade and internal finishes, solid wall insulation was not an option but with upgrades to the other three facades, roof and floor, the overall thermal efficiency of the building envelope was determined to be efficient enough to work with a ground source heat pump. Vapour open insulation materials were specified to be compatible with traditional construction and condensation risk analyses and thermal bridge assessments were done to minimise the chance that the proposed retrofit measures and materials would lead to any unintended consequences.

Discoveries that caused the initial design to be revised

Structural Elements, Decorative Finishes, Evidence of Social History/Patterns of Use

Some solum areas have been covered with concrete beneath the suspended timber floors, so different insulation strategies are required across the different apartments within the building. The remains of original early 18th c staircases between the two-story apartments were found and will be retained. The steel trusses of the late 19th century roof and upper floor addition were found to extend into the walls and thermal bridge analysis will be required to ensure the external insulating lime render doesn't cause any issues.

The project is due for completion in Winter 2022.

Location

Trinity College, Dublin, Ireland

Building Use

Residential accommodation

Status

Under construction

Project representative

Caroline Engel Purcell, Carrig Conservation International Ltd,
the conservation specialist of the Historic Property that is being retrofitted

Post Occupancy evaluation results

n/a

Reasons for Retrofit

- Ground water dispersal
- Fire Safety
- update to internal furnishings
- reconfiguration of internal apartments

Scale of retrofit (from light to deep 1-10)

6 Retrofit measures include external hemp lime render, repair and draught proofing of existing windows and doors, warm roof rafter insulation, suspended timber floor insulation (GF and intermediary), mechanical and natural ventilation strategy, geothermal heat pump.

Historic slate covered with a lime and horsehair mix held in place by batten below the suspended timber floor. © Carrig Conservation

Internal GreenTEG in-situ u-value monitor installed in test apartment. © Carrig Conservation

ICOMOS guidelines used

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Karsten tube porosity tests underway on the historic brick of the Rubrics Building. © Carrig Conservation

Early 18th-century sash window to the east elevation with thick glazing bars. © Carrig Conservation

Original early 18th c. wall panelling in what would have originally been a two-storey apartment. Very little of the original panelling survives throughout the rest of the building. © Carrig Conservation

Guidance consulted when approaching the retrofit design

Historic England, Sustainable Traditional Building Alliance (STBA), The Society for the Protection of Ancient Buildings (SPAB), Historic Environment Scotland

Project Evaluation Criteria

(from most important to least important)

1. Heritage Priorities
2. Energy/Carbon performance targets
3. Project budget
4. Construction budget
5. Operational Priorities
6. Procurement route

THE NEW ST ALBANS MUSEUM AND GALLERY

© Nick Guttridge

CASE STUDY SPECTRUM 7

THE NEW ST ALBANS MUSEUM AND GALLERY

Project Description

John McAslan + Partners was commissioned by St Albans City Council to restore its Grade II* Old Town Hall and Court Room and convert it into a museum and gallery for the city, to re-energise the building as a showcase for 2000 years of history for future generations to enjoy. Completed in Spring 2018, the project makes a significant contribution to the rejuvenation of cultural life in the town and the outlying area.

The early Victorian building and its repair requirements have much in common with the former Assize Court in Devizes, in terms of scale, history and brief for the conversion.

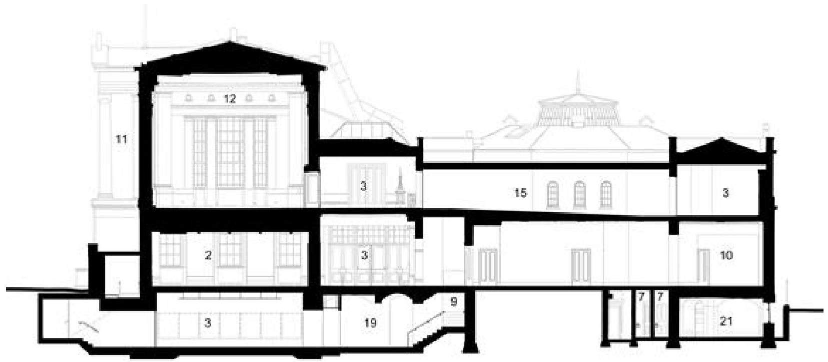
The significance of the Town Hall and Courtroom lies as much in its history as an early municipal building as in its accomplished architecture. The Courtroom in particular, is a rare survivor of the Georgian judicial system. Listed at Grade II*, the building is of exceptional architectural and historical interest. However, by the mid-20th Century the Town Hall functions had ceased and its civic importance faded into memory. Parts of the ground floor were used for a cafe, tourist information office and occasional book fairs, but much of the building stood vacant and closed to the public.

As is typical with a historic building, St Albans Town Hall – a building that had been empty for many years – had minimal insulation, solid masonry walls and inefficient services when the project started. John McAslan + Partners' scope in transforming the Grade II* building was to upgrade the thermal efficiency wherever this could be achieved without adversely affecting its special historic interest. The practice worked closely with key heritage bodies – Historic England and The City Council's Conservation Team to achieve the best possible energy performance, given the heritage constraints inherent in the project.

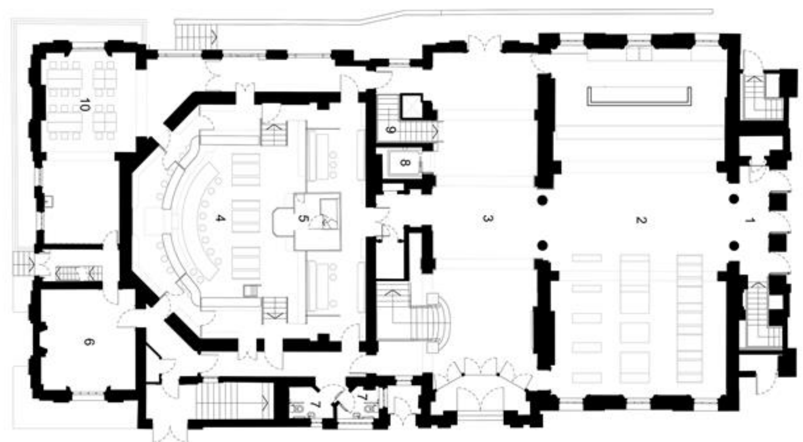
The project consisted of excavation of the basement to provide a new state-of-the-art gallery space, a reconfiguration of the circulation spaces and conservation of the historic fabric. New glazed windows at the first-floor level allow visitors to circulate around the building and enjoy stunning views of the surrounding townscape and cathedral. These changes had to be carried out sensitively to respect the building's special historic interest whilst ensuring the building's survival through optimising it for its new function.

Alongside the new gallery spaces, the historic courtroom has been refurbished as a creative educational resource and cafe's extra seating area, with visitors able to explore its Victorian cells in the basement below. Changes to fabric and uses, historic and current, were carefully designed to respect the building's heritage and deliver substantial public benefits.

Conservation of the fabric consisted of extensive repairs to the external render which was undertaken following analysis and matching of the Roman Cement render, careful reinstatement of some of the missing and damaged mouldings, and replacement of much of the leadwork



Proposed plans © John McAslan + Partners



Proposed floor plan © John McAslan + Partners

on the roof and cornices. Internally, lime plaster was matched to the original and repaired. Paint analysis in the principal rooms was also carried out to establish original painting schemes, although a more restrained palette was eventually chosen for the new gallery spaces. In the courtroom the joinery was extensively repaired and the grained finish was carefully reinstated. The courtroom can now be used for court re-enactments and, day-to-day, as cafe seating generating revenue for the museum which will be critical to its long-term success.

Discoveries that caused the initial design to be revised

Structural Elements, Openings or Accessways.

Location

St Alban's, London

Building Use

Museum and Gallery

Status

Completed

Project and Construction Budget

£7.75 million

Project representative

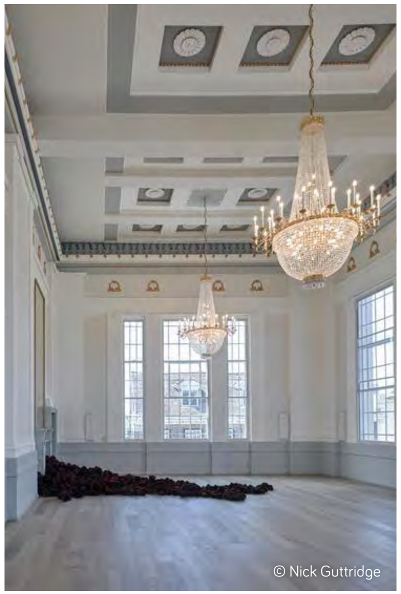
Katherine Watts, RIBA SCA, John McAslan + Partners, both designer and conservation specialist

Reasons for Retrofit

- Water Ingress
- Fire Safety
- Decay

Scale of retrofit (from light to deep 1-10)

7 Deep in terms of structural strengthening, Light in terms of new finishes and servicing



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- ✓ Give expert advice on maintenance strategies, management policies and the policy framework for environmental protection, and the preservation of monuments as well as their contents and sites
- ✓ Document works executed and make them accessible
- ○ Work in multi-disciplinary groups using sound methods
- ✓ Be able to work with inhabitants, administrators and planners to resolve conflicts, and to develop conservation strategies appropriate to local needs, abilities and resources

© Nick Guttridge

Guidance consulted when approaching the retrofit design

Historic England; The Society for the Protection of Ancient Buildings (SPAB)

Project Evaluation Criteria

(from most important to least important)

1. Operational Priorities
2. Heritage Priorities
3. Project Budget
4. Construction Budget
5. Energy/Carbon Performance Targets
6. Procurement Route

HAMPSTEAD COTTAGE

Hampstead Cottage – after © Yvette McGreavy

CASE STUDY SPECTRUM 8

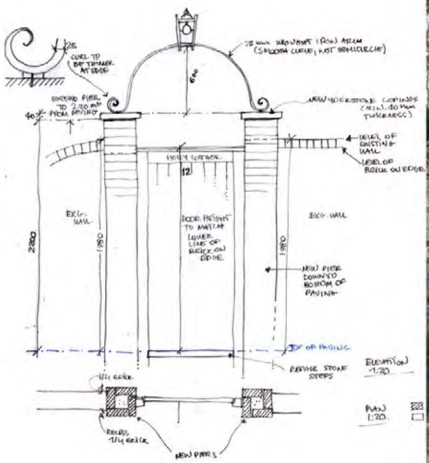
HAMPSTEAD COTTAGE

Project Description

This project is about a Grade II Cottage semi-detached residential dwelling situated in Camden, London. It is dated as 18th century by Historic England, although some of its construction material may have been recycled from an older site.

The painter Ford Maddox Brown lived in this house in 1883, and the house appears in the background of his 1852 painting 'Work'.

When the house was acquired by the current owners, there was almost no sign of any original internal fabric, apart from the early 18th-century staircase. An investigative survey revealed original panelling behind plasterboard in almost all rooms. Work on the house involved reinstating the original panelling, repairing the panelling and structure, removing the unsympathetic alterations carried out by the previous owners, upgrading insulation and bringing the house back to its original state as much as possible. The landscaping was done by Jenny Bloom Garden Design.



© Yvette McGreavy

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Discoveries that caused the initial design to be revised

Original Wall Surfaces, Structural Elements, Decorative Finishes, Openings/ Accessways

Location

Camden, London

Building Use

Residential dwelling

Status

Completed

No. Storeys

3

Project and Construction Budget

£500k

Project representative

Sarah Khan, RIBA SCA, Roger Mears Architects, designer of the historic property that has been retrofitted.

Reasons for Retrofit

- Low Energy Performance
- Water Ingress
- Structural Instability
- Decay

Scale of retrofit (from light to deep 1-10)

8 The retrofit was as deep as possible given the conservation constraints.

Exerpt-from-investigation-report

ICOMOS guidelines used

- [x] Read a monument, ensemble or site and identify its emotional, cultural and use significance
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© Yvette McGreavy

© Yvette McGreavy

Guidance consulted when approaching the retrofit design

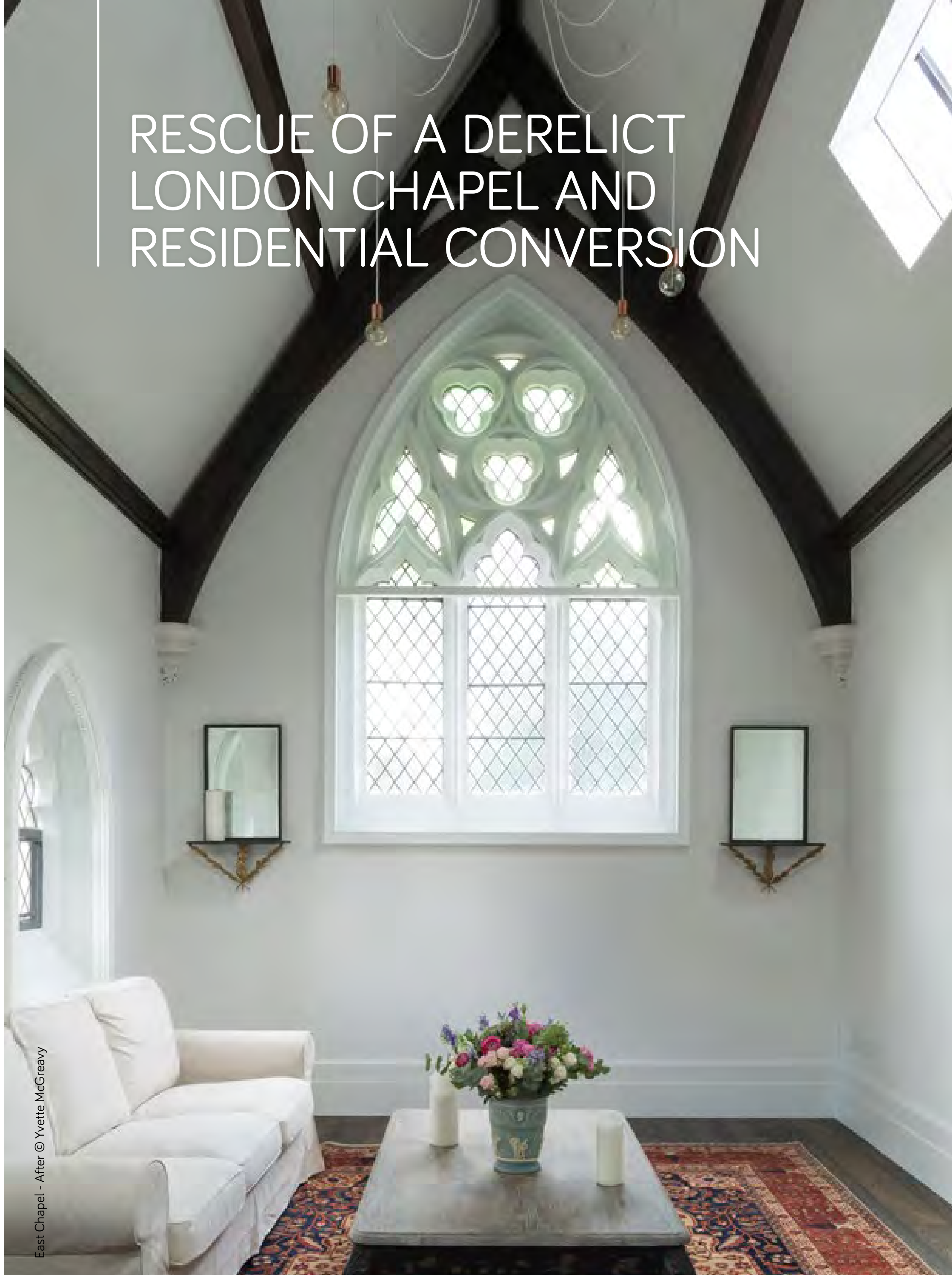
Historic England, Sustainable Traditional Building Alliance (STBA), The Society for the Protection of Ancient Buildings (SPAB)

Project Evaluation Criteria

(from most important to least important)

1. Heritage Priorities
2. Energy/Carbon Performance Targets
3. Operational Priorities
4. Project Budget
5. Construction Budget
6. Procurement Route

RESCUE OF A DERELICT LONDON CHAPEL AND RESIDENTIAL CONVERSION



East Chapel - After © Yvette McGreavy

CASE STUDY SPECTRUM 9

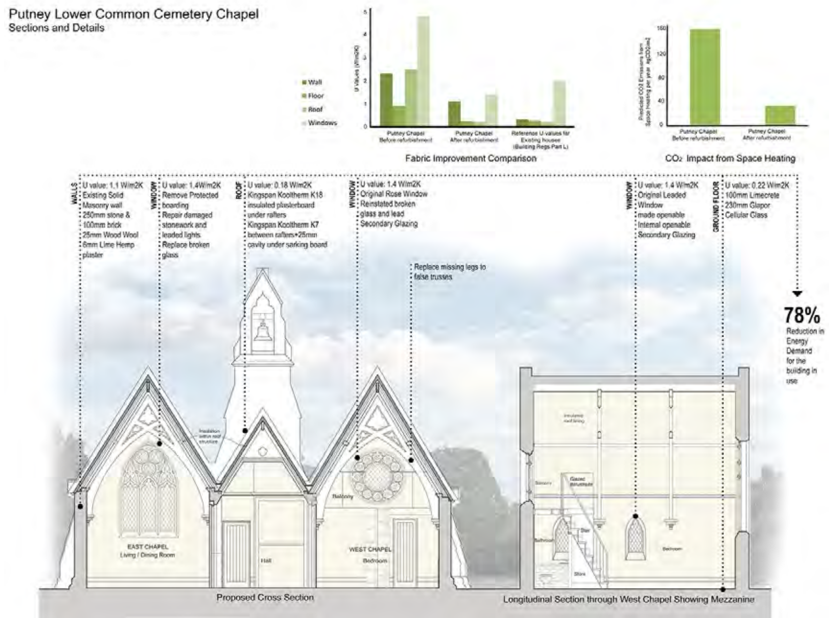
RESCUE OF A DERELICT LONDON CHAPEL AND RESIDENTIAL CONVERSION

Project Description

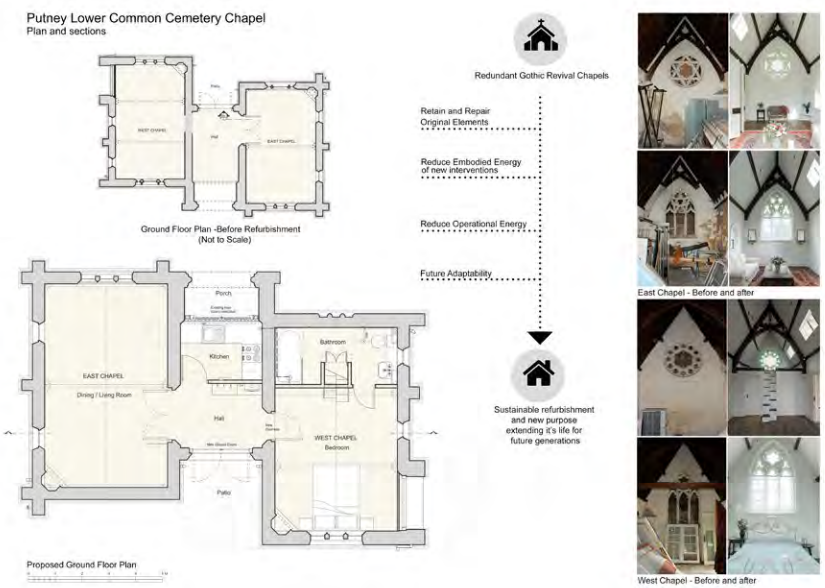
This project relates to two locally listed Gothic Revival Chapels, located in a historic cemetery in Putney; unused for over 30 years and in a state of dereliction. Stonework was deteriorating, the roof damaged and lead gutters stripped, causing extensive water penetration and damage. This project has rescued these crumbling Gothic Revival Chapels using traditional materials and techniques in an imaginative and subtle conversion into a small private dwelling. The design is very simple, but effective.

The East Chapel is used as the principal living space, with the bedroom, bathroom and a mezzanine balcony in the West Chapel. A new kitchen and entrance lobby are in the central aisle. The recessed porch has been retained at the front with doors transferred from the rear, with a private main entrance through glazed doors at the rear. The large tracery windows are supplemented by small side and roof windows providing ventilation and light, while new timber floors and woodwork with painted lime plaster walls and ceilings create a simple clean aesthetic successfully combining the character and form of the chapel and its new home use.

The building was bare bones, it was easy to read all the information. Some vandalism and theft occurred during the project which had to be dealt with.



Sections and details © RMS



Plan and sections © RMA
Right: West Chapel before and after ©Yvette McGreavy

Discoveries that caused the initial design to be revised

n/a

Location

Putney, London

Building Use

Residential dwelling

Status

Completed

Project and Construction Budget

£425,000+ VAT

Project representative

Sarah Khan, RIBA SCA, Roger Mears Architects, designer of the historic property that has been retrofitted.

Post Occupancy Evaluation results

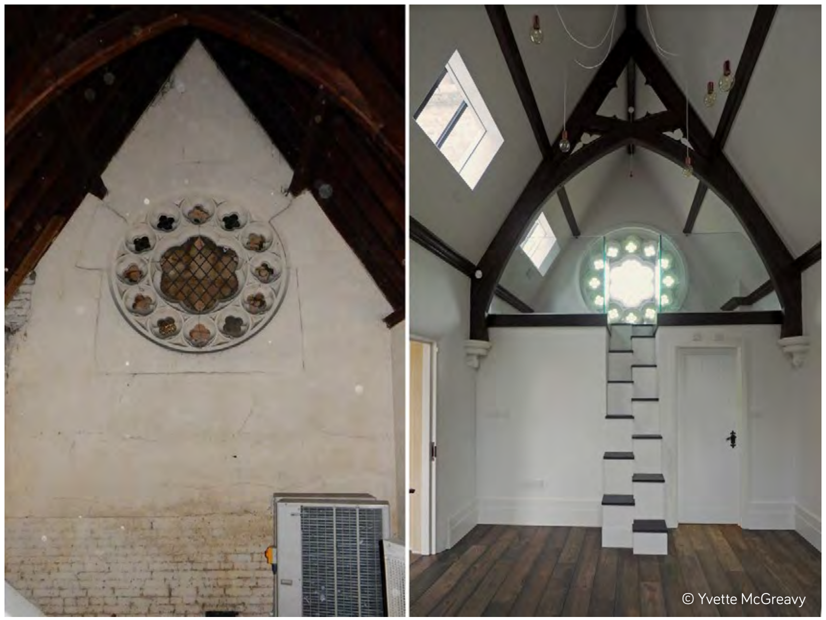
The team responsible carried out energy use monitoring from energy bills. They also monitored air temperature and humidity during use for 6 months, as well as a pattern of using heating/ passive cooling.

Reasons for Retrofit

- Water Ingress
- Structural Instability
- Fire Safety
- Decay
- neglect
- risk of vandalism
- no secure use

Scale of retrofit (from light to deep 1-10)

9 The retrofit was as deep as possible given Heritage constraints



© Yvette McGreavy

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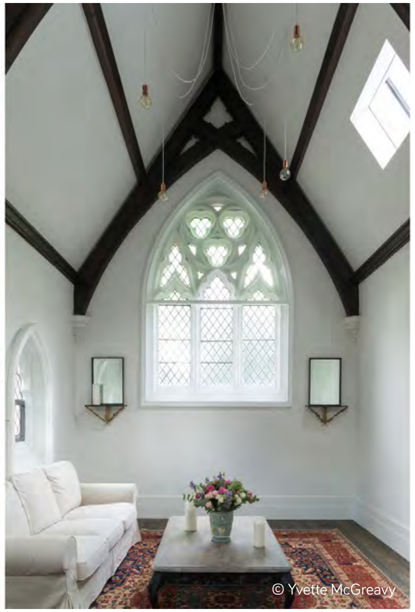


© Yvette McGreavy

Guidance consulted when approaching the retrofit design

Historic England, Sustainable Traditional Building Alliance (STBA)

Project Evaluation Criteria

(from most important to least important)

1. Operational Priorities
2. Heritage Priorities
3. Energy/Carbon performance targets
4. Construction budget
5. Procurement route

ZETLAND PASSIVE HOUSE

Front view 8 Zetland © Rick McCullagh

CASE STUDY SPECTRUM 10

ZETLAND PASSIVE HOUSE

Project Description

The Zetland Passive House project is the UK's first certified EnerPHit Plus building. Originally built in 1894, this Passivhaus project is intended to provide a blueprint for retrofitting the UK's 8 million pre-1930's, hard to treat homes. Using natural, breathable materials and reusing all the recoverable, original fabric, the project is a pioneering example of sustainable low carbon retrofit.

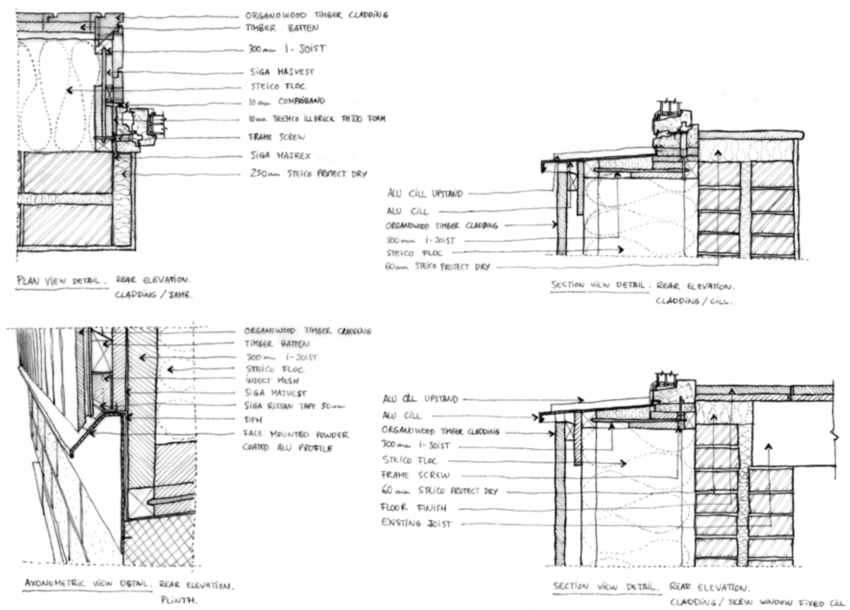
These semi-detached townhouses achieved a 95% reduction in space heating demand and a 7-fold reduction in carbon emissions. These dwellings feature an 11kW PV system powering an AI driven hot water tank and a 2kw post heater piggybacking on the MVHR system, removing the need for a traditional central heating system.

The UK has set a target of net zero carbon emissions by 2050, but with 80% of the country's housing stock estimated to still be inhabited by that point, sustainable retrofit is the critical solution for achieving the government's targets. Of these 24 million existing properties, about 8 million are built prior to 1930 and classified as hard to treat; therefore, falling outside of the standard upgrade guidance and incentives available.

Prior to this EnerPHit conversion, the Zetland Road townhouses had been occupied as 5 rental flats for decades, with many period architectural features lost due to unsympathetic alterations. Energy bills for a typical home of this size costs about £5000 per year, making this type of property expensive and highly carbon consuming to maintain.

The Zetland Passive House project sought to minimise carbon and build costs by working within the existing footprint, using tiny house design principles to prevent the need to extend, and reducing embodied energy. Existing building fabric was retained to minimise waste and maximise thermal mass potential. A healthy internal environment was created through the specification of a breathable, natural, petrochemical free building fabric and the application of air filters, humidity control, and VOC and CO,, absorbing materials. This project involved restoring period features with exemplar solutions such as the first Passivhaus stained glass windows and doors, as well as Victorian-style plaster cornicing and ceiling roses, decorative mosaic tiling, stone steps and ornate porch.

The project was conceived as a laboratory for retrofit with knowledge sharing at its core. Ecospheric has offered tours and shared learning with thousands of visitors, including architects, policymakers, developers, students and homeowners. The Zetland Passive House has been featured in more than 50 media outlets, including the cover issue of Passive House + magazine.



Hand-drawn details © Chris Rodgers_Guy Taylor Associates

© Rick McCullagh

Insulation and cladding © Ecospheric

Discoveries that caused the initial design to be revised

Structural Elements; Openings or Accessways

Location

Manchester

Building Use

Residential dwellings

Status

Completed

Project and Construction Budget

£1.8 million for 2 homes including cost of purchasing the land

Project representative

Kit Knowles, Ecospheric, designer, developer, and principal contractor

Post Occupancy Evaluation results

Upon completion, Ecospheric collaborated with the University of Salford and Jesus Mendnedez of Zero Energy to test air quality, wall moisture and true U-Value tests to analyse the building fabric performance. Results showed that real time U-Value measurements matched modelled U-values predictions as per PassivHaus Planning Package (PHPP).

Zetland Passive House wall moisture measurements were 30-50% dryer than a typical wall with Aw varying from 0.45 – 0.6. Air quality measurements (RH) varied from 47% and 59%, well within the recommended zone for comfort and health. Indoor air was found to have significantly lower particulate matter and CO2 readings when compared to a typical dwelling. It was found that 60% of the time it would have been more unhealthy to open a window.

Ecospheric is continuing to work with the homeowners to monitor internal air quality, temperature, energy use and building performance using remote sensing equipment over the long term.

Ecospheric also has an ongoing collaboration with the University of Liverpool's Low Carbon Architecture department to produce an embodied carbon and life cycle analysis of the Zetland Passive House project. The aim is to allow us to compare the embodied and operational carbon over an agreed nominal life span for the building (say 60 years) for the following case:

- Retrofit to Part L standards using common building materials
- Retrofit to PH plus standard using typical petrochemical based insulation and gypsum plaster.
- The actual project, retrofit to PH plus standard using natural and low embodied carbon materials including lime plaster

Reasons for Retrofit

- Water Ingress
- Structural Instability
- Fire Safety
- Pollutants
- Decay
- Embodied carbon

Scale of retrofit (from light to deep 1-10)

10 Ecospheric is working with the Greater Manchester Combined Authority to ensure that lessons learned can be applied to the region's retrofit strategy for 61,000 homes.

ICOMOS guidelines used

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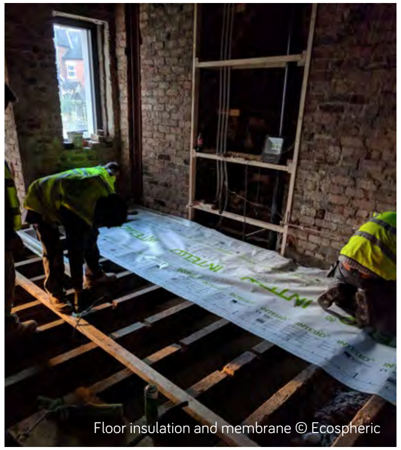
- [x] Other: Climate heritage – Climate change is forcing a completely new perspective on refurbishment of existing housing stock. Zetland Road proposed new standards for the depth of possible refurbishment.

Dining living space © Rick McCullagh



Floor insulation and membrane © Ecospheric

Floor membrane and timber supports © Ecospheric

Guidance consulted when approaching the retrofit design

RIBA Sustainable Outcomes Guide; Historic England; The Society for the Protection of Ancient Buildings (SPAB); LETI Climate Emergency Design Guide; LETI Embodied Carbon Primer; UK Green Building Council's 'The Retrofit Playbook'

Project Evaluation Criteria

(from most important to least important)

1. Energy/Carbon Performance Targets
2. Heritage Priorities
3. Construction Budget
4. Procurement Route
5. Operational Priorities
6. Project Budget

What does good look like? Principles for future action:

'The 'spectrum' framework avoids the frustration of trying to compare incomparable things. Instead, this guide simply presents a range of buildings that offer project specific solutions that collectively address key issues such as moisture, fire, fabric first, energy optimisation and embodied carbon. We provide an overview of the issues and a set of solutions that can hopefully prompt innovations from readers:

- Levels of interventions and key sustainable strategies to be considered
- Upfront cost vs. long-term/ operational cost
- One size does not fit all

The intention of this document is to illustrate a range of approaches and strategies that deploy a critical understanding of cultural significance and how the application of sustainable materials and technologies come together.

Compromise is intrinsic to working with heritage buildings, however, a building's performance issues can provide numerous constraints which architects need to critically assess when attempting to define how energy can be linked to longevity.

Timescales are critical to retrofit – the principle of payback impacts significantly on the ability to optimise solutions. In aknowledging the longevity of historic buildings, their carbon storage within their fabric and their ability to sustain accommodation for decades to come, the ability to argue for similarly robust and well-considered energy and material installations becomes greater.

The process will even vary between similar projects aimed at the same outcomes.

Moreover, emphasis must be given on **contractions** and **parameters**.

'Good' is when a better solution can't be found.

While **context** can sometimes be both a constraint, it may also provide the starting point for any environmentally responsible conservation project – conserving energy, conserving building fabric, conserving resources and conserving heritage skills are part of the same project: addressing the climate emergency through sustaining cultural value.

In offering these case studies as examples of the range of opportunities that responsible retrofit presents, we hope to encourage conservation architects to expand on their existing learning and to research and apply many of the concepts discussed in this text.

RIBA
Architecture.com