ECD Architects
ENERGY CONSCIOUS DESIGN

# WILMCOTE HOUSE

## A new model for tackling estate refurbishment and fuel poverty

www.ecda.co.uk

## CONTENTS

"Despite the many challenges of undertaking the largest EnerPHit scheme in the world with residents in occupation and the resulting programme delays, the Wilmcote House project has already achieved its principle objective to address fuel poverty by significantly reducing residents' energy bills whilst also simultaneously improving their living environment and comfort levels. In addition, the scheme has transformed a deteriorating 1960s tower block into a modern, secure block with an extended life span that will most likely meet future energy performance standards."

**STEVE GROVES**
Asset Manager, Portsmouth City Council



# INTRODUCTION

**Portsmouth City Council. Wilmcote House.**

Wilmcote House provides 111 flats of affordable housing for social rent in Somerstown, Portsmouth and is an 11-storey development comprising of three interlinked blocks with a combined GIA of approximately 10,200m$^2$.

It was built in 1968 and is a pre fabricated concrete structure of LPS (Large Panel System) using the Bison Reema system. Following the partial collapse of a similar LPS building at Ronan Point (East London), measures were taken to remove gas from all LPS buildings in the UK and carry out strengthening as necessary.

As a result, the flats at Wilmcote House were heated by old, inefficient and expensive electric storage heaters with residents typically on key meters. The existing concrete panels incorporated a very small amount of insulation however this was ineffective and the flats experienced extreme heat loss. Whilst double glazed windows had been installed in the 1990s these were relatively inefficient and now required replacement. However, whilst it was clear that the building required urgent attention, it was first necessary to undertake a thorough structural investigation to establish the condition of the concrete panels. Once the structural condition of the building had been confirmed and its suitability for refurbishment proved, the project team began to prepare feasibility options.

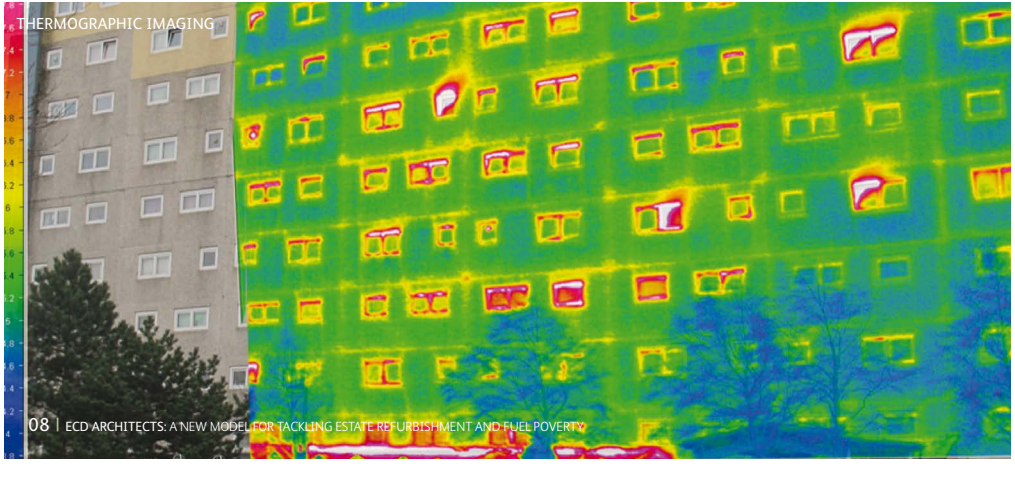
# DRIVERS TO RETROFIT

**Fuel Poverty. Thermal Comfort. Maintenance. Carbon Emissions.**

The retrofit of our building stock, especially that of the residential sector, is of key importance in reducing our carbon emissions. UK buildings produce approximately 88MT$CO_2$e per annum (2015) from the burning of fossil fuels to provide space heating and hot water. This represents 17 % of total UK carbon emissions. The UK building stock and the associated space heating demand has therefore been identified as a key target to fully decarbonise by 2050.

Whilst carbon reduction is an imperative and energy consumption is often (although not always) directly linked to this target, we should not forget that buildings are primarily designed to serve human needs and human comfort. Given that many existing buildings fail to provide good levels of thermal comfort this should be a key driver when tackling our ageing building stock. Other triggers for refurbishment may include the rising cost of energy and disproportionate cost of heating an inefficient building which in the housing sector may result in 'Fuel Poverty'. In 2014, 11 % of English households were defined as being in Fuel Poverty with around 1 in 5 people finding it difficult to afford the cost of heating their home. Living in a cold home can result in a series of avoidable health related problems, both physical and mental, and has been linked to increased cases of 'Excess Winter Deaths'.

A study of Wilmcote House by Southampton University had shown that many residents were under-heating their homes, well below WHO (World Health Organisation) recommendations, which exacerbated mould growth. This was largely due to the high degree of heat loss caused by the poor quality of the existing building and the expensive, inefficient heating system. Given the findings of this work and the ongoing deterioration of the block Portsmouth City Council (PCC) sought options to address these issues.



THERMOGRAPHIC IMAGING



# CHOOSING THE TEAM

**ECD Architects. Keegans. Wilde Carter Clack.**

ECD Architects were selected as Multi-disciplinary lead consultants for Wilmcote House by PCC via an OJEU tender process in 2012.

This included architectural, structural, M&E, CDM and cost consultancy services from inception to completion. ECD Architects have completed over 30 similar high rise residential retrofit projects over the last 30 years and have a very detailed understanding of the specific technical challenges of this building typology. ECD also have a strong track record of delivering both new build and retrofit housing projects for affordable housing landlords working with many resident groups to transform housing blocks and estates. The ECD team included Keegans cost consultants who have expertise in affordable housing and Wilde Carter Clack structural engineers who have specialist knowledge of LPS buildings.

| ECDA APPOINTED | FEASIBILITY COMPLETED | PLANNING APPROVAL | DESIGN COMPLETED | CONTRACTOR APPOINTED | STARTED ON SITE | ANTICIPATED COMPLETION | ACTUAL COMPLETION |
|---|---|---|---|---|---|---|---|
| FEB 2012 | OCT 2012 | APR 2013 | JUL 2013 | DEC 2013 | JULY 2014 | OCT 2016 | JUL 2018 |

**ECD Architects**
Project Director: James Traynor
Lead Project Architect: Loreana Padron

**Wilde Carter Clack**
Structural Engineer: John Carter
Structural Engineer: Tim Smith

**Keegans**
Project Director: Ian Sarchett
Director, Principal Designer: Andrew Morrison
Senior Project Manager: Ron Spence
Project Manager: Rohan Coombs
Quantity Surveyor: Ibrahim Logun

# WHAT IS ENERPHIT?

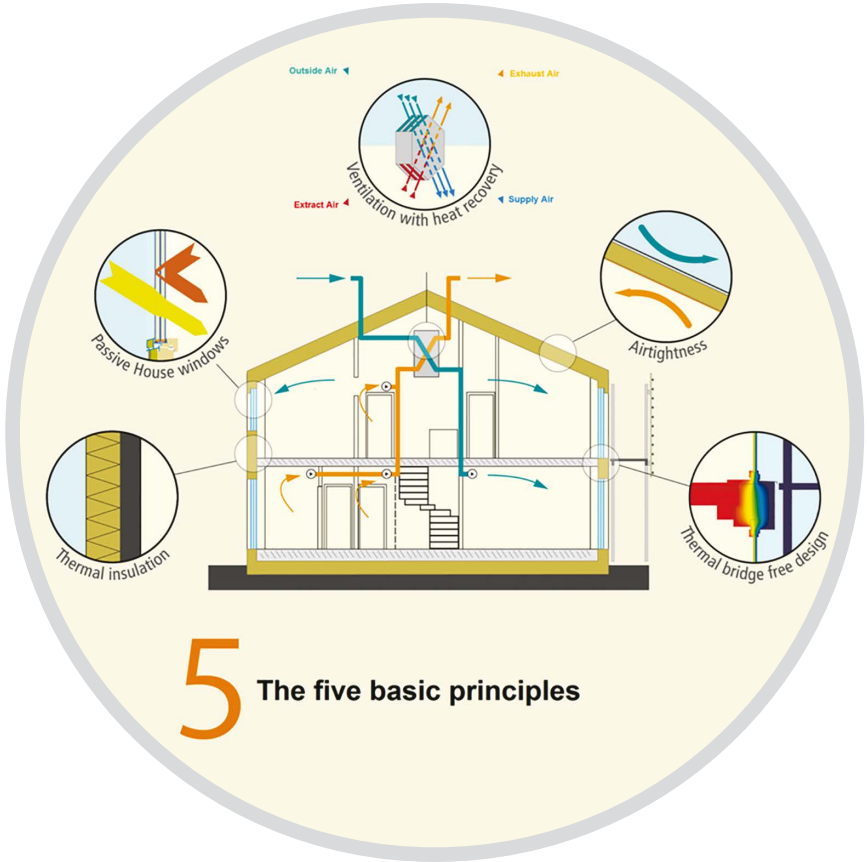
**The Importance of Quality Control.**

EnerPHit was launched by the Passivhaus Institute (PHI) in 2010 as the target standard for the refurbishment of buildings.

It uses the same five principles as Passivhaus to ensure that design proposals address all the key aspects of building performance. These include:

1. Building Envelope: This should be a continuous layer, without gaps around a building which minimises heat transfer relative to the function of each element, whether it is a window, wall, floor or roof. Threshold levels of performance are required for each element to ensure overall integrity. The efficiency of the envelope relative to floor area also plays an important part in reducing energy demand.
2. Airtightness: The airtight layer plays a crucial role in reducing heat losses from draughts as well as protecting the building fabric from condensation. The measurement of airtightness should be done during construction and on completion to ensure performance.
3. Solar Gain: Windows are typically required in all building types and seasonal variations need to be carefully modelled to provide sufficient heat in the winter whilst avoiding overheating in the summer.
4. Thermal Bridges: A thermal bridge is a localised weak spot in the envelope of a building where heat losses are substantially greater than surrounding areas. This weakness is common in many existing buildings and careful detailing is required to resolve this.
5. Ventilation: This means providing optimal indoor air quality for the health and comfort of residents whilst avoiding uncomfortable draughts and associated heat losses caused by excessive uncontrolled ventilation. In practice this means using mechanical ventilation with heat recovery (MVHR) extracting from bathrooms and kitchens whilst supplying fresh preheated air to living rooms and bedrooms.

Applying these five measures and their respective targets, Passivhaus and EnerPHit buildings are designed to achieve specific performance outputs for a range of measures such as Space Heating/ Cooling Demand; Space Heating/ Cooling Load; Frequency of Overheating; Frequency of excessive high humidity; Airtightness; Non-Renewable Primary Energy Demand (PE); Primary Energy Renewable (PER).



# FEASIBILITY OPTIONS

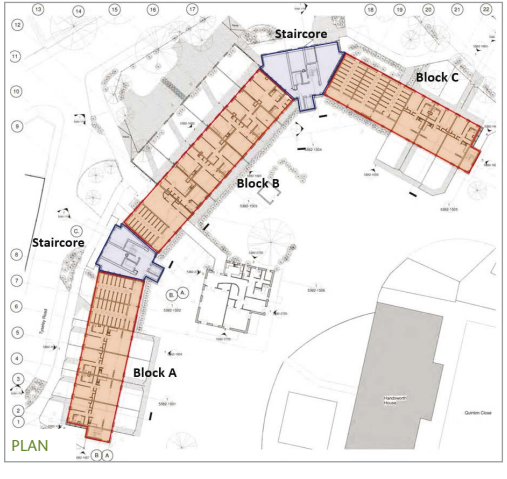
## Demolish, Refurbish or Retrofit?

ECD Architects provided two options for the refurbishment of Wilmcote House:

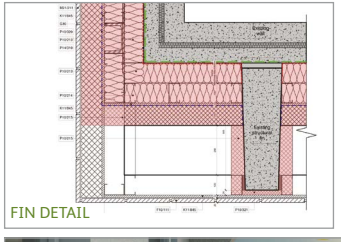
1. The first option being the installation of a communal heating system with insulation to the existing envelope in accordance with UK building regulations Part L2B.
2. The second option was to super-insulate externally and simplify the existing envelope to the EnerPHit standard such that a new heating system might not be required. In this option ventilation would be provided by individual high efficiency MVHR units installed in all flats with triple glazed windows throughout.

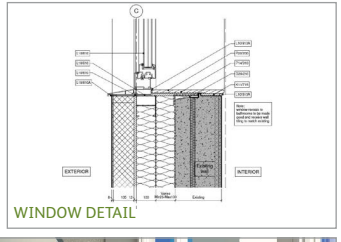
The first or 'standard' option proposed insulation to all existing elements and accepted continued thermal bridging at complex junctions. Whereas the second 'EnerPHit' option proposed to extend the existing building to simplify the thermal envelope and thereby reduce the 'form factor' and resulting heat losses. This option also super-insulated the roof and extended the insulation zone below ground to create a thermal 'skirt'. These options included specialist input from structural engineers (Wilde Carter Clack) and M&E consultants (NLG) with an outline cost study prepared by the quantity surveyors (Keegans). A comparative cost was also prepared to understand the likely cost of demolition and rebuild although this was significantly more expensive than both refurbishment options.


PROPOSED OPTION

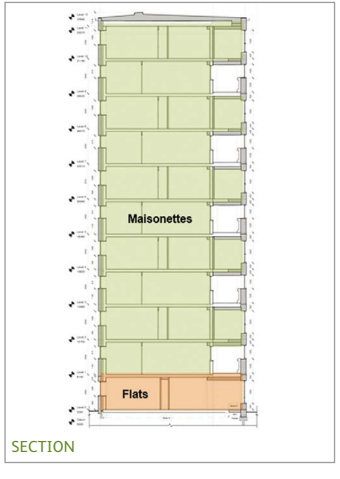


PLAN


FIN DETAIL


WINDOW DETAIL


ENCLOSED WALKWAYS



SECTION

# LONG TERM VISION

**PCC 30-year Investment.**

Portsmouth City Council own and manage approximately 15,000 residential properties with a further 2,000 leaseholders. They also own approximately 800 commercial buildings and have an annual repairs and maintenance budget of £50M.

They have a long-term interest in the quality of their assets and as a responsible social landlord they have a duty to provide decent housing for their residents. As a major landowner and local authority PCC also have the opportunity to finance long-term investments and improvements to their building stock.

As a result of the initial feasibility study ECD recommended the deep retrofit of Wilmcote House and this was accepted by the Head of Finance (PCC) who noted in the 2012 Cabinet report that...

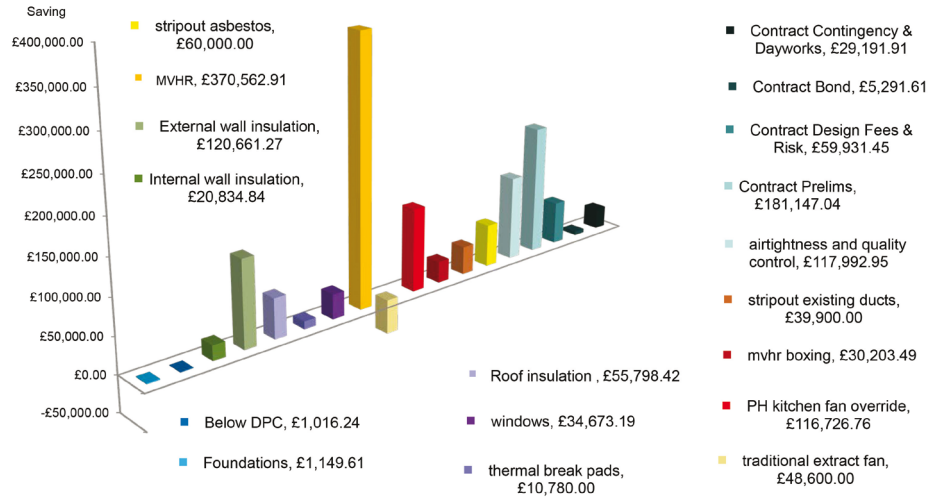
***"Wilmcote House is over 40 years old. Without refurbishment it will be uninhabitable in the medium term and costly to maintain in the short term…the financial appraisal of the scheme demonstrates that the high specification of work is cheaper over the 30-year plan than demolition and replacement…the energy saving measures proposed will in addition reduce the ongoing running costs of the block."***

This project was financed by PCC to drastically reduce the heating bills by approximately 90% and as such the primary beneficiaries will be the residents of Wilmcote House. However, PCC will also benefit from the significant reduction in ongoing maintenance costs and increased ability of residents to pay their rent. This project has informed both PCC and the wider housing industry and will hopefully be the first of many similar retrofit projects as we seek to tackle fuel poverty and decarbonize our building stock.



BREAKDOWN OF CONSTRUCTION CAPITAL COST DIFFERENCE

| | | | |
|---|---|---|---|
| Enerphit Contract Sum | £13,044,183 | = | £897/m² |
| Building Regulations | £11,836,921 | = | £814/m² |
| Difference | £1,207,262 | = | £83/m² |





AUTHORS SUBMISSION VERSION

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Special symposium issue

Fuel poverty-induced 'prebound effect' in achieving the anticipated carbon savings from social housing retrofit

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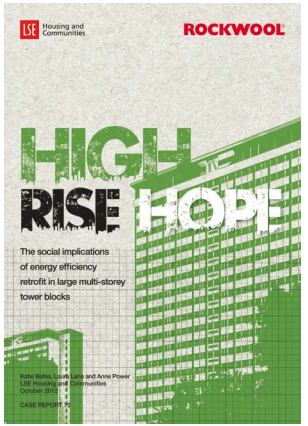



# COLLABORATE, MEASURE, LEARN, IMPROVE

**Partnerships and Performance.**

A key objective of this project was to measure actual performance to both inform and improve future projects. Both PCC and ECD sought to collaborate with others to understand the outcomes of the project and disseminate these more widely.

PCC invited Southampton University (Sustainable Energy Research Group) to undertake pre-retrofit studies to establish the extent of fuel poverty and later to measure the thermal performance of the completed building in both summer and winter heating seasons. ECD invited London School of Economics (Housing & Communities) with Rockwool to undertake detailed surveys of existing residents before, during and after the works to understand the challenges and benefits of working with residents in-situ and what impact the project has had on their lives.

With Keegans cost consultants ECD also sought to measure the financial cost of achieving EnerPHit and proved that this could be recovered through reduced running costs within the planned 30 year investment. Finally, ECD introduced BRE as UK partner of the Passivhaus 'EuroPHit' programme. Wilmcote House subsequently became the EuroPHit UK case study which resulted in additional funding for training and technical support. Throughout the project both PCC and ECD have supported many housing professionals and construction students in the study of the project with several tours of the building both during the works and after completion. As a result, Wilmcote House has won several awards and has become the benchmark for future housing retrofit in the UK and remains the largest occupied building to target EnerPHit in the world.

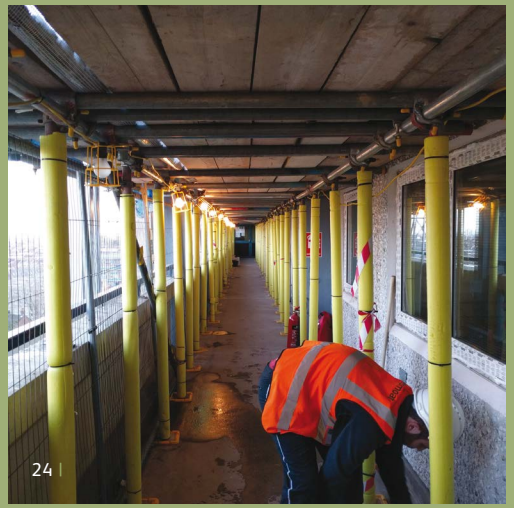
# IMPLEMENTING THE VISION

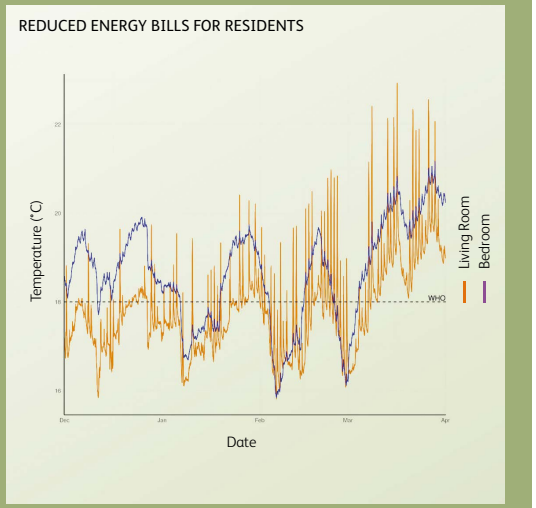
**Design, Procurement and Delivery.**

Aside from the thermal improvements and carbon reductions the project sought to improve the appearance of the existing building. As part of an estate-wide regeneration programme Wilmcote House has transformed the Somerstown area of Portsmouth and provides new accessible flats at ground floor in lieu of the former housing office. The works have also improved the security and visibility of the blocks leading to a significant improvement in communal areas.

As an occupied LPS building the project included several key challenges which had to be addressed in the design, procurement and delivery of the project. Ensuring minimal disruption and the safety of residents was a critical requirement given the need to remove prefabricated concrete walls at high level. This was achieved by a number of measures which included the use of mast climbers for contractor access, limiting the volume and period of 'noisy' working hours and screening the residents from the opening up works. This was identified in tender documents and the selected contractor (Engie) prepared detailed method statements identifying how risks would be mitigated.

The existing building was modelled in Revit to improve both the coordination of the detailed design and visual imagery for consultation with residents. PHPP (Passive House Planning Package) was used to understand the thermal performance of both the existing building and retrofit design options. Following PCC's decision to target the EnerPHit standard this was used as the primary compliance tool and was further developed by the contractor post-tender. ECD completed RIBA Stage 4 information in 2014 and the project was tendered with CDP (contractor design portion) for the external envelope. ECD and Keegans continued to provide technical support and contract administration until the project completed in 2018 with ongoing research support beyond.






# LESSONS LEARNED

**Outcomes.**

LSE and Southampton University continue to monitor the performance of the building and satisfaction of Wilmcote residents. Southampton University results for winter and summer seasons have shown that the building provides thermal comfort in winter with little or no active heating whilst reducing the risk of overheating in the summer. LSE interviewed residents before, during and after the works and feedback has shown that residents are very pleased with the outcome.

Prior to the works LSE interviewed 15 residents and sought to maintain contact with the same residents throughout the project and post-completion. During pre-retrofit interviews, one resident said, "I hate it [the mould], I mean I've got pictures at one side of my bed and one picture now is…it gets mould spores all over it. I had like little mushrooms growing on the window out there, in the inside, little tiny mould mushrooms…" Another resident said, "I know most of my friends in the block are struggling, quite often they knock at the door 'can I borrow a tenner over the electric?' …it's most weeks during the winter. I went to my friend's house and I had to borrow a coat to put on when I went in, on the third floor, because she doesn't have any heating on at all, she can't afford it."

As a result of the refurbishment works Southampton University have found that during the extremely low temperatures of winter of 2017-18 popularly known as 'The Beast from the East' over 60% of the residents interviewed used their heating system less than once a month and nearly 40% never used their heating at all. Despite this, internal temperatures in virtually all flats remained well above World Health Organisation thresholds for human comfort. This proves that thermal comfort and reduced fuel bills can be achieved by deep retrofit. When LSE revisited the block following completion tenants provided the following remarks:

***"In the winter its much, much better and warmer, the heater provides heat for the whole flat not like before."***

***"It is better because before all this was old. We had drafts, condensation and mould everywhere but now because of the new windows that's gone, it's a lot better."***

***"Before you had heaters in every room and it was storage heaters which cost a lot."***

# NEXT STEPS

There are many reasons to target the deep retrofit of buildings from human comfort to carbon savings to fuel poverty and associated health benefits but there are also significant practical challenges which need to be addressed.

Indeed, given the scale of the challenge and its global importance and the need for a coordinated plan it could be considered as a national infrastructure project (as per the Scottish Energy Efficiency Programme). However, this is not a plan that can be imposed on existing buildings because it involves millions of separate projects and building owners.

As shown deep retrofit to the EnerPHit standard can deliver huge improvements in thermal comfort to building users whilst offering significant energy and carbon savings and is cost effective in the long term.



# DELIVERING DEEP RETROFIT FOR ALL

In summary EnerPHit can offer enormous improvements to both residential and commercial building owners and users. The Passivhaus methodology upon which it is based, offers transparency, quality, flexibility and proven performance which could unlock the massive energy and carbon savings we need from our existing buildings by 2050.

By targeting best practice in building retrofit and establishing a clear route for every building to achieve this, it is possible to both improve thermal comfort and avoid the worst impacts of climate change. By providing clear signals to industry of what is required, whilst providing financial stimulus and consumer guidance to early adopters, government can support the much-needed growth of the retrofit industry. As shown over the last 10 years modest piecemeal energy efficiency measures can result in numerous damaging unintended consequences and fail to deliver the much-needed improvements to our existing building stock. It is hoped that over the next 10 years policymakers will target best practice to ensure that over the next 30 years our existing buildings can provide low-energy, low-carbon comfort for all.

"The retrofit of Wilmcote House, three adjoining tower blocks in Portsmouth, has been an invaluable experiment in upgrading existing homes to a high energy standard, at the same time improving the quality of life for residents and the surrounding community. It proves that it will usually be cheaper to upgrade existing concrete built multi-storey homes, cladding them with non-flammable insulation material, and involving the landlord directly in liaising with tenants. It is a difficult process, but it does help to save our environment, our energy, and our communities."

**PROFESSOR ANNE POWER**
Head of LSE Housing & Communities,
Centre for Analysis of Social Exclusion, London School of Economics

Portsmouth CITY COUNCIL

# PORTSMOUTH CITY COUNCIL

Portsmouth is one of the major cities along the south coast, it is the UK's only island city that is in a very built up area and the most densely populated city in the UK outside of London. The Somerstown area of the city, in which Wilmcote House is situated, is one of the most deprived areas in England.

Portsmouth City Council maintains and improves approximately 14,800 council owned dwellings as well as 2,000 leasehold properties. The existing housing stock was predominantly constructed throughout the 1950s and 1960s. The in-house building maintenance teams, who manage the reactive repairs service and planned maintenance projects, manage a total expenditure in the region of £45M per annum.

**Project Team**
Meredydd Hughes – Assistant Director Buildings
Steve Groves – Head of Building Maintenance
Adam Hardwick – Property Projects Manager
David Sambells – Area Housing Manager

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# KEEGANS

Keegans was involved in this project from the outset, appointed as project managers, quantity surveyors and principal designers to work closely with sister company ECD Architects, Portsmouth City Council, the contractor (Engie) and residents.

As project managers, Keegans created a collaborative team approach which worked closely together to ensure that the project ran smoothly and completed in accordance with contractual conditions. Keegans cost consultants ensured the project delivered value for money.

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keegans


ROCKWOOL®

# ROCKWOOL

**ROCKWOOL is delighted to have supported ECD Architects in the transformation of Wilmcote House, the largest EnerPHiT standard scheme yet delivered with residents in-situ.**

This project involved the super-insulation of Wilmcote House. It featured several products and systems, including a combination of ROCKWOOL External Wall and Flat Roof insulation together with a selection of our Firestopping and Fire Protection products and a Rockpanel cladding façade system.

The ROCKWOOL external insulation was fitted as a 300/400mm zone fixed to newly assembled, external steel frames to insulate and wrap the entire building. The result is excellent thermal performance and exceptional air tightness, reducing draughts, condensation and mould growth.

These fabric improvements are minimising the use of heating at Wilmcote House.

Portsmouth City Council invited the University of Southampton to install data loggers into a number of properties to measure the effectiveness of the intervention works and the impact on heating usage. Early results show positive signs of a reduction in fuel poverty with tenants staying warmer in their flats and using their heating less. Resident health and well-being is also improving because there is less damp, mould and condensation.

We are pleased too that this refurbishment has brought the community together by improving the appearance of the estate and investing occupants with a greater sense of pride in their surroundings. ROCKWOOL has worked in partnership with the London School of Economics (LSE), recording and assessing the social outcomes of this project to validate the success of the community engagement.

We look forward to working with ECD Architects on future projects and using our experience on Wilmcote House to share insights and best practice with other local authorities who are seeking to renovate existing, high-density tower blocks for comfortable, efficient and healthy modern living.

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# WILDE CARTER CLACK

**Wilde Carter Clack was delighted to work with ECD Architects on the Wilmcote House project to create an award winning 21st century EnerPHit building from a 1960's concrete structure which provided thermally inefficient conditions for the residents.**

The work was carried out with the building occupied and construction techniques were designed which minimised disruption to residents. Evaluation of the concrete structure indicated that with suitable preservation the future life could be extended for another 40 years without significant deterioration. The modifications to the structure and the new cladding system frameworks were designed to minimise intrusion upon the structure but enhance its future performance.

Wilmcote House is one of many similar projects carried out by Wilde Carter Clack with ECD and for other Local Authority and Housing Association clients to improve their building stock and the condition and future life of the buildings in which their residents live.

Wilde
CARTER·CLACK


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