Crescent House

Windows Appraisal Report

January 2023 (updated)

Studio Partington

CITY OF LONDON

Executive Summary

The Climate Emergency

We are in a climate emergency and the City of London Corporation have declared their support of net zero. In response, they have pledged to 'step up' by building and retrofitting existing building stock for climate resilience and a zero carbon future.

Retrofitting Heritage Buildings

The listed status of Crescent House and the Golden Lane Estate, presents unique challenges when it comes to retrofitting the fabric (such as the windows or adding insulation); upgrading building services or adding renewable technologies such as solar panels.

Reports and Research

Detailed research into the Estate history and archived construction drawings has been undertaken to understand the existing building and original design intent, focusing on what makes Crescent House unique. Sustainability engineers, Etude, have conducted an analysis of the building fabric and the possible effects of any proposals, for instance, the increased risk of condensation and mould. The City of London have also commissioned structural, condition and acoustic surveys of the building, which will continue to inform decisions made by the project team. Costing advice has also been sought to understand and allow for a cost-benefit analysis of the different approaches.

Consultations with residents (both tenant and leaseholder) and statutory stakeholders and others (Historic England and Twentieth Century Society) have taken place to date. A Resident's Liaison Group who meet on a monthly basis has ensured that the residents are kept up to date with the project's progress, as well as feeding back any thoughts and opinions directly to the project team. These sessions will continue as the project progresses.

A website, which is regularly updated, has been set up to provide information on the project: www.communityuk.site

Recommendations

Ultimately, the chosen window proposal will be required to balance the need to create healthier, more affordable and more comfortable homes, whilst preserving the important heritage of the building, which is Grade II* listed. Compromises are inevitable, if the competing goals of heritage, climate, cost and disruption to residents are to be given proper consideration and suitably addressed.

There are two options presented in this document for further consideration:

- Refurbishing the existing frames and retrofitting them with vacuum glazing
- Replacing the existing windows with a new frame and high-performance glazing

This document also outlines the importance of considering a whole building retrofit plan alongside the windows project to ensure that isolated changes don't damage the building in the long term.

Next steps

This report explores the most practical, low carbon and heritage sensitive ways to move forward with the window works, taking into account the building's heritage status. It observes the guidance set out in the Listed Building Management Guidelines, and also considers reduction in carbon emissions; comfort of residents; upfront and running cost implications; and intrusiveness of works for those living in the flats.

In direct response to resident and stakeholder consultation and with the ambition to investigate issues raised, the project team are undertaking a Pilot Project before a decision is made on which window approach to proceed with. The strength of the Pilot Project lies in giving a unique opportunity to the residents, planners, members of the Corporation, designers and other stakeholders the chance to observe, assess and understand the impact of the various proposals on the existing building.

Contents

1.0

Introduction

1.1 Project Team

Client	City of London Corporation
Architect	Studio Partington
Structural Engineer	Stand Consulting
Building Physics/ Sustainability Engineer	Etude
Principal Designer (CDM 2015)	Studio Partington
Project Manager	Hav Consult
Cost Consultant	Keegans
Planning Consultant	Grade Planning
Heritage Consultant	The Heritage Advisory
Communications Consultant	Thorncliffe

Critical for this project, the specialist consultants that form the project team have extensive experience working on retrofit projects, including reinforced concrete buildings and listed buildings, navigating the careful balance between heritage and sustainability.

1.2 Project Overview

The City of London Corporation has appointed the project team (above) to design and deliver window upgrades to the residential blocks on the Golden Lane Estate. Dependant on several factors (explored within this report), these window works include refurbishment or replacement.

The windows to the properties on the Golden Lane Estate are bespoke and there are various window types present. Taking this, and the broader sensitivities of this project into account, a full options appraisal has been undertaken for each of the key housing blocks across the estate.

1.3 Purpose of Report

This document has been prepared by Studio Partington on behalf of the City of London Corporation. It explores several possible approaches for improvements to the condition and performance of windows in Crescent House.

This study takes a typical window type from Crescent House and through detailed investigation and review of it's construction, unique design features, heritage value, and current problems, reviews the challenges and opportunities that face the ambition to improve the windows across the estate.

The project team have identified several key stakeholders whose input will be critical in ensuring the success of this project, including residents and numerous statutory advisors/organisations. The report concludes with a series of options for addressing the challenges, to allow these stakeholders and the Corporation to make an informed decision about how best to proceed and take a balanced view on how to ensure a comfortable, low carbon future for the Estate, whilst protecting what makes this building a valuable heritage asset.

Please note that this report sits within a suite of documents, each of which captures a key flat/window typology within the broader Golden Lane Estate; Stanley Cohen House, Cullum Welch House and the Maisonette blocks (Basterfield, Bayer, Bowater, Cuthbert Harrowing and Hatfield House). The aluminium windows of Great Arther House were replaced in 2018 and are not included as part of these works. A number of timber windows to Great Arthur House will be included.

1.4 Heritage Context

Historic England are the main stakeholder organisation for all heritage buildings in England, helping people care for, enjoy and celebrate our historic environment. They hold a register of all nationally protected historic buildings and sites in England, including Listed Buildings. The Golden Lane Estate (including buildings and landscaping) is Grade II listed, with the exception of Crescent House which is Grade II* listed. The Golden Lane Estate is entry number 1021941 on this list.

When assessing the heritage significance of an asset, Historic England set out three areas of interest for consideration, namely, archaeological, architectural and historic. The primary heritage interest of the Golden Lane Estate is architectural. The listing entries of the wider Estate and specific building types have been our principal reference point when understanding the heritage value of Crescent House.

In addition to the Historic England listings, a second document has been crucial in providing expert clarity on heritage priorities and architectural nuances across both the wider estate and each unique building: the Golden Lane Listed Building Management Guidelines.

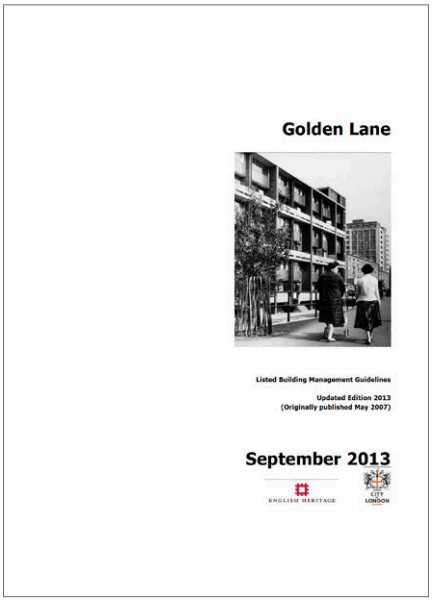
In 2007, the City of London Corporation adopted a set of Listed Building Management Guidelines as a Supplementary Planning Document (updated in 2013). The guidelines were written by the City of London Department of Planning and Transportation and Avanti Architects, in consultation with Golden Lane residents (both tenants and leaseholders), English Heritage (now Historic England), the Twentieth Century Society and the Department of Community and Children's Services.

At several points within this document, the Listed Building Management Guidelines for the Golden Lane Estate are quoted directly. These quotes can be recognised by the following formatting:

Any text which is in light grey, thin italics is taken directly from the Listed Building Management Guidelines.

The Listed Building Management Guidelines establish that the particular architectural signficance of Crescent House, which is acknowledged by its Grade II* listing, lies in *"its skilful design and planning to respond both to the rectilinear geometry of the estate and also to the curve of Goswell Road."*

The document acknowledges that *'modifications to glazing, cladding and lining of structures may become necessary to resolve what appear to be widespread problems of noise and heat loss or retention across the estate',* and is intended to be *'a tool for the positive, active management of historic buildings and to guide future change'.* Energy efficiency works to listed buildings that could affect their appearance and construction will need to be carried out in a way that minimises any impact to its aesthetics or elements of special interest, however, improving ventilation and thermal performance is also important to the long term survival of the building fabric.



Golden Lane Listed Building Management Guidance document

1.5 Climate Context

In 2019 the UK Government amended the Climate Change Act and adopted a target for achieving net zero emissions by 2050.

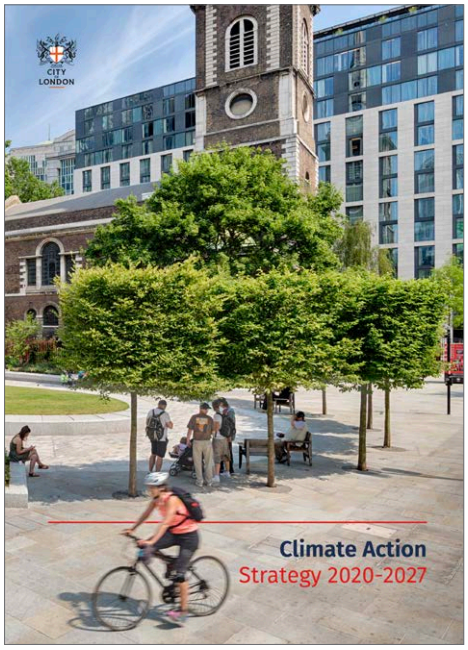
The City of London Corporation has adopted a Climate Action Strategy which sets out how the organisation will achieve net zero, build climate resilience and champion sustainable growth. By adopting the strategy, the City Corporation has committed to achieve net zero carbon emissions across their built assets (such as Golden Lane Estate) by 2040. The City of London Corporation also commits to achieving climate resilience in buildings - for example, limiting overheating risk in homes.

The UK Green Building Council (UKGBC) predict that 80% of 2050's homes have already been built, so a major priority is retrofit to de-carbonise our existing housing stock. This means reducing energy use in homes by taking a fabric-first approach. In other words, improving the performance of the building so residents don't need to use as much energy to be comfortable and healthy in their homes.

Initial heat loss studies of flats on the Golden Lane Estate have established that a substantial amount of heat in the flats is lost through the extensively glazed façades and air leaks through the building fabric. Therefore, addressing these issues will go a considerable way not only towards improving residents' comfort, but also towards heating homes more efficiently and economically.

The retrofit challenge is huge. Over one million homes every year for the next 30 years will need to be retrofitted to meet climate targets and we cannot afford to retrofit them twice. The targets set for retrofit are ambitious, but need to also be realistic, given the constraints of working with an existing building. The minimum target is to make homes suitable for low carbon heating, which in general terms, means improving the energy performance to at least EPC C.

If we retrofit well, we can enjoy many social and economic benefits, as well as environmental.



The City of London Corporation Climate Action Strategy document

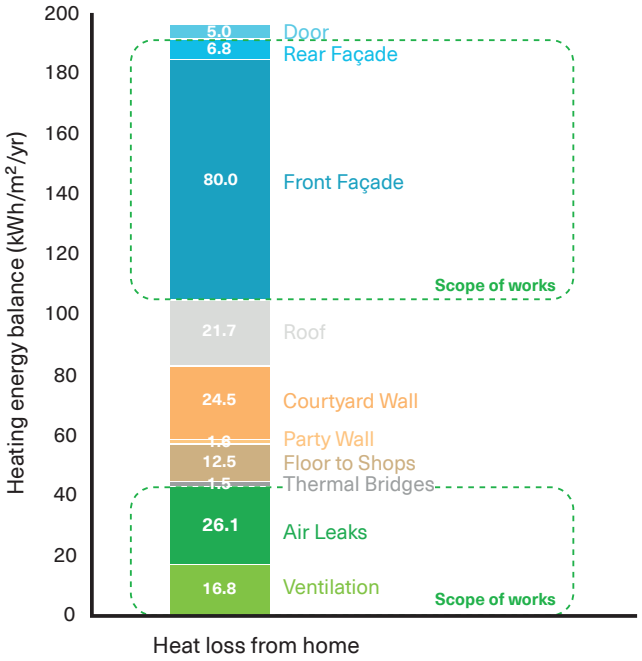


Table taken from Etude's report[1] which shows that most of the heating energy needed for the homes in Crescent House is lost through the façade. A vertical stack of three samples flats were looked at to model this table. Across all flats 55% of the winter heat loss from Crescent house flats is due to just the front façade and rear glazing. For the mid floor flats this is significantly higher, at around 68%.

[1]Energy, Carbon And Thermal Comfort Strategy, July 2021 Rev E, Etude. Full report can be found in the Appendix.

1.6 Relevant Examples

Within London and the wider UK, we have a large amount of 20th Century housing, the significance of which has been recognised through listed building status. In particular, there are a number of relevant case studies which can be referenced within this project. Each project spotlighted below is complex and comes with heritage sensitivities, however, they are touchstone projects for future works to Golden Lane Estate and lessons can be learnt from each window replacement, where appropriate.

The following pages list the key aspects of the window works for each of the case study projects, beginning with Great Arthur House on the Golden Lane Estate.

Great Arthur House (Golden Lane Estate): Photos of the existing windows/façade (top left) and completed replacement (top right & bottom left); sketch from the architects, John Robertson Architects, showing process of replacement (bottom right).

1. Great Arthur House
Golden Lane Estate, City of London
Chamberlin, Powell & Bon (constructed 1953-7)
Grade II listed

Original: aluminium windows
New: replaced with aluminium (with modified profiles and opening mechanisms)

In 2018, the existing windows were replaced with a new aluminium curtain wall system. The works improve the performance of the windows, with a new double glazed and thermally insulated prefabricated panel system, carefully designed to match the original design intent.

2. Alexandra Road Estate
Camden, London
Neave Brown (constructed 1972-9)
Grade II* listed

Original: hardwood timber windows
New: retained frames, replacement glass (vacuum)

In 2022, a pilot project to improve thermal efficiency and upgrade heating to homes is being undertaken. These wider retrofit proposals consider the building as a whole and include replacing the existing glass with vacuum glazing throughout the Estate. The windows are hardwood timber frames.

3. Balfron Tower
Brownfield Estate, Tower Hamlets, London
Ernő Goldfinger (constructed 1965-7)
Grade II* listed

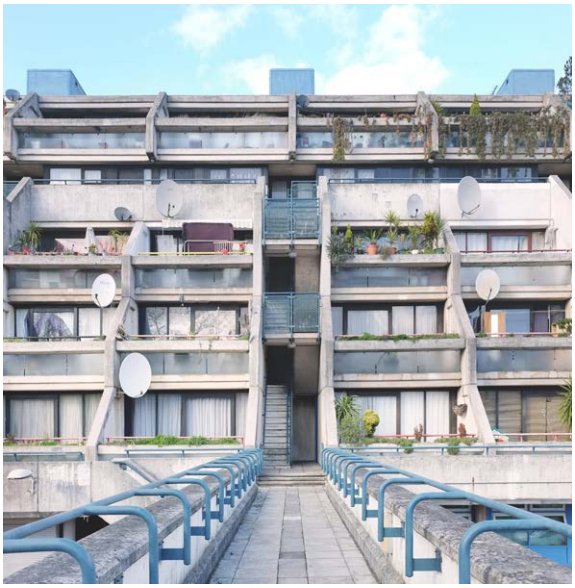
Original: painted timber windows (white)
New: replaced with aluminium (brown)

In 2014, works began to upgrade the building thermally and acoustically, including replacing all windows with doubled glazed units (many were historically replaced with modern uPVC). The new windows changed the colour from white, instead referencing local, celebrated examples of Goldfinger's work. They were also changed from timber to aluminium due to the acoustic constraints of the adjacent A12 road. The windows were installed alongside other building fabric upgrades such as internal wall, roof and floor insulation.

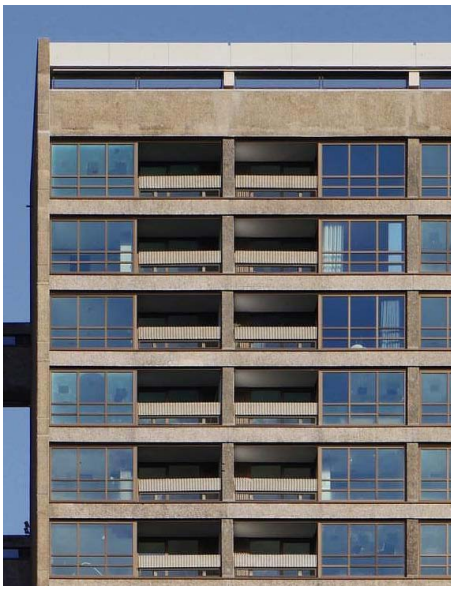
4. Trellick Tower
Cheltenham Estate, Notting Hill, London
Ernő Goldfinger (constructed 1968-72)
Grade II* listed

Original: painted timber windows
New: replaced with painted timber

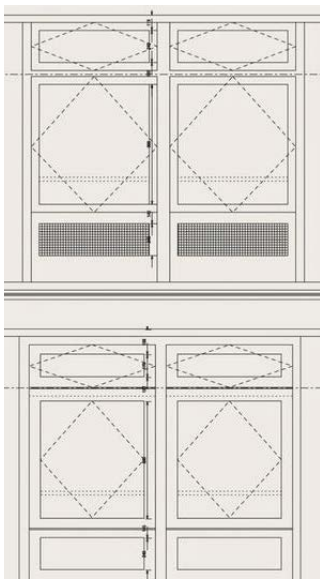
In 2005, window repair or replacement was reviewed for the building. Replacement was selected and the painted timber windows were upgraded with new, in a like for like design. The original glazing used was an experimental double glazing from Pilkington which was replaced with modern double glazing. The replacement windows were also changed from pivot to multipoint locking systems.

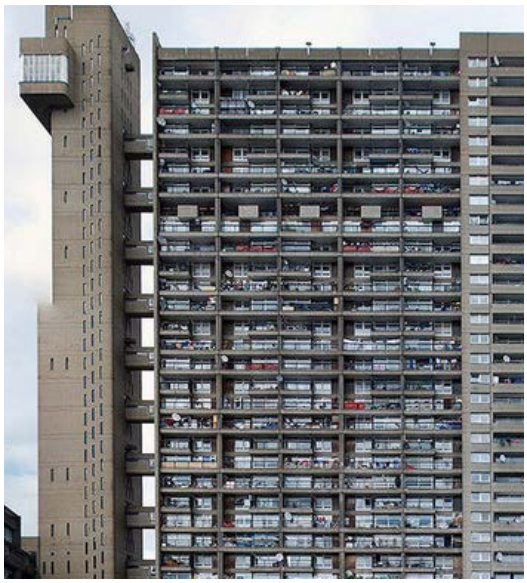


Alexandra Road Estate ahead of glazing replacement works.



Balfron Tower (Tower Hamlets): Existing window/façade treatment (left) and new, replacement windows/façade (right).





Trellick Tower (Notting Hill): The whole building (right); drawings of existing and proposed typical window, with the move from georgian wire glass to clear at low level (middle); before and after photos of window replacement (left).

5. Park Hill - Phase 1
Park Hill, Sheffield
Ivor Smith and Jack Lynn (constructed 1957-61)
Grade II* listed

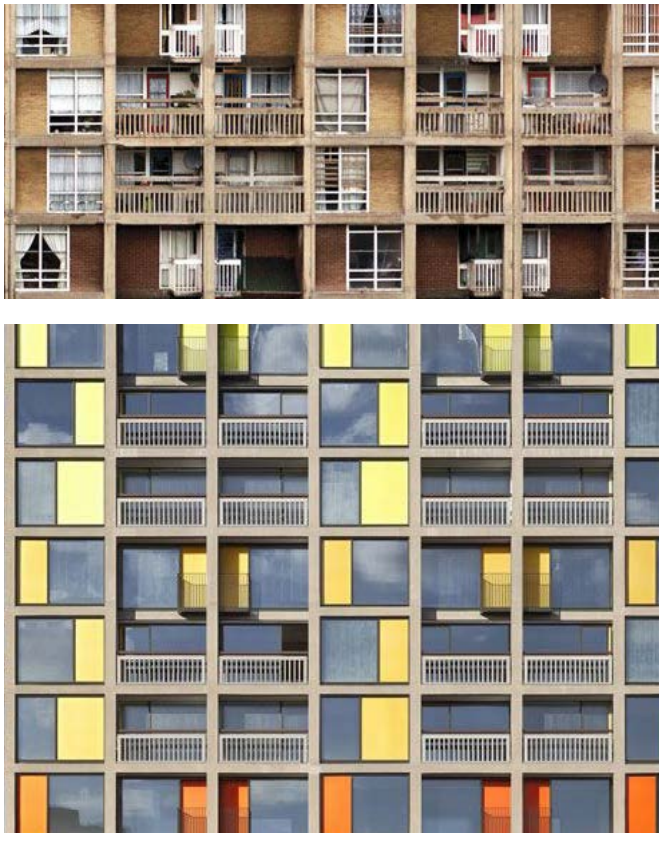
Original: timber windows (white)
New: replaced and reconfigured with aluminium (dark grey) and coloured panels

A multi-phase project to transform Park Hill began in 2009. In phase 1, the original façade (including timber windows) was replaced with brightly coloured anodised aluminium panels and large sections of new windows.

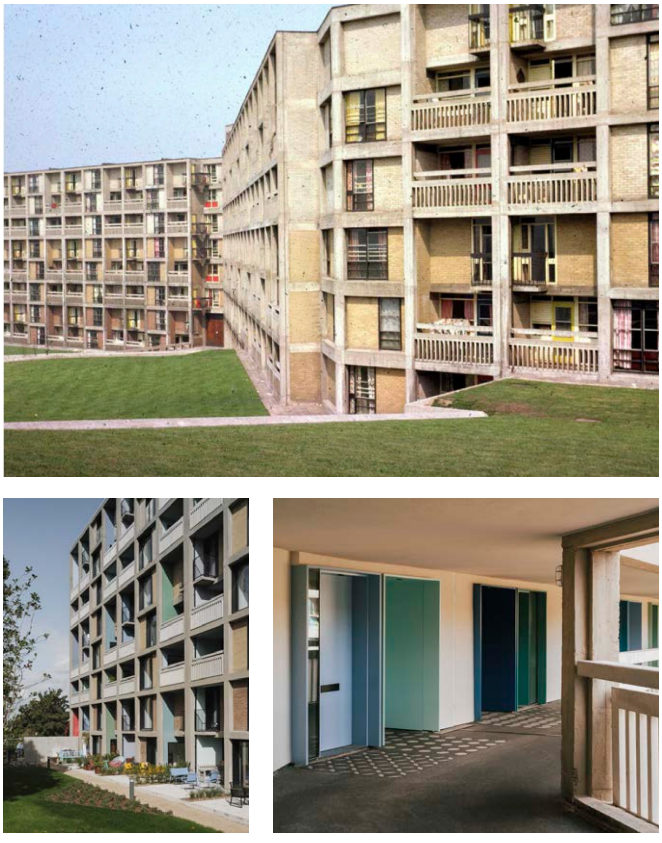
6. Park Hill - Phase 2
Park Hill, Sheffield
Ivor Smith and Jack Lynn (constructed 1957-61)
Grade II* listed

Original: timber windows (white)
New: replaced with modern black metal alternatives

In phase 2, the façade was maintained, but the windows were replaced with modern black metal alternatives. The approach followed for this phase was much more 'light touch' with a greater focus on improving the building's fabric. Coloured, insulated panels were introduced to the balconies externally, whilst internally, insulation was added to the cavity wall brick panels, windows moved back into thermal line and balcony flank walls and the soffits of living spaces were all lined in insulation.



Park Hill Phase 1 (Sheffield): Existing window/façade treatment (top) and new, replacement windows/façade as part of phase 1 refurbishment works (bottom).



Park Hill Phase 2 (Sheffield): Existing window/façade treatment (top) and new, replacement windows/façade as part of phase 2 refurbishment works (bottom).

2.0

Golden Lane Estate

2.1 Summary

The Golden Lane Estate was conceived when the City of London announced a competition for designs to regenerate the area in 1951. The site of the Golden Lane Estate had been devastated during the Second World War and was acquired by the City Corporation as a direct response to the need to provide additional housing for those who had lost their homes. In particular, they had a duty to provide housing for those people working in the City such as nurses, doctors and police.

In 1952, Geoffrey Powell was announced as competition winner and subsequently formed a partnership with two other lecturers in architecture from the Kingston School of Art to form the partnership of Chamberlin, Powell and Bon. The estate was constructed between 1953 and 1962 across two phases.

The Golden Lane Estate is an early example of post-war, large-scale urban design which demonstrated a departure from previous ideas underpinning urban planning and setting high standards for the future.

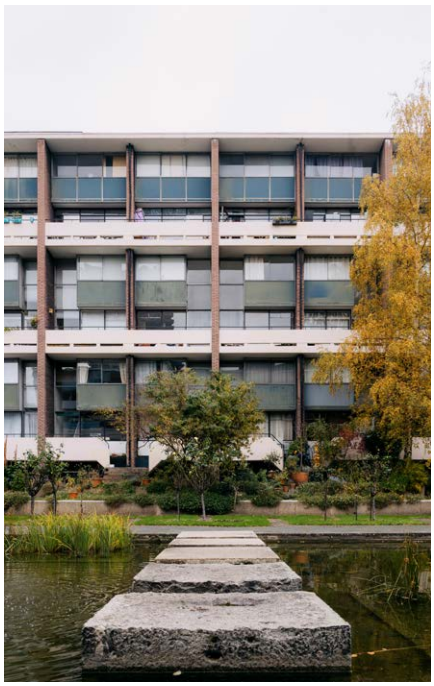
Innovative and unique, the Estate has particular value as a pioneering example of a diverse urban infill, which was wholly modern in spirit.

The Listed Building Management Guidelines states that the special architectural interest of the Golden Lane Estate starts with its considered approach to urban planning – how the buildings are arranged and the spaces between them. It then extends to the specific attributes of each of the buildings – their architectural form, language, structure, materials and components, and domestic design. The original colours – primary colours and black, white and grey – reflect the architectural ethos of the time.

The competition winning scheme for the Golden Lane Estate, from Geoffry Powell in 1952

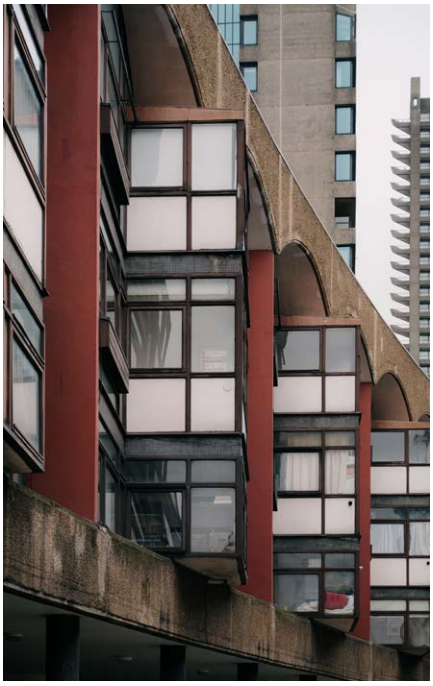
Goswell Road, looking towards the Barbican Estate with the curve of Crescent House and the oriel windows on the left.

The outside of Crescent House, looking across the tennis courts to Cullum Welch on the right, the leisure centre on the left and Great Arthur House in the background.



One of the maisonette blocks, Bayer House, looking across a courtyard from Basterfield House.

The outward facing Cullum Welch House elevation, capturing details such as the pre-cast concrete planter holders.



Crescent House projecting oriel windows on Goswell Road.

The West elevation of Stanley Cohen House, looking onto one of the shared courtyards.

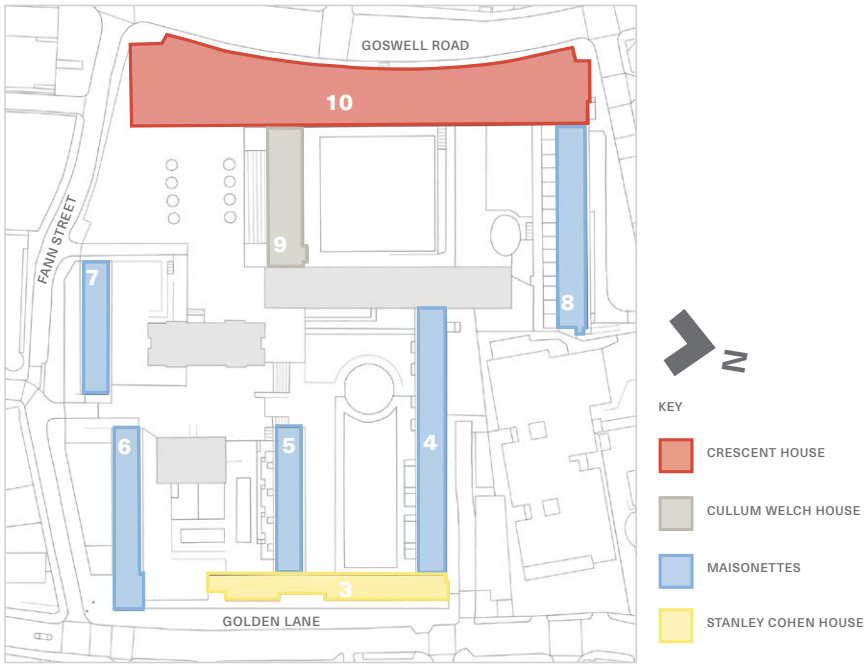
2.2 Building Types

There are 12 buildings that make up the Estate, including nine residential blocks which provide a total of 565 flats (break down per building provided in brackets on the right). The current split between leasehold properties and City of London tenanted homes is approximately 50:50.

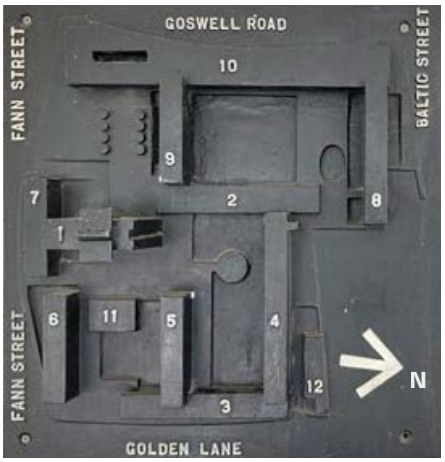
A list of the buildings included in the Golden Lane Estate is on the right. The blocks highlighted in bold text are included as part of the wider window regeneration study, capturing 445 homes. Please note that Basterfield, Bayer, Bowater, Cuthbert Harrowing and Hatfield House are grouped together and referred to as the 'Maisonettes' within this study.

Building numbers 1, 2 and 11 have all already had window upgrade works carried out. In all instances, this included double glazing as a minimum. Building number 12 on the original plaque was labelled 'workshop' but is no longer part of the Estate.

1. Great Arthur House (120)
2. Physical Recreational Building
3. **Stanley Cohen House (32)**
4. **Basterfield House (54)**
5. **Bayer House (30)**
6. **Bowater House (30)**
7. **Cuthbert Harrowing House (18)**
8. **Hatfield House (56)**
9. **Cullum Welch House (72)**
10. **Crescent House (153)**
11. Community Centre



Site Plan of the Golden Lane Estate, highlighting types of housing block included as part of the wider window regeneration study.



One of the original, wall-mounted, bas-relief plaques at the Golden Lane Estate, highlighting the layout of the blocks.

3.0

Crescent House

3.1 Summary

Crescent House is a four-storey block of flats which forms part of the Golden Lane Estate, located on the western boundary of the site on Goswell Road. The block is curved to the front (Goswell Road) and straight to the back.

The building contains 153 flats - a mix of 1-bed and 2-bed homes, split across the top three floors, which sit above 20 retail units and The Shakespeare public house on the ground floor. The 2-bed flats are all located at the south end of the building and have private balconies. In addition to the flats on the first, second and third floors, there are six guest rooms on the north end of Crescent House. These were designed in as a response to the compact flats on the Golden Lane Estate. To this day, the guest rooms are still used for their original purpose. The building was the last to be completed on the estate, in 1962. On the eastern façade, it directly abuts Hatfield House (Maisonette block) and Cullum Welch House.

On each floor, there are two rows of flats, either side of a central shared corridor, punctured with lightwells and exposed to open air on the top floor, which provides access up the building. The flat layouts are largely the same across the three floors. As a general rule, the kitchen and bathrooms face the internal corridor/ lightwells. Head-height partitions and louvred sliding doors to the bedroom recess separate the living and sleeping areas. The living areas are all located on the external façades, overlooking the estate's courtyards to the east, Fann Street to the south and Goswell Road to the west.

The building is east-west oriented. Most flats are dual aspect, meaning that they have windows on two, opposite façades. A third of them are single aspect and have internal kitchens and bathrooms with artificial ventilation. Despite the footprints of the studio flats being the same, the external façade window arrangement varies across the three floors.

Crescent House is constructed from a hybrid of reinforced concrete frame and load-bearing, concrete piers on the ground floor, concrete party walls on the first floor and generally thin brick party walls on the second and third floors.

3.2 Special Features

Crescent House is Grade II* listed - it's Historic England list entry number is 1021941. Historic England accredit the building's listing to 'its place in the evolution of post war architecture and for the sophistication with which the contrasting materials and geometry of the façade are handled'. It also describes the materials used for the windows, picking up the 'hardwood timber windows stained dark, with pivoting centrally-hung casements and some aluminium side opening lights'. Note that the kitchen and bathroom windows are painted softwood and not mentioned in Historic England's listing.

In addition to the listing description, special features of Crescent House which contribute to it's distinctive character have been highlighted in the Listed Building Management Guidelines. A summary is listed below:

1. *in situ concrete bands (define the roof line and first floor level) are bush-hammered*
2. *dark hardwood timber window frames had a clear finish (now painted brown externally)*
3. *pivoting centrally hung casements*
4. *aluminium opening lights*
5. *glazing from floor to cill level is Georgian wired*
6. *white infill panels*
7. *stepped profile of the building - created by the largely glazed projection of the flats - corresponds to the gentle curve of the road*
8. *exposed edges of the floor slabs are finished in grey-green mosaic tiles (now appears black)*
9. *rendered concrete cross walls, painted rust-red*
10. *built-in timber 'floating' shelves between the timber-framed window and wired glass below*

1 bush-hammered, in situ concrete bands

2 hardwood timber window frames

3 pivoting centrally hung casements

4 aluminium opening lights

5 georgian wired glass

6 white infill panels (spandrel panels)

7 stepped profile of the building along the curve of the road

8 mosaic tiles on exposed floor slab edges

9 rendered concrete cross walls, painted rust-red

10 built in timber 'floating' shelves

Crescent House West elevation, facing Goswell Road, highlighting the barrel vaulted in situ concrete and dark wood window frames.

Crescent House highlighting the projecting oriel windows and the rust-red painted rendered concrete cross walls, progressively projecting further forward towards the North and South.

Crescent House East elevation, facing the courtyards and Great Arthur House, highlighting the three different window configurations on the first, second and third floor.

Crescent House South-West corner, showing the 2-bedroom flats and concrete balconies.

The full length of Crescent House from Goswell Road, highlighting the building's position as a boundary to the wider estate and relationship with the curve of Goswell Road.

4.0

The Windows

4.1 Description

Materials

The same window styles and a simple, consistent palette of materials are used throughout the building. The majority of the windows on the external façades have hardwood sapele timber frames. In some instances there are aluminium opening lights. The bathroom and kitchen windows which face the internal lightwells and corridors all have white, painted softwood frames.

Glazing

All windows are single glazed, including the opaque white Muroglass panels at low level on the oriel windows and the georgian wired glass from floor to cill level. Some windows have had obscuring film applied retrospectively.

Opening lights

The majority of the opening lights in the living spaces are centrally-hung. Timber opening lights pivot horizontally and the aluminium framed opening lights pivot slightly off-centre, along their vertical axis. Several timber opening lights in the living spaces on the 1st and 2nd floors are top hung. Opening lights in bathrooms and kitchens vary across storeys and elevation - they are a mix of top and bottom hung and horizontally, centrally pivoting. The large centrally hung pivoting windows have a set of angled slots which appear to be for background ventilation. None of the other windows have built-in trickle ventilators to ensure adequate background ventilation, but, over time, ad-hoc ventilators have been added mid-pane.

Ironmongery

The ironmongery to opening lights is metal throughout, but the style varies dependant on the opening mechanism. Aluminium espagnolette window openers are found on the centrally-hung windows. Many bottom and top hung windows have had opening restrictors retrospectively installed for safety.

Additional comments

White spandrels are found on the oriel windows and beneath the windows at the far northen end on the West elevation. Many windows (bathrooms, kitchens and living room) have had plastic vents retrospectively installed mid-pane.

The oriel roofs were originally designed to create a slender, unobtrusive profile. At some point after construction, the flat roof was replaced with a metal standing seam roof, believed to be supported on timber rafters. A series of timber panels have been incorporated into the fixed lights inside the flats to conceal the thickness of the replacement roof.

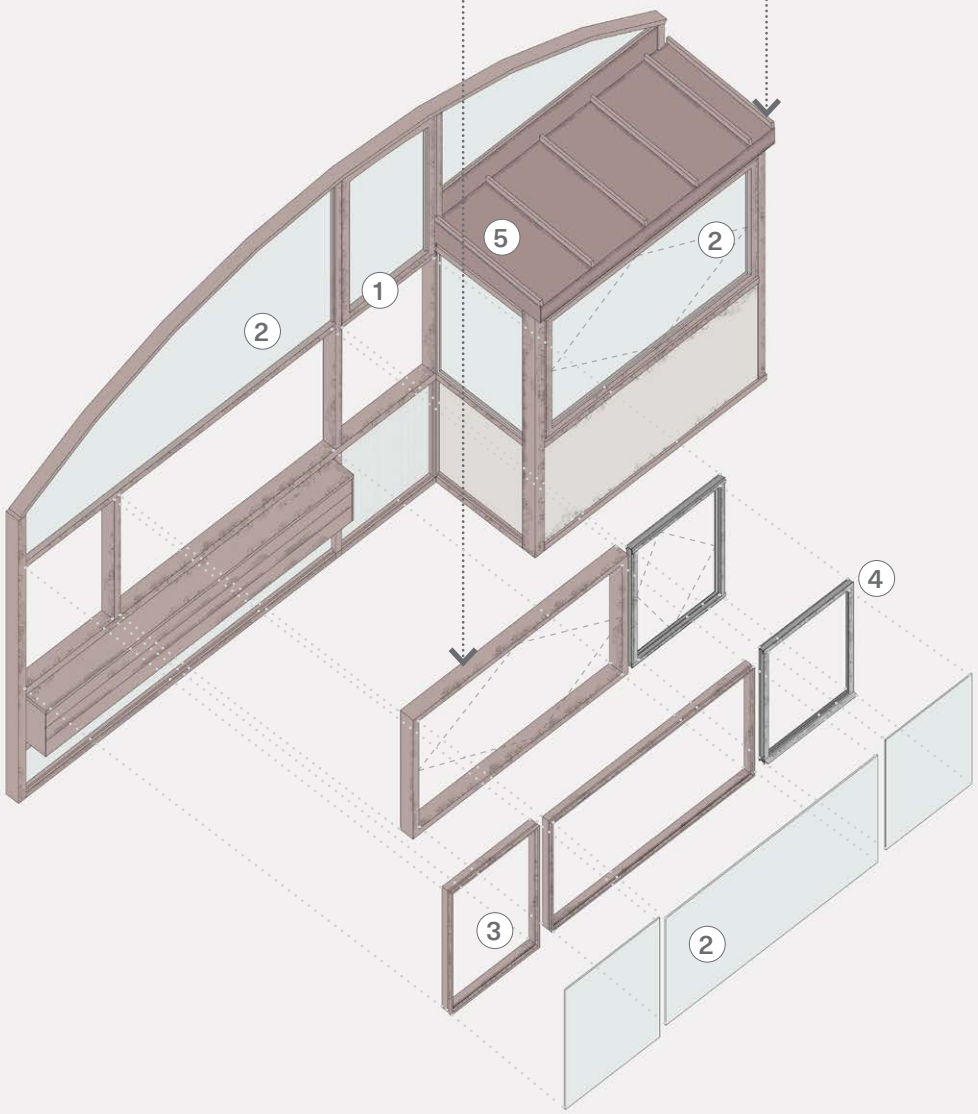
The images on the following pages highlight the typical window design at Crescent House, including the window frame, types of glazing (fixed/opening), methods of operation and additional, unique details.

The west elevation projecting oriel windows, facing Goswell Road.

4.2 Typical Existing Window

Existing windows showing signs of deterioration, especially the hardwood frames/ beads. See photos overleaf. More information in Section 4.4 and 5.2.

The existing oriel roof presents some design issues and does not provide adequate draining which over time has damaged the timber corner posts.



Key

1. hardwood timber frame
2. single glazing
3. hardwood timber beading - external
4. aluminium framed opening window
5. oriel roof

This drawing highlights the different elements of a typical, **existing** window found on the top floor of Crescent House. The principles can be applied to all windows in the block, apart from the internal lightwell facing softwood windows (these are not described as significant in heritage terms). The majority of the frames are hardwood and open by pivoting centrally horizonally, vertically or top hung.

WINDOW FRAME

Hardwood timber window frame

All window frames on the external façades are sapele hardwood. Frames support fixed glazing and openable lights, including hardwood sapele opening lights. Originally a clear finish, now painted dark brown externally. Some finished with white paint internally.

Aluminium window frame

Aluminium-framed opening light - found in the main living space in majority of the flats.

Softwood timber window frame

Kitchen and bathroom window frames facing the internal lightwells are white, painted softwood. External timber beading to secure the fixed panels of glass in place. Painted white to match frame.

TYPES OF OPENING

Vertical, central pivot opening light

Single-glazed. Found in aluminium on the external façades. Pivot mechanism is vertical and located off-centre.

Horizontal, central pivot opening light

Single-glazed. Found in hardwood on the external façades - each flat has at least two, one in the oriel and and the other incorporated into the full-height glazing. Some flats also have one on the oriel returns and top floor flats have one in the vaulted, curved glazing. Several flats have a white, painted softwood version to the internal elevation, overlooking the lightwells.

Bottom and top hung opening light

Single-glazed. Found in softwood on the internal lightwell façades. Painted white finish externally and internally. Top hung opening lights (fanlights) found in hardwood on the external façades (2nd and 3rd storey) - one per flat.

OPERATION & IRONMONGERY

Hinges

Original brass pivot hinges are found in most windows with this opening mechanism. Aluminium pivot hinges incorporated into aluminium frame (small image).

Espagnolette

Aluminium espagnolette window openers to all centrally-hung casement windows (horizonal shown in large image, vertical in small image). Bar-style handle, push/ pull pivot mechanism.

Restrictors

Metal restrictors fitted to various openings, including metal arms fitted to bottom-hung window for safety (large image), Preston stays (screw-jack mechanism) to top hung softwood windows and aluminium stays to vertical pivot opening lights.

ADDITIONAL DETAILS

White spandrels

White, Muroglass spandrel panels found beneath the windows on the projecting oriel windows and under windows on the western façade at the far northern end.

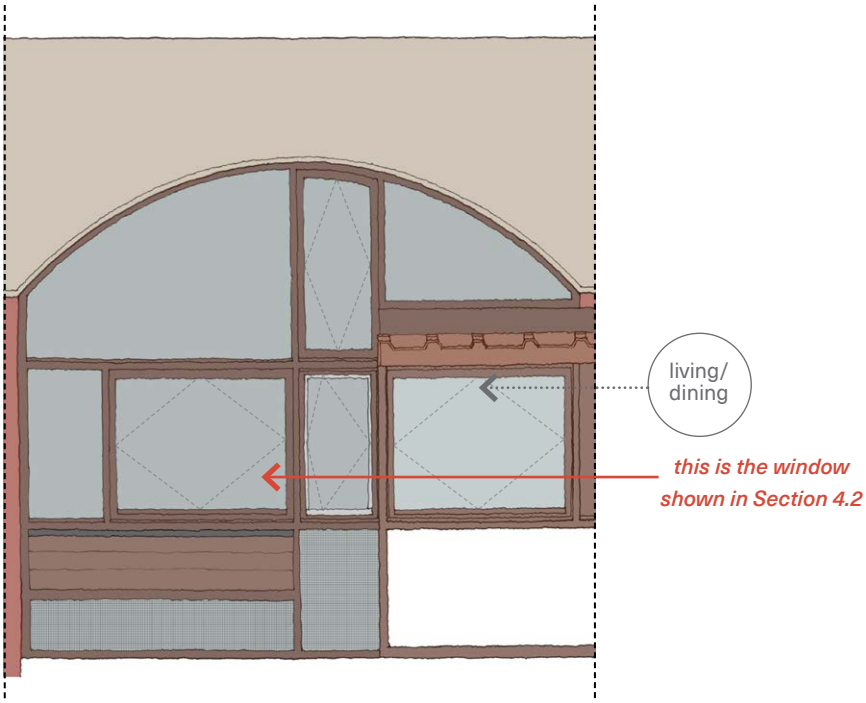
Bookshelf

The integrated bookshelves are supported within the hardwood timber frame and are constructed out of tongue and goove timber planks. Their tops are covered in lead flashing to provide a measure of protection from the rain. Some painted white internally.

Georgian wired glass

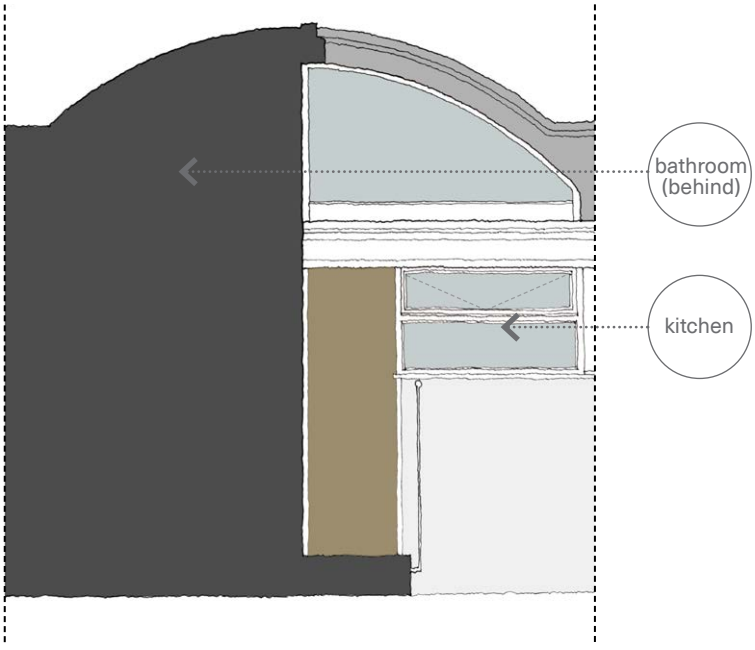
All low level fixed lights are georgian wired glass - a glass manufactured with wire mesh embedded into it to prevent it from shattering and breaking whilst also increasing its fire rating. Note that photo shows obscure film added to glazing retrospectively, for privacy.

4.3 Example Flat

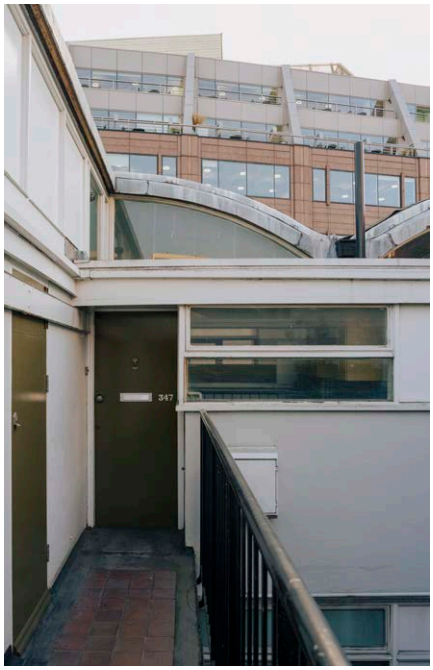


East/West Elevation: *Sketch of a typical flat elevation (top floor) on the east or west side of the building. This flat is a 1-bed and has the living/dining room on this elevation. Windows frame are hardwood. Glazing is a mix of fixed lights and veritcal and horizonal pivot opening lights, with either hardwood or aluminium frame.*

A section of the east facing side of the building, which looks onto the courtyards and Great Arthur House.



Internal Lightwell Elevation: *Sketch of a typical flat elevation (top floor) on the internal corridor/lightwell side of the building. This flat is a 1-bed and has the kitchen and bathroom on this elevation, with white painted softwood timber window frames.*



A section of the internal lightwell elevation, showing the kitchen and bathroom. Note that these elevations vary more from flat to flat than the external elevations.

4.4 Condition

In addition to a visual survey undertaken by Studio Partington, the City of London commissioned an independent condition survey[2] of Crescent House which has confirmed that after over sixty years of use, the condition of the windows across the estate has deteriorated considerably. The painted finish (not original) on the timber frames has visibly worsened and there is clear damage to the softwood and hardwood timber frames beneath. Likewise, the finish on the aluminium-framed opening lights has deteriorated and shows signs of oxidisation over time, leaving the frame exposed and vulnerable.

Windows on the projecting oriels have been subjected to a higher level of exposure to the elements. Due to their scale and vulnerable position, they have been affected the most. The oriel roofs do not have a functioning draining system and as a result, water tracks down the corner posts, which over time has damaged the window frames further. It is worth noting that significant deterioration has also occurred on the internal side of the windows, suggesting that some of the damage has been caused by condensation rather than the external elements.

Although it is clear that most windows are damaged and decaying, the exact extent of repair or replacement works that are required is not fully known. It is highly likely that windows on the exposed parts of the building have deteriorated to an extent that would not prove economic to repair. A thorough intrusive survey of the windows will need to be done to establish the full existing condition. The pilot project will give an indication on the condition of the frames, although it is acknowledged that this is for one flat and the extent of decay varies throughout the building, from flat to flat.

The life expectancy of windows varies significantly with usage, weather/exposure, installation, maintenance, and quality of materials. As a general rule, the life expectancy of a painted softwood frame, such as those at Crescent House, is typically 20-40 years on average, with hardwood averaging at 30 years, therefore, the frames have exceeded their expected lifespan.

Note that the windows would fail to meet many modern regulations, including thermal performance standards and current safety standards for new homes.

Deterioration of the hardwood frame/sill on the west façade where the glass pane has become exposed to the elements. Evidence of mould growth.

Deterioration of the softwood frame/sill on the kitchen window facing the internal lightwells.

Deterioration of the hardwood frame/sill on the west façade (oriel window).

Paintwork deteriorating on timber frame and the spandrel panel. Evidence of mould growth.

[2]A visual survey conducted by Hallas & Co. West in March 2020 stated that wet rot is a common defect identified across the building, with rot defects making up 73% of all defects identified. Full report can be found on the website www.goldenlanewindows.site

4.5 Comfort

The building fabric, including the windows, is a significant factor in how comfortable a building feels. Focusing on the windows in particular, this includes technical, thermal, acoustic performance, but it also includes factors such as ease of use.

To help the team understand what it's like to live on the Golden Lane Estate, a Residents' Comfort Survey was undertaken across the whole Estate in 2020. Responses included 26 residents of Crescent House, accounting for 17% of residents in this block. Although a small sample, there are clear, shared experiences within the building. The responses are highlighted on the right.

This anecdotal information from residents, combined with the condition of the existing windows, confirms that it is likely that a number of households are living in unhealthy, cold homes and that air quality is compromised and condensation problems are widespread, leading to a higher likelihood of health issues, both physical and mental.

Please note that the survey was undertaken in early 2020, therefore, the responses do not take into account the increase in energy prices which have been steadily rising, with a recent, significant jump in late 2022.

58% consider the comfort of their home to be between 0-5 (0 is extremely uncomfortable and 10 is extremely comfortable)

77% feel draughts and have uncomfortable places to sit in their home, especially close to the windows

85% suffer from condensation or mould growth

77% feel their flat is hot and uncomfortable in the summer months

50% feel their windows don't open sufficiently to get good ventilation

note that whose windows don't open sufficiently cite the windows difficult operation as the primary reason for keeping them closed. Noise and poor condition are also cited

69% keep their windows closed due to external noise and pollution

27% feel the air in their flat feels fresh when the heating is on

65% feel their home heats up slowly, and **81%** feel their home loses heat quickly when the heating is turned off

56% live in colder conditions than they would like to save money on heating bills

5.0

Evaluation

5.1 Heritage

For Crescent House, the buidling's geometry and the use of a variety of timber and concrete finishes are both referenced in the listing description. In addition, the window size, contributing to the qualities of light and space, is referenced within the Listed Building Management Guidelines, therefore, these details are deemed to be the most significant parts of the buidling in heritage terms.

The Listed Building Management Guidelines state that the materials and components used are an important element of the estate's character and special interest. Among the most striking elements are the glazing and glass cladding. Repairs or replacements must be closely matched to maintain visual consistency, and there should be no generic changes to the materials used in the buildings' fabric, components or finishes, including aluminium or timber glazed screens, windows, doors and panels.

In addition, they also state that the characteristics of transparency, light and space are dominant throughout the estate. The architects' vision for all buildings, whether residential or communal, was that light and openness be experienced both internally and externally.

The quality of accommodation that Crescent House provided was exceptional for the time: heating and hot water provided centrally; natural light and ventilation to kitchens and bathrooms; spacious, private balconies (for the 2 bedroom flats); and ample storage space even within tightly planned interiors. Chamberlin, Powell and Bon were using the technology and information available at the time to provide high quality, healthy, comfortable homes for London's essential workers.

Section 1.2.2.2 of the Listed Building Management Guidelines specifically references works to the 'Thermal and Acoustic Performance of Glazing and External Envelope'. It also states the following:

1. *Modifications to glazing, cladding and lining of structures may become necessary to resolve what appear to be widespread problems of noise and heat loss/retention across the estate*

2. *Any works to resolve these problems should be applied consistently across the block/blocks and the estate as a whole. Piecemeal interventions in individual flats which would have a seriously detrimental impact on the external appearance of the building should not be permitted.*

For this reason, piecemeal interventions on a 'flat by flat' basis has been ruled out. The Listed Building Management Guidelines also reference the window replacement works that have already taken place at Great Arthur House. The principles of this project can be applied across the Estate:

- *While the aluminium-framed glass cladding of Great Arthur House was state-of-the-art when completed in the 1950s, its performance and appearance have deteriorated over they years*

- *Where original details or material specifications have failed, it is likely to be necessary to develop a new and improved design*

- *The solutions proposed should respect the key visual intentions and character of the original design, whilst optimising environmental performance standards.*

Crescent House West elevation, highlighting the three different types of windows accross the three floors and their relationship with the ground floor retail units.

5.2 Condition and Comfort

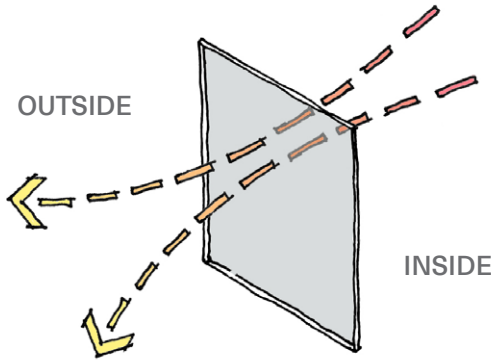
Despite being innovative at the time of design and construction, aspects of the mid-twentieth century detailing, including the thermal performance of the window frames/single glazing, combined with additional uninsulated elements of the building envelope, such as the external walls, mean that heat is not retained once the source is turned off. Residents have described experiencing difficulties during cold winter conditions including high fuel bills, difficulty maintaining comfortable internal temperatures and condensation and mould growth issues. The building's age and condition of windows is likely to be worsening this.

Without the benefit of double or triple glazing, heat from inside the flat escapes easily. This is exacerbated in the living rooms of the Crescent House flats, where most of the external wall is glass. Central heating, cooking, washing, bathing and breathing all add heat and moisture to the internal air. Condensation forms when warm moisture laden air hits a cold surface. Whenever the external temperature is lower than the internal temperature there is potential for condensation to form on the inner surface of single glazing. This risk is significantly reduced or eliminated with double or triple glazing, where a cavity separates the inner pane from the lower, external temperature. Condensation tends to pool at the bottom of the timber frames, resulting in their deterioration. A lack of efficient ventilation within the homes then leads to mould growth in areas of lingering condensation.

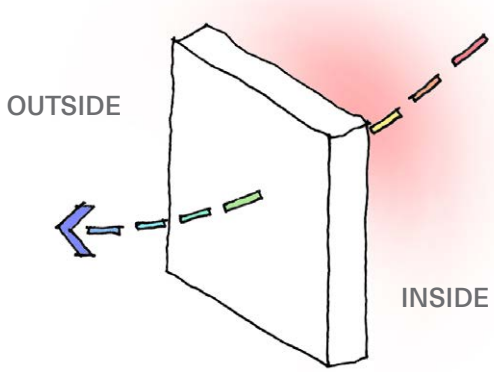
Older windows can often be draughty as over time they distort and gaps open up as joints become weakened. The seals, brushes, rollers etc. also wear out. The small gaps found around the window frames/openings mean that there is poor airtightness - the building is 'leaky' and draughty. Although adequate ventilation is important to limit condensation and mould, excessive, uncontrolled air leakage through windows is uncomfortable for occupants and wastes heat.

Overheating during the summer months also needs to be considered as part of a climate resilient design proposal. Single glazing has a high 'g-value', which means it lets in a high percentage of the sun's rays which subsequently can't escape and cause flats to overheat in summer. Regardless of the efficiency of the glazing, poor window condition and difficulty of operation will lead to further overheating if residents don't feel confident to open windows and increase ventilation to 'purge' their homes on particularly warm days.

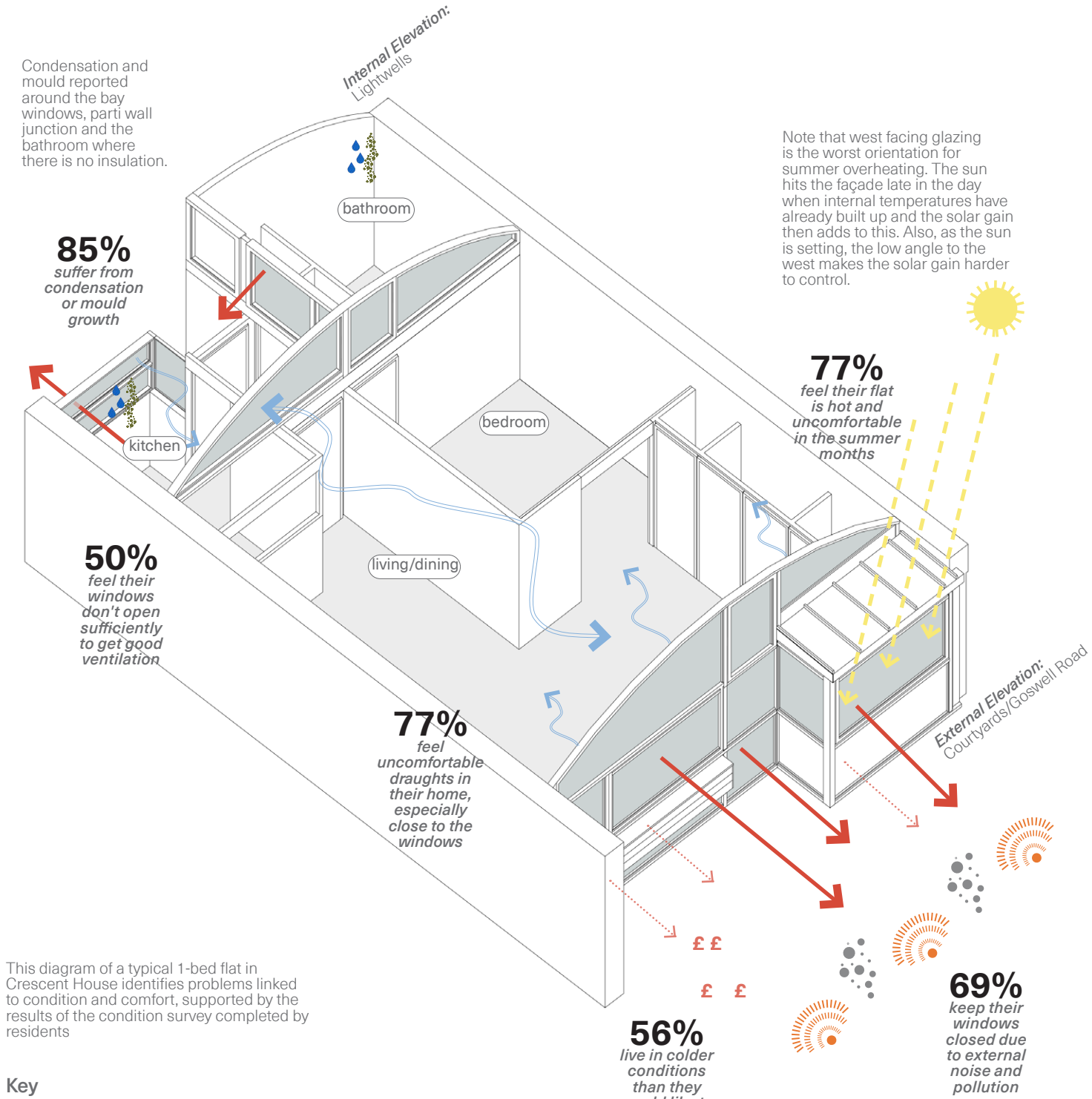
Noise is an issue for homes in Crescent House, likely due to the proximity of Goswell Road and the tennis courts. A noise monitoring survey undertaken by AECOM at Crescent House confirmed that in addition to the Goswell road, noise levels from the internal courtyards were also significantly higher than rec



Heat loss through single glazing is significant as the glass has a high thermal transmittance - it is a very good transferer of heat (not good for heat retention in homes!). Glass is better at retaining heat when it is high performance (vacuum/double/triple) and in an insulated (thermally broken) frame. A standard single glazed unit has a U-value of up to 5.8 W/(m^2K).



Heat loss through external walls is less significant as a typical wall build up does not have a thermal transmittance rate as high as glass - it is better at retaining heat. A standard solid brick wall has a U-value of 2 W/(m^2K).



This diagram of a typical 1-bed flat in Crescent House identifies problems linked to condition and comfort, supported by the results of the condition survey completed by residents

Key

- Heat loss through single glazing
- Heat loss through external walls & thermal bridges (incl. window frame)
- Uncontrolled incoming air (draughts)
- Excess solar gains (summer)
- Noise pollution
- Air pollution
- Mould growth
- Condensation build-up

5.3 Environmental

To suppliment the information included in this report, Sustainability and Building Physics Engineers, Etude, were commisioned to produce a report[3] which looks at the energy improvement strategy for Crescent House.

This included modelling a sample stack of flats against different refurbishment options using SAP (Standard Assessment Procedure) and PHPP (Passive House Planning Package) calculations, in addition to detailed thermal bridge modelling for key junctions. An analysis of heat losses through the building fabric shows that some of the greatest losses occur through the façades, comprising of the hardwood-framed glazed construction and the rear glazing.

Etude's study recommends that:

- the thermal efficiency of the glazed elements be optimised not only to mitigate the effects described in section 5.2, but also to offset any possible comfort taking, whereby residents of upgraded homes often forego the savings brought by increased thermal efficiency, in favour of increasing their comfort by heating their homes to a higher temperature

- some form of mechanical ventilation is provided to ensure adequate movement of air, given the increased efficiency of the glazed elements

- cold bridges such as the slab edge, exposed party walls and concrete vaults be insulated where possible to protect against the risk of condensation and mould

In addition to Etude's work which focuses on operational carbon and possible cost savings for residents, embodied carbon calculations have been undertaken by XCO2[5] to understand the whole life carbon associated with each of the approaches being considered by City of London.

5.4 Structural

Structural Engineers, Stand, were also commissioned to produce a report[4] which reviews the building structure of Crescent House.

This included a summary of the existing structure, context for the original structural design and a structural assessment of different refurishment options.

The report concluded that the proposed increase in load if new, triple glazing windows (the heaviest option) is selected, it is not structurally significant. The structure of Crescent House consists primarily of:

- in situ cast, reinforced concrete floor slabs

- party walls of reinforced concrete and load-bearing brickwork

- roof composed of reinforced concrete barrel vaults

The oriel windows at second and third levels are supported on cantilevered projections from the slab, while those on the first floor are supported on slabs at cill level, cantilevering off a concrete upstand. The Pilot Project will allow the fixings and their supporting structure to be fully exposed, enabling the project team to assess the existing condition of the concrete against the one assumed in the analysis.

Removing the painted finish and the existing glazing, to expose parts of the frame not currently visible, will allow a more thorough assessment of the frames' existing condition as well as the extent of original material in the frames.

A greater certainty regarding the structure will help to avoid costly and abortive work, once work begins on the rest of the building.

[3]Energy, Carbon And Thermal Comfort Strategy, July 2021 Rev E, Etude. Full report can be found in the Appendix.
[4]Structural Engineering Report on the Proposed Replacement of Windows and Cladding Panels,Stand Consulting Engineers. Full report can be found in the Appendix.
[5]Embodied And Operational Carbon Technical Note, XCO2. Full report can be found in the Appendix.

6.0

What Can Be Done Now?

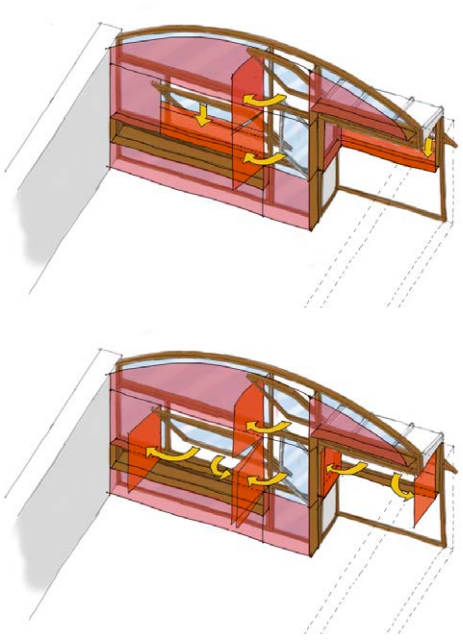
6.1 Overview of Approach

Studio Partington have undertaken a detailed analysis of the windows in Crescent House, encompassing design, condition, residents' comfort, structure and thermal performance and heritage significance.

On the basis of the analysis completed to date, several options for window improvements have emerged. Each bring with them their own set of advantages and disadvantages, which will need to be weighed against each other in order to make a considered decision regarding any proposed work to the windows.

There are two core options for how the window improvements can be approached: refurbishment or replacement. A summary is provided overleaf, supplemented with an options comparison provided in diagram and table format over the following pages.

A secondary glazing solution was also considered. Secondary glazing has been installed in other flats on the Estate, however, this has not been entirely successful. While secondary glazing can reduce heat loss and draughts, it can exacerbate condensation problems and cannot easily be used with pivot windows or doors.



Exploration of a secondary glazing option which highlights the difficulties with operating the opening horizontally pivoting windows.

The following extract from the Listed Building Management Guidelines, highlights that the heritage significance of the building lies in its overall form, position and relationship to Goswell Road and the rest of the estate.

The particular architectural significance of Crescent House as an important indicator of the evolution of post-war architecture, and of design and construction in the late 1950s and early 1960s, is acknowledged by its listing as Grade II.*

Part of the special architectural interest of Crescent House lies in its skilful design and planning to respond both to the rectilinear geometry of the estate and also to the curve of Goswell Road. The stepped profile of the building – created by the largely glazed projection of the flats – under a segmented, round-arched band of concrete corresponds to the gentle curve of the road. The façade has a complex geometry which leaves all flats rectangular despite the curve. It was 'designed as a coherent piece of street architecture'. With the backdrop of the three Barbican Estate towers, the dramatic façade of Crescent House along Goswell Road provides a particularly impressive and responsive urban composition. The east elevation completes the rectilinear layout of the estate.

REFURBISHMENT

This could be summarised in a **neutral** heritage impact, but a **poorer** thermal performance.

Refurbishment is the option which would result in the least amount of perceived change from the existing appearance, but it also means that there is the least amount of improvement from a thermal performance/resident comfort/ease of use perspective.

A refurbishment option does not allow the building to be reinstated to its original intention. A significant number of repairs were undertaken in the 1980s before the building was listed, and it is believed that the overpainting of the windows helped to conceal the patchwork of spliced and epoxy filled repairs. The repaired frames will need to be painted over to match the current existing condition.

It's worth noting that low impact does not mean minimal disruption for residents during the construction phase. Refurbishment requires expert craftsmanship which can be time consuming and may not negate the need to remove and/or replace the existing windows.

REPLACEMENT

This could be summarised as resulting in a **negative** heritage impact and an **improved** thermal performance.

Replacement is the option which would result in the most perceived change from a heritage perspective and also a thermal performance/resident comfort/ ease of use perspective.

A replacement option allows the building to be reinstated to its original intention. The replaced frames will be left as unpainted hardwood sapele frames.

It's worth noting that although this option is high impact, it does not mean it will be the highest level of disruption to residents. When planned effectively, replacement can be a time efficient solution.

6.2 Summary of Changes

In all approaches, improved, high-performance glazing is proposed. Single glazing is typically 3-6mm thick, vacuum glazing is 8-9mm, high-performing double glazing is nominally 32mm and triple is nominally 44mm thick. In the refurbishment approach, in order to utilise the existing frames, the high-performance glazing options which would be thin enough are double glazing and vacuum glazing. A small adjustment to the rebates for the glass would be required for this. If the replacement option is undertaken, frames can be designed to take vacuum, double or triple glazing thicknesses.

The Pilot Project will explore the potential to install insulation on the underside of the oriel roof. It will also allow the project team to fully understand its construction in order to propose a better performing detail which is closer in appearance to the original design intention.

It's important to note the following:

- A percentage of the window frames in the 'refurbishment' option could require replacement, where frames cannot be repaired effectively. These replacements will match the existing like for like.

- Within the full replacement approach, the configuration and style of the openings and proportions of the windows will be the same as existing. Replacement frames will be matched to the existing design intent as closely as possible, however, certain changes will be unavoidable, such as frame thickness.

Certain parts of Crescent House were made off site whilst others were jointed on site. The frames and the concrete structure meet with no obvious details to accommodate tolerances, suggesting that a high level of custom sized joinery exists in the façade of Crescent House.

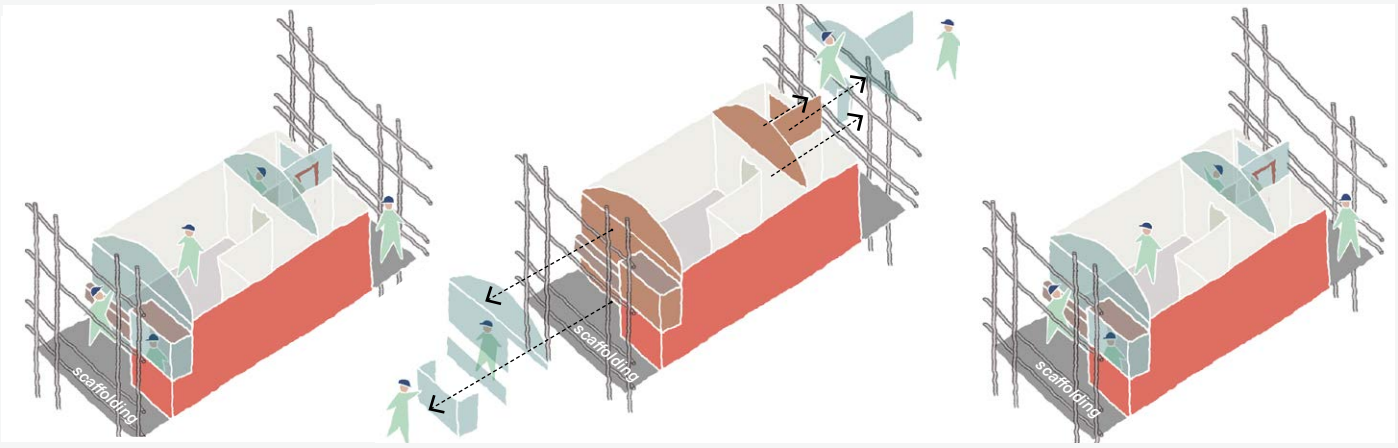
The photographs above show Crescent House under construction from Goswell Road.

6.3 The Process

The diagrams below describe the anticipated process of works for the refurbishment and replacement approach for each flat. This includes works on site vs off site and inside the flat vs outside (accessed via scaffolding).

Given the varied extent of deterioration across the building, the time-frame attached to the refurbishment process is unknown and will likely differ flat to flat, potentially taking a significant period of time to complete. When considering the replacement approach, given that the windows will be manufactured off site and every flat will be treated the same, the time-frame attached to this process can be predicted more reliably.

REFURBISHMENT



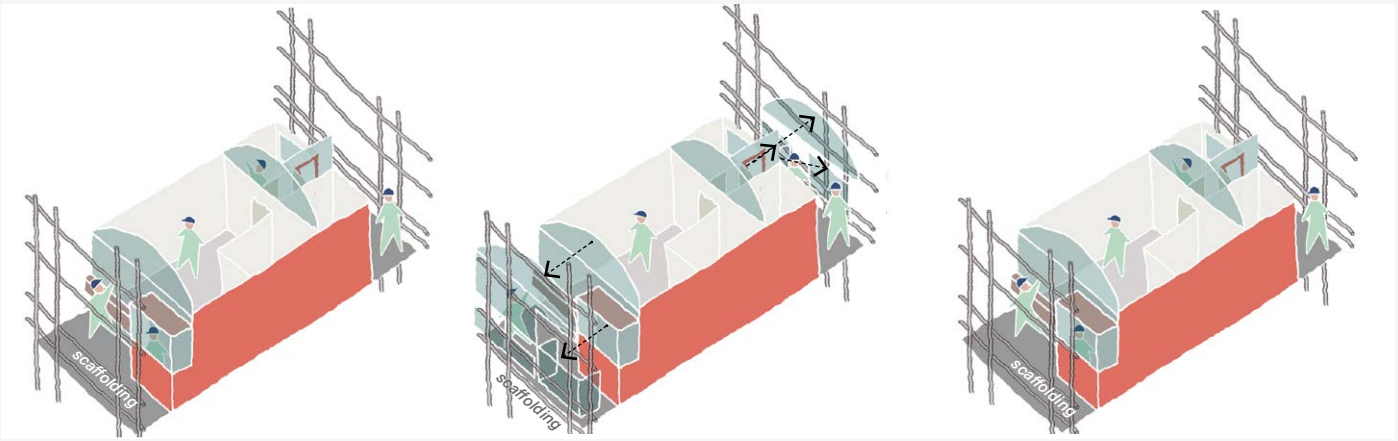
Step One: *Install scaffold. Temporally remove existing glass to template for new vacuum glazing. Measure glass and place order (min 12 weeks from order to delivery). Strip decorations on existing window frames. Establish extent of repair needed for the frames and estimate programme for the repair works. Put existing glass back in. (1 week)*

Step Two: *In accordance with the estimated programme for repair, remove the existing windows and repair damaged frames to coincide for them to finish at the time of the glass delivery. Replace any damaged sections of frame that cannot be repaired. Insert new perimeter seals into opening lights. Redecorate frames. (5-7 weeks)*

Step Three: *Install new vacuum glass. Making good and decorations to surrounding areas completed. (2-3 weeks)*

timeframe will vary on a flat by flat basis, dependant on extent of damage (overall programme 16-20 weeks)

REPLACEMENT



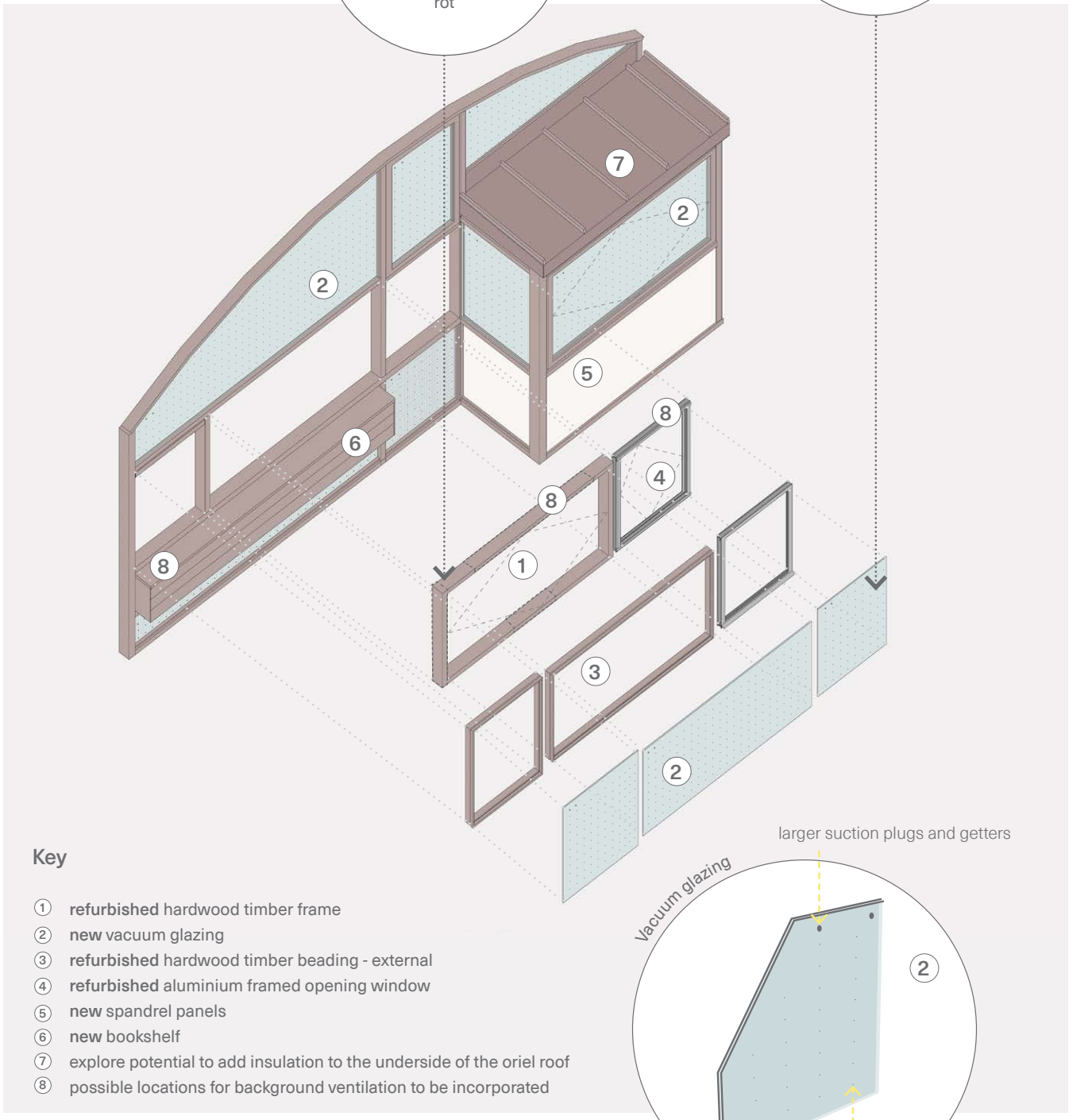
Step One: *Install scaffold. Measure existing frames and openings to place order for new frames (8 weeks from order to delivery).*

Step One: *Prepare for removal of existing frames. Once new frames on site, existing frames to be removed.*

Step Two: *New frames installed. Additional internal insulation added. Making good and decorations to surrounding areas completed.*

timeframe can be predicted and is reduced by off-site manufacture (overall programme 12-14 weeks)

6.4 Refurbishment

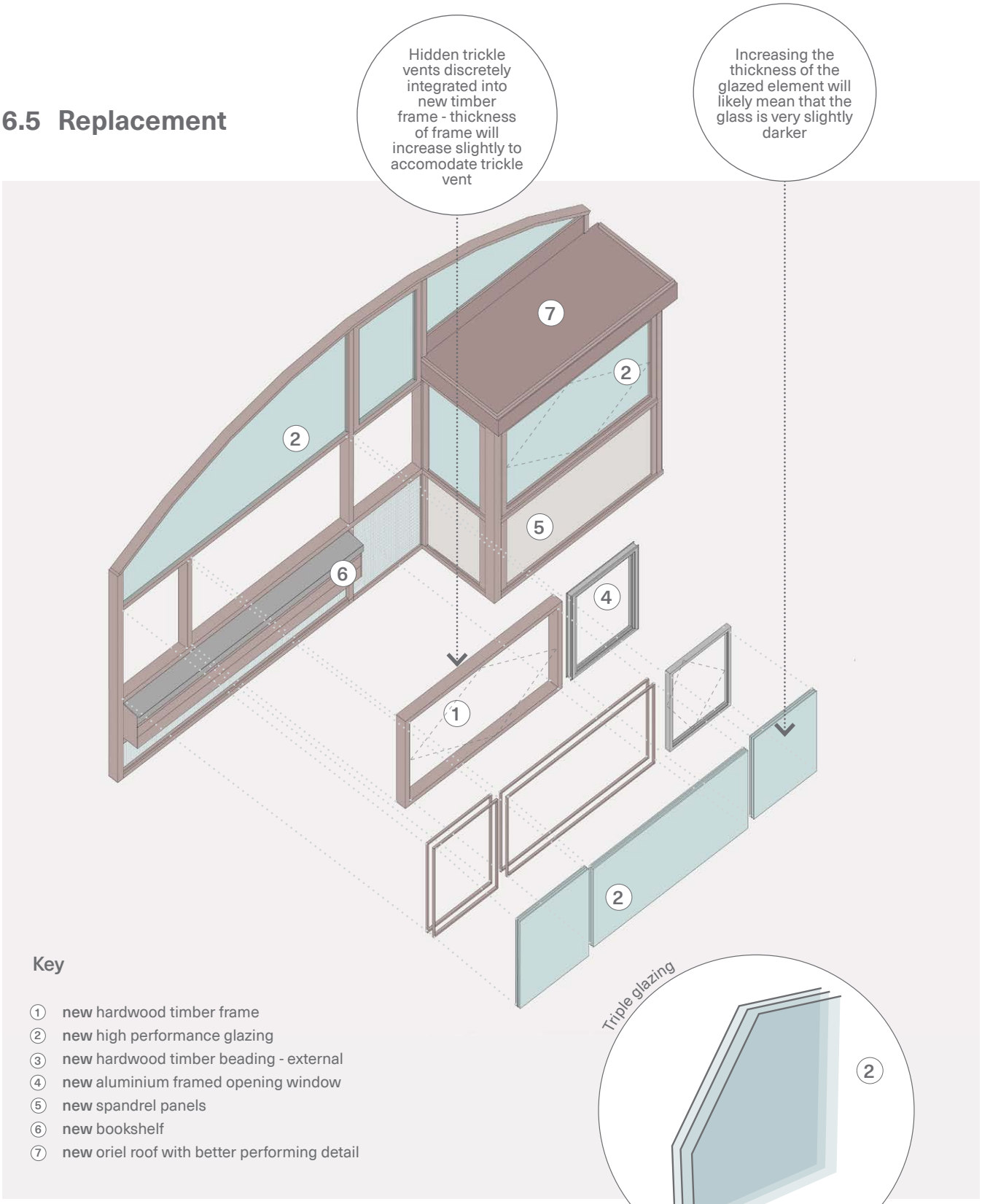


Key

① **refurbished** hardwood timber frame
② **new** vacuum glazing
③ **refurbished** hardwood timber beading - external
④ **refurbished** aluminium framed opening window
⑤ **new** spandrel panels
⑥ **new** bookshelf
⑦ explore potential to add insulation to the underside of the oriel roof
⑧ possible locations for background ventilation to be incorporated

This drawing highlights the different elements of a typical, **refurbished** window at Crescent House. The principles can be applied to all windows in the block, apart from the internal lightwell facing softwood windows (these are not described as significant in heritage terms). Principally, the vast majority of the frames are hardwood and open by pivoting centrally horizonally, vertically or top hung.

6.5 Replacement



This drawing highlights the different elements of a typical, **replacement** window at Crescent House. The principles can be applied to all windows in the block, apart from the internal lightwell facing softwood windows (these are not described as significant in heritage terms). The majority of the frames are hardwood and open by pivoting centrally horizonally, vertically or top hung. All to match existing. High performance glazing could be vacuum, double or triple, however, triple glazing is shown as this would have the maximum thermal and acoustic improvement.

6.6 Options Comparison

Crescent House: Options Comparison Table (1 of 5)

	Refurbished frames and retrofit with vacuum glazing	**Replacement frames with triple glazing**
Disruption to Residents *For more information refer to: Section 6.3 of document.*	• The extent of work required will vary from home to home depending on the condition of the existing frames. • The overall duration of the work cannot be predicted accurately as the extent of works cannot be fully assessed in advance. • Work will be required both internally and externally within resident's homes. • Scaffold will be required to all facades of the building (including to the internal lightwells and corridors) to access the window frames externally. • It is predicted that from the installation of the scaffolding to the installation of the vacuum glass in a typical home will be **16-20 weeks**. • The pilot project will help to refine the refurbishment process.	• The extent of work in each home is defined. • The overall duration of the work can be predicted more accurately. • Work will be required both internally and externally within resident's homes. • Scaffold will be required to all facades of the building (including to the internal lightwells and corridors) to access the window frames externally. • It is predicted that from the installation of the scaffolding to the installation of the new glazing in a typical home will be **12-14 weeks**.
Maintenance	• Globally there is only a single supplier of vacuum glazing which can meet all the requirements for new glass in Crescent House (toughened and curved). • The glass is manufactured in China and the typical lead-in time for any vacuum glass are currently 12-16 weeks. This means any breakages will have to be temporarily replaced with either timber boarding or standard single glazing while new glass is ordered and shipped. • Vacuum glazing is a relatively new product and has not yet been thoroughly tested in-situ. There is no precedent in the UK for an installation of vacuum glazing at this scale. • The window frames will require cyclical maintenance and decoration.	• Triple glazing units are a standardised, well established technology and are available from multiple sources. Typical lead-in times for a replacement glass unit would be 2 weeks. This means replacement and repairs are simple, and cheaper. • The new frames will need less maintenance in the medium term and will carry a warranty. • The window frames will require cyclical maintenance and decoration.

Crescent House: Options Comparison Table (2 of 5)		
	Refurbished frames and retrofit with vacuum glazing	**Replacement frames with triple glazing**
Operation	• Overhauling the existing opening lights and the ironmongery will improve the ease of opening and closing.	• New window and associated ironmongery, significantly improving ease of use. Opportunity to make ironmongery more accessible. • Triple glazed windows will be heavier, however, this should not affect the operation of the windows due to hinge design.
Acoustic	• The existing frames, single glazing and poor sealing between the frames and opening windows give a very poor acoustic performance. • Replacing the single glazing with vacuum glazing will improve the acoustic performance of the glass itself, but sound leakage through gaps in the frames will remain. • The refurbishment option may only make limited improvements to the overall acoustic performance of the combined frames and glass due to the reliance on brush seals around the opening lights. • The pilot project will measure the sound levels in the home before and after the installation of vacuum glazing.	• New frames with triple glazing will deliver a high level of acoustic performance. • Comparison of acoustic properties of glass only: • Single glazing sound reduction: 29dB • Vacuum glazing sound reduction: 35dB • Triple glazing sound reduction: 37dB
Thermal (Heat Loss)	• Vacuum glazing has a centre pane u-value of 0.5 - 0.7 W/m^{2}k, depending on the product. • It is difficult to provide an overall u-value for the existing frames and the glass. However, this is likely to be in the order of 1.0 - 1.2 W/m^{2}k depending on the ratio of frame to glass. • The improved thermal performance of the glass should lead to less condensation on the glass.	• The specified triple glazing has a centre pane u-value of 0.5 W/m^{2}K. • The overall window u-values for the new triple glazed windows have been calculated and range from 0.9 -1.1 W/m^{2}K depending on the ratio of frame to glass. • The improved thermal performance of the glass, better overall airtightness and compression seals will lead to less condensation.

Crescent House: Options Comparison Table (3 of 5)

	Refurbished frames and retrofit with vacuum glazing	**Replacement frames with triple glazing**
Thermal (Heat Loss)	• A significant amount of heat loss will still be attributable to the existing frames which have a low level of airtightness. The introduction of new seals to the opening lights can improve but not eradicate this entirely. • The inset aluminium frames have a significant cold bridge. Condensation risk will remain.	• The new horizontal pivoting window frames have been laboratory tested to achieve an airtightness of circa 0.24m^3/(m.h) at 50Pa per m of opening light, which results in zero heat loss due to air leakage. • The new inward opening window frames have been laboratory tested to achieve an airtightness of circa 0.04m^3/(m.h) at 50Pa per m of opening light, which results in zero heat loss due to air leakage. • New aluminium frames will include a thermal break to reduce the thermal bridge and the risk of condensation.
Weathertightness	• Little change compared to the existing. • Repairs to the frame, replacing the existing brush seals and replacement timber glazing beads, will help to improve some of the existing water leakage problems. • This option will not improve the weathertightness to the perimeter of the frames, or any of the inherent design weaknesses around the pivoting windows.	• The new frames have been laboratory tested to achieve highest possible standard of water tightness (rating 9A tested at 600Pa in accordance with EN1027).
Whole life and embodied CO_2 (CO_2e) *For more information refer to: Energy, Carbon And Thermal Comfort Strategy, Etude and Embodied And Operational Carbon Technical Note, XCO2. Full reports can be found in the Appendix.*	• The whole life carbon emissions for vacuum glazing with refurbished frames are higher than the triple glazed, full replacement. • The retention of the existing timber frames does mean there are lower $C0_2$e impacts from the supply of new timber. However, timber is a relatively low source of embodied carbon when compared to glass. • $C0_2$e calculations were carried out on the basis of vacuum glass coming from Europe. For glass sourced from China, the $C0_2$e emissions will increase.	• The whole life carbon emissions for full replacement with triple glazing are lower than the refurbished frames vacuum glazing. • There is additional embodied carbon associated with new timber and aluminium frames and the removal of the existing. The transport of the new timber from West Africa has been included in the whole life carbon analysis. However, this option brings a higher operational carbon reduction that offsets the increase in embodied carbon. • Responsible disposal of the existing frames for example reuse or recycling.

Crescent House: Options Comparison Table (4 of 5)		
	Refurbished frames and retrofit with vacuum glazing	**Replacement frames with triple glazing**
Operational cost and CO_2 savings *For more information refer to: Energy, Carbon And Thermal Comfort Strategy, Etude. Full report can be found in the Appendix.*	• Predicted reduction in heat loss through the façade of approximately 56%, representing an average 18% reduction in CO2 emissions. • The cost of low-carbon energy will be higher than current gas and electricity prices. The reduction in heat loss through the glazing will help to reduce operational costs.	• Predicted reduction in heat loss through the façade of approximately 68%, representing an average 23% reduction in CO2 emissions. • The cost of low-carbon energy will be higher than current gas and electricity prices. The larger reduction in heat loss through the glazing help to reduce operational costs further.
Heritage *For more information refer to: Section 5.1 of document.*	• Retains as much of the original timber & aluminium frames as possible. None of the glazing retained. • Original design intent would be maintained internally. • The external finish will be painted, hiding the previous and new repairs. The historic harm to the original external appearance cannot be reversed. • Some adaptation of existing frames may be required to accommodate the increased thickness of vacuum glazing. • Existing window ironmongery retained. • Minor change to the appearance of the window, owing to the darker tint of vacuum glazing and use of microspacers which read as dots and evacuation ports visible in the corners of each pane of glass. • Note that the Listed Building Management Guidelines state that: "Only like-for-like, seamless repairs and replacements should be considered. [...] If a length of the frame is partially damaged, then the whole length would need to be replaced."	• None of the original frames or glazing retained. • New frames will match existing profiles as closely as possible and replicate the existing materials. • The original design intent for external finishes maintained as replacement frames will be sealed hardwood (sapele). • External line of window (how much the glass is set in from the edge of the frame internally) will change to accommodate the thicker glass. • None of the existing window ironmongery retained. • Some change to the appearance of the window, owing to the darker tint of high-performance glazing.

Crescent House: Options Comparison Table (5 of 5)		
	Refurbished frames and retrofit with vacuum glazing	**Replacement frames with triple glazing**
Capital Cost	• The extent of repairs and replacement is unknown. It is not possible to provide an accurate prediction of the capital costs for the works. • A significant contingency sum should be allowed. • The capital cost of vacuum glass is higher than triple glazing. • Capital cost must be balanced against ongoing cost-in-use of the existing window frames which will require continued maintenance (see above). • The cost of the pilot project should not be used as an indicator for the cost of the complete project as the condition of the windows may not be representative of the whole project. • Cost estimates will be provided by a cost consultant, for resident review and cost/benefit analysis alongside proposals.	• The full replacement of glazing and frames allows for more cost certainty as the scope of works and programme is known. • The capital cost of new triple glazing could be higher than a refurbishment project although this depends on the final amount of timber to be replaced in the refurbishment option. • The cost consultant's analysis shows that the cost-in-use over a 25-year period is lower for the full replacement strategy. • The cost of the pilot project should not be used as an indicator for the cost of the complete project as the complete project would use automated CNC manufacture that is not available for the pilot project. • Cost estimates will be provided by a cost consultant, for resident review and cost/benefit analysis alongside proposals.
Risk	• Any contractor costing the works will be likely to include a large element for risk. • Conservation type repair works are often contracted on a re-measurement basis with a surveyor assessing the cost of repairs as they are revealed. • Final costs for Leaseholders cannot be assured. • The pilot project will help to refine the refurbishment process and project risks.	• Contingencies and contractor's risk should be lower as scope and programme is better defined. • Construction and disruption risks better defined, for instance being able to fix the duration of time residents will need to be 'decanted' from homes during works.

6.7 Technical Compliance

Any works undertaken at Golden Lane must comply with a set of industry standards, described in England's Building Regulations (2010). It is acknowledged that no matter the approach chosen, the proposed upgrade to the windows at Crescent House will need to comply with current, relevant regulations. The historic value should be considered, but issues that lead to poor performance cannot be ignored. Building Regulations protect the health and safety of people in and around buildings and guidance for compliance is included in a suite of Approved Documents.

The following Approved Documents are relevant to the windows works and the guidance will be consulted throughout the project to ensure compliance: Certain Approved Documents have exemptions for listed buildings - in this instance, the Approved Document will still be used as best practice and full compliance will be sought wherever possible.

Approved Document A: Structure
Regardless of which approach is chosen, a more thorough assessment of the frames' existing condition as well as the extent of original material in the frames will need to take place. A greater certainty regarding the structure will help to avoid costly and abortive work, once work begins on the rest of the building.

Approved Document B: Fire Safety
The guidance in Approved Document B focuses specifically on fire safety regulations. From the 1st of December 2022, the latest versions of the Fire Safety Act and Approved Document B - Volume 1 (dwellings) will come into effect. These documents set out the regulations around fire safety in dwellings (including blocks of flats) and outline the following three key conditions to consider:

1. The height of the top floor
2. The distance from any relevant boundary
3. The control of combustible materials, in association with the above

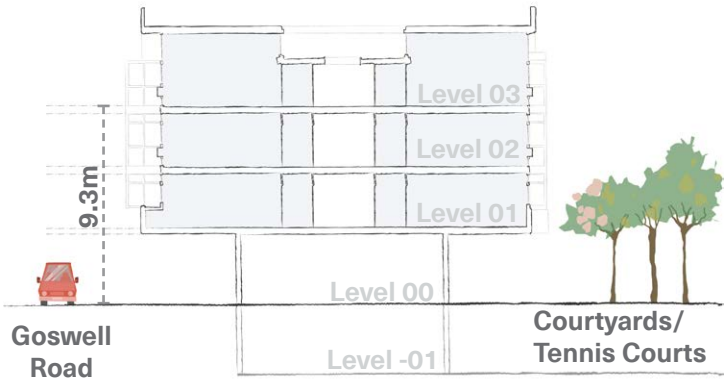
Building Height
The top floor of Crescent House, measured from the general external level of Goswell Road to the West, is 9.3m. This has been confirmed by Building Control.

For any building over 18m, more onerous requirements apply.

As Crescent House is below 11m in height, clauses 10.6 and 10.7 of Approved Document B - Volume 1 do not apply.

Relevant Boundaries
The boundaries to the North, South and West of Crescent House are all greater than 1m. The block abuts both Hatfield House and Cullum Welch on the East façade, therefore, this boundary is less than 1m.

The regulations specify that "the external wall of a building should not provide a medium for fire spread" and that designs should reduce the "risk of ignition from flames coming from adjacent buildings". If the top floor of a building is above 18m and has a relevant boundary which is less than 1m to another building, then the external surface of the walls must be non-combustible (of class A2 or better). However, window frames and glass are excluded from this regulation.



Sketch section through the shorter end of Crescent House, highlighting the height of the uppermost floor level (confirmed with Building Control).

Approved Document F: Ventilation

This document states that when building work is carried out that will affect the ventilation of the existing dwelling, for example, replacing a window, the ventilation of the dwelling should either meet the standards in the relevant approved document or not be less satisfactory than before the work was carried out. The checklist for existing dwellings states 'Make a visual check for mould or condensation. If either are present, install additional ventilation provisions or seek specialist advice'. Compliant ventilation proposals will be made.

Approved Document J: Combustion appliances and fuel storage systems

The required safe distance between a gas flue extraction point and opening windows/vents is outlined in this document. Flue locations will be reviewed alongside window openings and any new vents e.g. trickle vents.

Approved Document K: Protection from falling, collision and impact

Certain windows at low level within each home will need to comply with protection from falling, collision and impact requirements, which can include glass specification and opening mechanisms.

Approved Document L: Conservation of fuel and power

This document provides minimum requirements for renovation of existing elements and/or new building elements in existing dwellings, such as windows. It covers areas such as U-values and air tightness.

Approved Document M: Access to and use of buildings

Guidance is provided on how to create accessible dwellings for residents and/or visitors. Undertaking any building works to an existing dwelling provides an opportunity to review and/or improve it's accessibility.

Approved Document O: Overheating

This document has a strong intersect with Part F and window design. Overheating mitigation must factor in noise, pollution and security, among other considerations. This document only applied to new homes, therefore, is not a requirement for Crescent House, however, the potential to reduce summer overheating will be considered.

Throughout the project development, the project team will continue to have regular discussions with Building Control, to ensure any proposals made comply with all relevant Building Regulations.

CDM 2015

The Construction (Design and Management) Regulations 2015 cover the management of health, safety and welfare when carrying out construction projects. There are a number of roles defined within CDM 2015: namely designers, contractors, a Principal designer and Principal contractor.

CDM 2015 focuses specifically on either pre-construction and construction information. Studio Partington are undertaking the Principal Designer role and subsequently will coordinate the pre-construction health and safety information required by the regulations. This will include understanding and mitigating risks associated with working on existing buildings, such as asbestos.

7.0

Whole House Retrofit

7.1 A Whole House Approach

This project focuses on window upgrades to the residential blocks on the Golden Lane Estate and the final design which gets delivered on site should create healthier, more affordable and more comfortable homes. That said, to create truly healthier and comfortable homes, the windows cannot be considered in isolation. Best practice requires a whole house approach.

Piecemeal retrofit of a building, whereby individual fabric elements are upgraded in isolation of each other, can lead to unintended consequences. Heat will escape through the weakest part of a building fabric and until all of the external envelope is performing better, heat will continue to find a route out of the home. There are various aspects of each home that should be considered holistically alongside any works to the windows (see diagram overleaf).

Without considering these measures together, the impact that the window works have will be less significant and could, in some instances, make the condition within the flats worse in certain areas. The thermal bridges in the building fabric, which allow heat to escape, should be addressed for the thermal efficiency of the flats to be fully optimised.

It is acknowledged that many of these measures and the associated possible solutions will be subjective to residents and other stakeholders and not all of them will be appropriate for this building type, however, the project team feel it is important to highlight these thermal comfort measures alongside the window considerations. These improvements also allow the building to be brought as close as possible to the current thermal performance standards in the Building Regulations.

PAS 2035

Following several poor examples of single measure retrofit projects, a best practice guide was developed for retrofit works, called PAS 2035. Whilst this project will not be delivered to PAS 2035, it is interesting to look at the document which details how to carry out quality energy retrofits of existing domestic buildings, alongside best practice guidance for implementing energy efficiency measures.

What makes PAS 2035 unique is that it outlines a whole house approach to the retrofit process, considering the home, environment, occupancy and the improvement objectives of the client. Regardless of whether all of the measures listed in this section happen now or in the future, they must be considered alongside the window works. In line with the principles of PAS 2035, it is essential that a retrofit plan is developed for how and when the changes will take place.

The framework ensures that quality retrofit is achieved, eliminating the issue of retrofit work being considered in isolation (which can unintentionally damage the overall building performance).

The key aspects for consideration and coordination:

1. ***Heat loss through fabric***
Due to the concrete and masonry elements of construction and lack of insulation within the building envelope, heat is transferred and lost through the fabric and key junctions.

2. ***Air infiltration***
Excess air infiltration is experienced as cold draughts, particularly near windows.

3. ***Ventilation***
Moisture is not being effectively removed from all homes. None of the existing windows have trickle vents for background ventilation and there is no mechanical background ventilation.

Additional factors to be considered:

4. ***Solar heat gains***
Solar gains from the west provide free heat on sunny days in the winter but means that this side of the home can suffer from overheating in summer

5. ***Thermal mass***
Concrete and masonry are thermal mass materials - they absorb, store and release heat slowly. In summer this helps to keep homes cool, but in winter it can mean that they take longer to heat up.

6. ***Heating System***
Ineffecient heating systems increase energy consumption and energy bills. Also, increased maintenance costs. Gas boilers will be removed and where possible there will be no gas flues penetrating the new glazing.

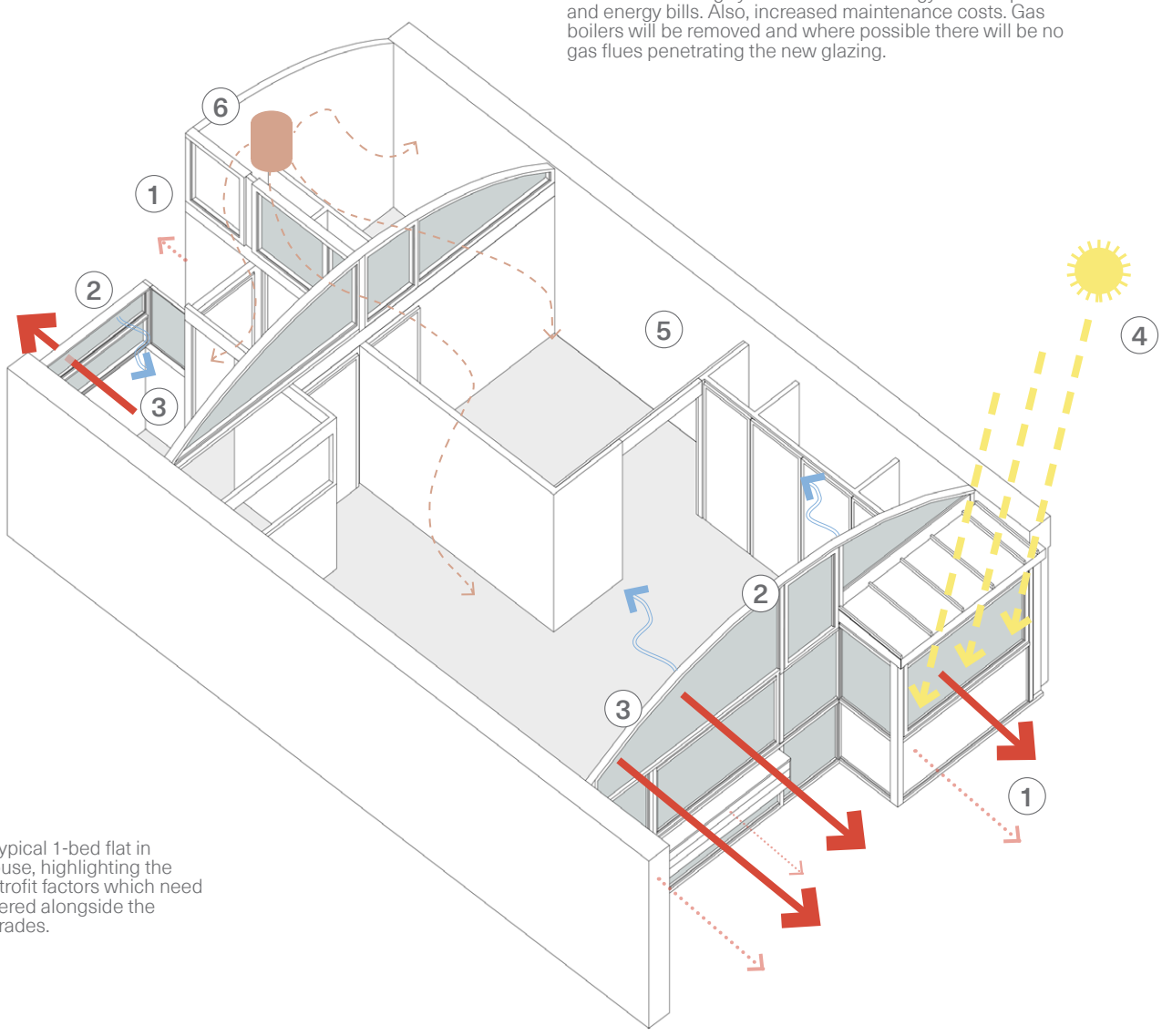


Diagram of typical 1-bed flat in Crescent House, highlighting the additional retrofit factors which need to be considered alongside the window upgrades.

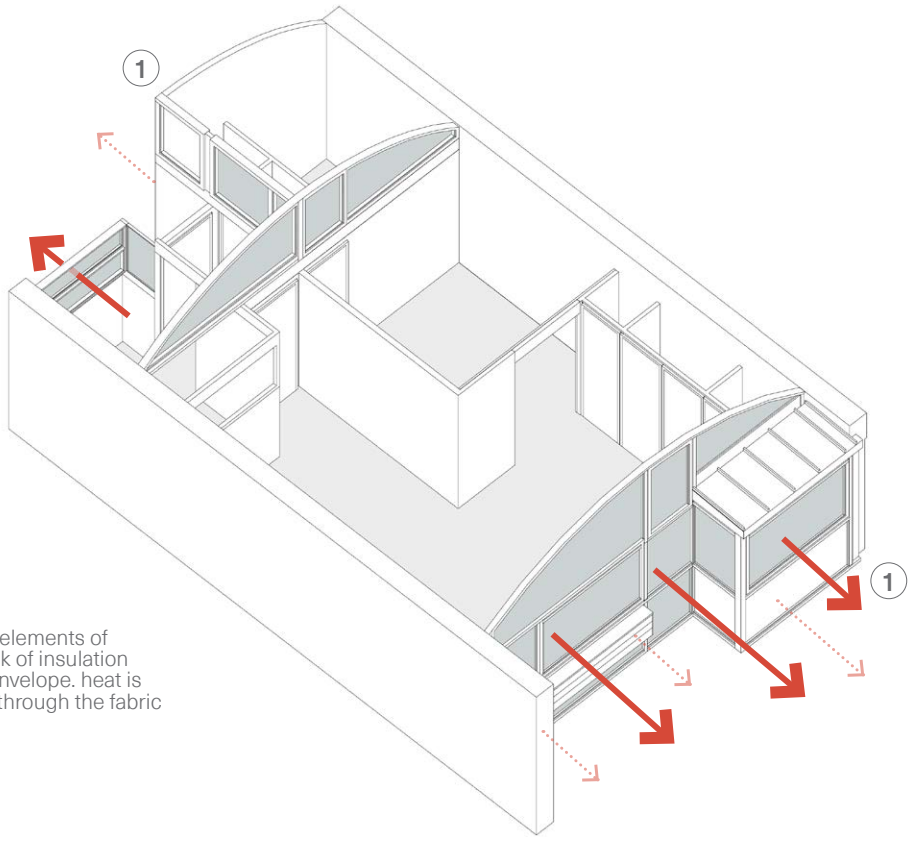
7.2 Heat Loss Through Fabric

The fabric of the buildings at Golden Lane Estate is generally in good condition for the age of the building, however, it is poorly insulated and unsealed. Similarly to the other blocks on the estate, the walls of Crescent House do not have cavities, and, unlike contemporary construction, they don't appear to have any breathable membranes or vapour control layers and they also are uninsulated.

The uninsulated concrete and brick construction of Crescent House means that a number of significant thermal bridges exist. This means heat is transferred and lost through the building envelope and key junctions, including external walls, floors, roofs and windows. In addition, the existing window frames are not thermally broken, which means that they are not insulated. This creates a significant thermal bridge where heat can escape from inside the flat.

Possible, high level solutions are included below:

- **Windows/doors (confirmed):** Improvement of the windows' thermal performance. New frames would be thermally broken, further reducing thermal bridging and heat loss.
- **External walls:** In addition to this, install insulation to the cavity of the external walls. Where there is no cavity, install insulation internally or externally, to ensure that the existing poor thermal performance isn't exacerbated by the improved windows.
- **Roof:** In addition to this, install insulation to the roof, internally or externally. This includes the roof to the oriel windows.
- **Floor slab:** In addition to this, install external insulation to any exposed floor slab. This includes the slab to the oriel windows.



1 Due to the concrete elements of construction and lack of insulation within the building envelope. heat is transferred and lost through the fabric and key junctions

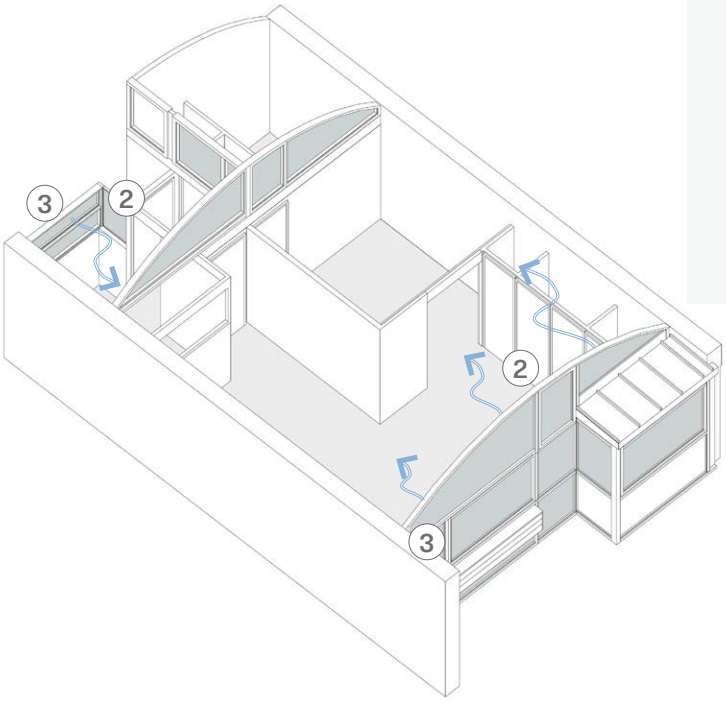
7.3 Air Infiltration

Poor airtightness can be attributed to gaps (big and small) in the building fabric. Excess air infiltration is experienced in homes as draughts. Majority of these draughts are felt due to poorly sealed windows and doors, which reduce the airtightness of the dwellings and subsequently increase heat loss.

Possible, high level solutions are included below:

- **Windows/doors:** Improved seals to windows and doors and airtightness around structural openings to help keep the heat inside the homes. New windows/doors installed with improved airtightness.
- **External walls/junctions:** Improved airtightness throughout the flat through installation of airtightness material e.g. airtightness tape.

2 Excess air infiltration is experienced as cold draughts, particularly near windows



7.4 Ventilation

Controlled ventilation in homes keeps air fresh and ensures moisture is effectively removed from the internal environment, preventing condensation and mould growth.

There is currently uncontrolled ventilation due to gaps in the windows/frames, leading to high levels of heat loss, without removing condensation build up. As homes become better insulated and more airtight, the addition of controlled ventilation is even more important.

Possible, high level solutions are included below:

- **Trickle vents:** New windows can incorporate trickle vents within the frame to provide background ventilation.
- **Centralised Mechanical Extract Ventilation (MEV):** One unit that can extract air from multiple spaces within the homes. Window vents or natural leaky fabric required for replacement air.
- **Mechanical Ventilation with Heat Recovery (MVHR):** As homes are constructed or retrofitted with higher levels of insulation and airtightness, MVHR is increasingly being used to provide fresh air without losing heat through uncontrolled gaps in the building envelope e.g. leaky fabric or users opening windows. Combining this with heat recovery means that incoming fresh air is heated in an exchanger using the warmth from the air which is being extracted.

3 Moisture is not being effectively removed from all homes. None of the existing windows have trickle vents for background ventilation and there is no mechanical background ventilation

7.5 Additional Factors

Thermal Mass

Concrete and brick are thermal mass. Thermal mass absorbs, stores and releases heat slower than lightweight materials such as timber. In summer, this helps to keep homes cool as excess heat is slowly absorbed during the day. If the home is suitably ventilated at night, the concrete can cool down again and recharge ready to absorb heat the next day.

However, this also means in winter the concrete will also absorb heat from the heating system, so homes can take a little longer to warm up at the beginning of the heating season.

Solar gains

Solar gains from the south elevation provides homes with free heat. It can also mean that this side of the home is warmer than the north side.

The kitchen and bathroom are rooms which generate a lot of moisture, however, they are consistantly located on the internal lightwell side of the building where they will not benefit from solar gains, likely exacerbating condensation problems here during the winter. In the summer, the main living space on the west side of the building can suffer with overheating, which needs to be considered within the proposals.

Heating

Heating and hot water in the flats is currently provided via gas boiler. Individual boilers were installed when the district heating system was decommissioned. Generally, the boilers have been installed within a cupboard by the entrance and the boiler flues are fixed through the external wall. Building regulations have guidance on the minimum distance a horizontal extract flue can be from an opening window when the flue serves a gas boiler. The regulations state that the flue should be 300mm from the opening window or vent. Any works to the windows will trigger the need to comply with these regulations.

Looking to the future, with the eventual phasing out of gas boilers and the Corporation aiming to achieve Net Zero in operations by 2027, and across its full value chain by 2040, the current window works also provide an opportunity to begin the transition to a low-carbon heating system ahead of the de-carbonisation of the national grid.

8.0
Conclusion

8.1 Concluding Remarks

The Golden Lane Estate is an extremely valuable example of post-war architecture and urban planning in London. Crescent House forms an important part of this history - recognised by it's Grade II* listed status. The proposed window works will adhere to the Listed Building Management Guidelines, whilst balancing an increasingly urgent need to retrofit our existing building stock in response to the climate emergency.

Ultimately, there is no single optimal solution to the numerous challenges posed by the condition of the flat windows across the estate. Compromises are inevitable, if the competing goals of heritage, climate, cost and disruption are to be given proper consideration and suitably addressed. The research and design work undertaken to date - and summarised in this document - has narrowed the window upgrade approaches at Crescent House down to two. The first involves refurbishing the existing frames and retrofitting them with vacuum glazing; and the second, replacing the existing windows with a new frame and a high performance glazing, such as triple-glazing.

The refurbishment approach prioritises the preservation of the historic fabric over optimisation of the thermal performance and resident comfort, while the replacement approach puts improved thermal performance and resident comfort first, but requires the replacement of historic fabric.

While the scope of this project only tackles the windows, the document also makes it clear that the upgrades need to be seen as part of a comprehensive upgrade to the whole building, encompassing insulation, ventilation, and ultimately, heating. Interventions to any one of the elements listed above will have an inevitable impact on the others, so consideration must be given to maintaining a healthy balance between each element, to ensure that each upgrade doesn't cause more harm than good.

The south western corner of Crescent House on Goswell Road, highlighting the building's position as a boundary to the wider estate and The Shakespeare pub on the ground level.

9.0

Next Steps

9.1 Actions

This document provides an overview of the windows project process to date. Ahead of the City of London Corporation making a decision about which option to proceed with for the windows at Cresent House, it has been confirmed that a Pilot Project will test the various approaches against the existing.

The Pilot Project will clarify any assumptions made by the project team and allow any concerns raised by residents to be addressed with regards to appearance and impact on heritage, acoustics, thermal performance, logistics and cost. It will help the team understand any unexpected details on site and confirm the level of disruption (and for how long) each home can expect for the works to their flat. The Pilot Project will help to ensure that any decisions made by the client, project team, residents, and stakeholders are well-informed.

Throughout the Pilot Project, engagement with residents (both tenant and leaseholder) will continue, to get a deeper understanding of occupant experience, concerns and aspirations for their home in Crescent House. In addition, engagement with relevant statutory stakeholders to bottom out any concerns and ensure that the proposals are acceptable in heritage terms will also continue.

Once a decision has been made about which approach to the windows upgrade the City of London would like to progress with, a summary of the subsequent process is listed below:

- Full planning application for chosen approach developed and submitted for approval
- A competitive tender process to find a contractor who can deliver the works on site, taking cost, quality and desired time-frames into account.

Throughout this process, the design and construction team will be in conversation with building control to ensure that the works being proposed/undertaken are compliant. Health and Safety requirements as per the Construction Development Management Regulations (2015) will be followed, overseen by the Principal Designer (Studio Partington) and the Principal Contractor (Abbotts).

9.2 Additional Works

As per the recommendations in this document, to meaningfully improve and future proof Crescent House, a 'whole house' review of retrofit measures should form part of a long-term retrofit plan.

In addition to these retrofit works, there is an opportunity to undertake general maintenance and repairs to the building. If scaffolding is required for the works and is already in place for the windows project, it would be ideal to undertake a programme of decoration to the external, common parts of Crescent House.

Glossary of Key Terms

Net zero

Refers to the balance between the amount of greenhouse gas produced and the amount removed from the atmosphere. It means cutting greenhouse gas emissions to as close to zero as possible.

Retrofit

Adding new components to a building to make it perform better.

Thermal Performance

A factor that is concerned with how well your home retains heat.

Thermal Comfort

Describes a person's state of mind in terms of whether they feel too hot or too cold.

Secondary glazing

A fully independent, secondary window system installed to the room side of existing windows. The original windows remain in position in their original unaltered form.

High performance glazing

Combines optimum thermal and acoustic performance, to create a comfortable internal environment. This glazing will have a low U-value, low G-value and high VLT (Visual Light Transmittance) value.

U-value

Thermal transmittance. The rate of transfer of heat through a structure, divided by the difference in temperature across that structure. Low is good, high is bad. With windows, a centre pane u-value is for the glass only, compared to a whole window u-value which is for the whole unit, including the frame.

G-value

A measure of how much solar heat (infrared radiation) is allowed in through the window. A low g-value indicates that a window lets through a low percentage of the heat.

VLT value

The amount of visible light that passes through a glazing system. The higher the rating, the more natural light passes through.

Vacuum glazing

Two pieces of glass, except that it doesn't have a gas in the cavity like double glazing, it has a vacuum which is an extremely thin gap.

Thermal Bridge

Also known as a cold bridge. A part of the building envelope where the material or detail used has a significantly higher heat transfer than what surrounds it (e.g. concrete or glass in an external wall), so significant heat is lost here.

Thank you for taking the time to read this document.

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