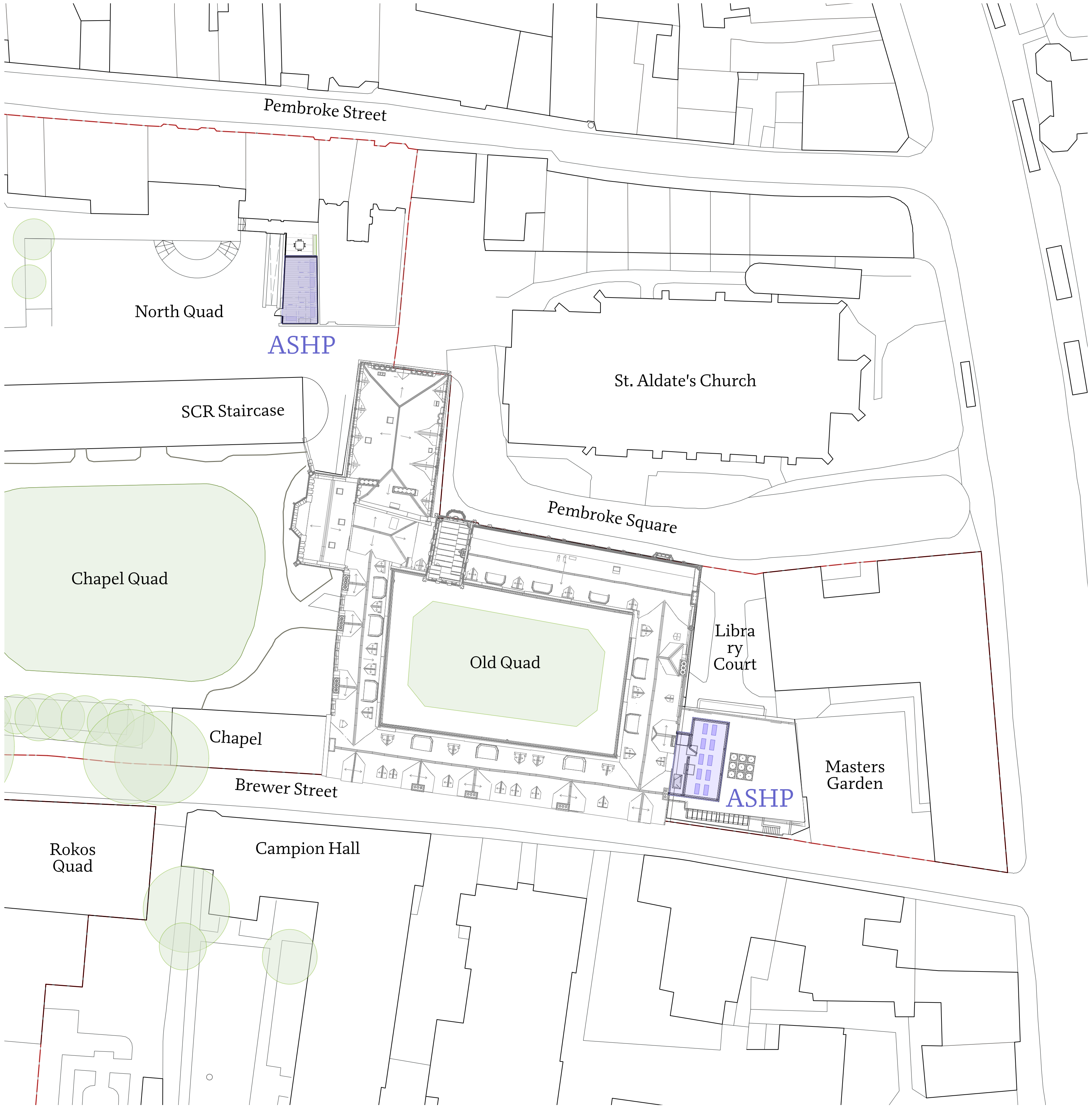
Decarbonisation – introduction
The proposed scheme will reduce the carbon emissions associated with the existing buildings by replacing the existing gas boilers and direct electric heating with air source heat pumps (ASHPs), and by making improvements to the thermal performance of the existing building fabric.

Replacing gas boilers with ASHPs
Staircases 1, 2, 7 and 8, the Tower Staircase and Broadgates Hall currently use gas boilers for heating and hot water. It is proposed that the gas boilers be decommissioned and replaced with ASHPs, which are a low carbon heat source (and will eventually be zero carbon when the national electricity grid no longer uses carbon intensive forms of generation). The proposed locations for ASHPs are shown on the site plan to the right; further information for each location is given on the following pages.

Replacing direct electric heating with ASHPs
Staircases 3-6 of Old Quad have direct electric heating. In order to improve internal comfort without putting excessive pressure on the electrical infrastructure (both within the College site and further afield) it is proposed that direct electric radiators be replaced with a wet system supplied by ASHPs. This approach is more efficient than direct electric heating, which means that it puts less pressure on electrical infrastructure.

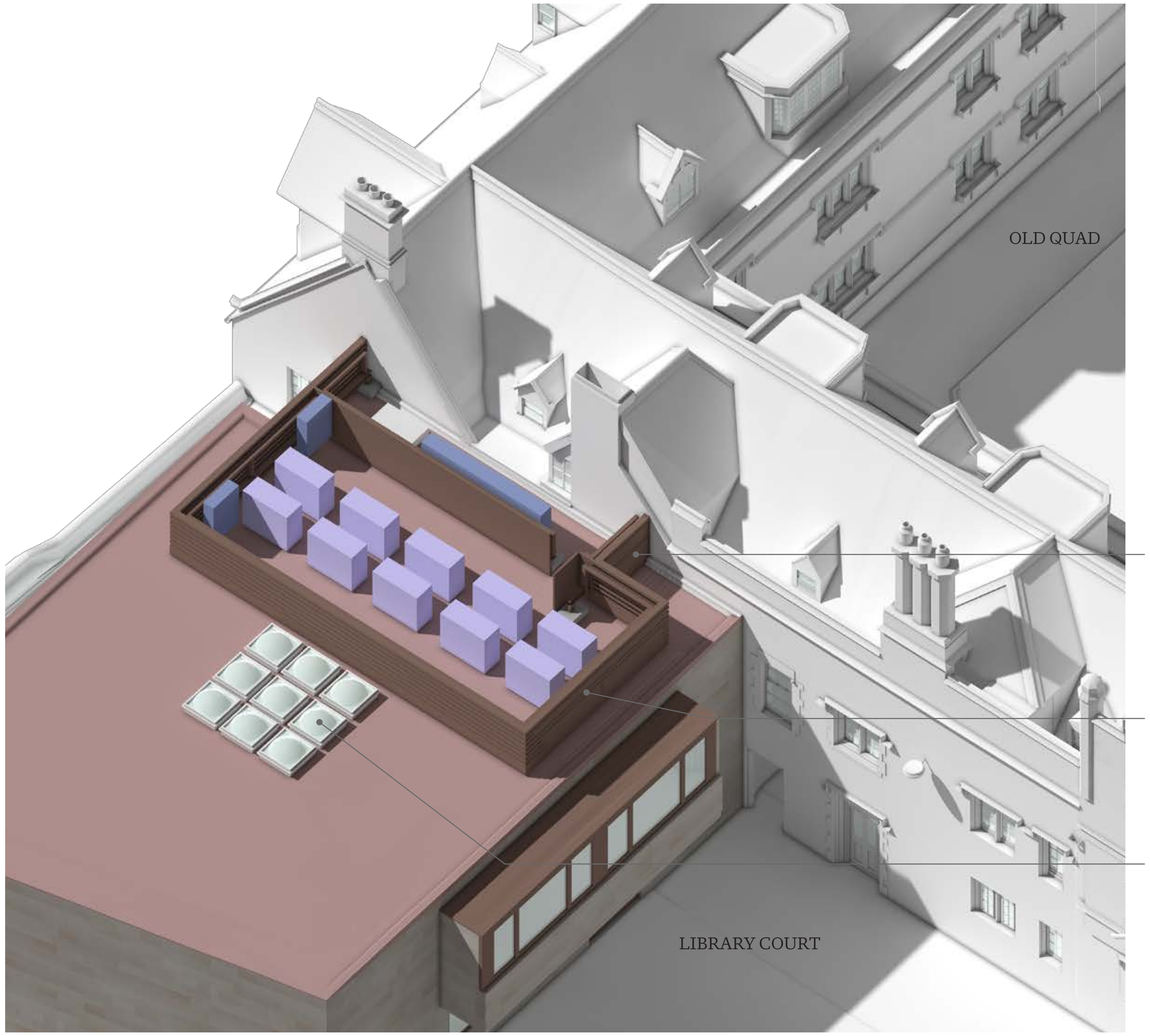
Thermal improvements to Old Quad building fabric
It is proposed that conversion to ASHPs be combined with thermal improvements to the building fabric. Combining heating upgrades with fabric improvements lowers energy consumption and reduces the size and number of ASHP units required.



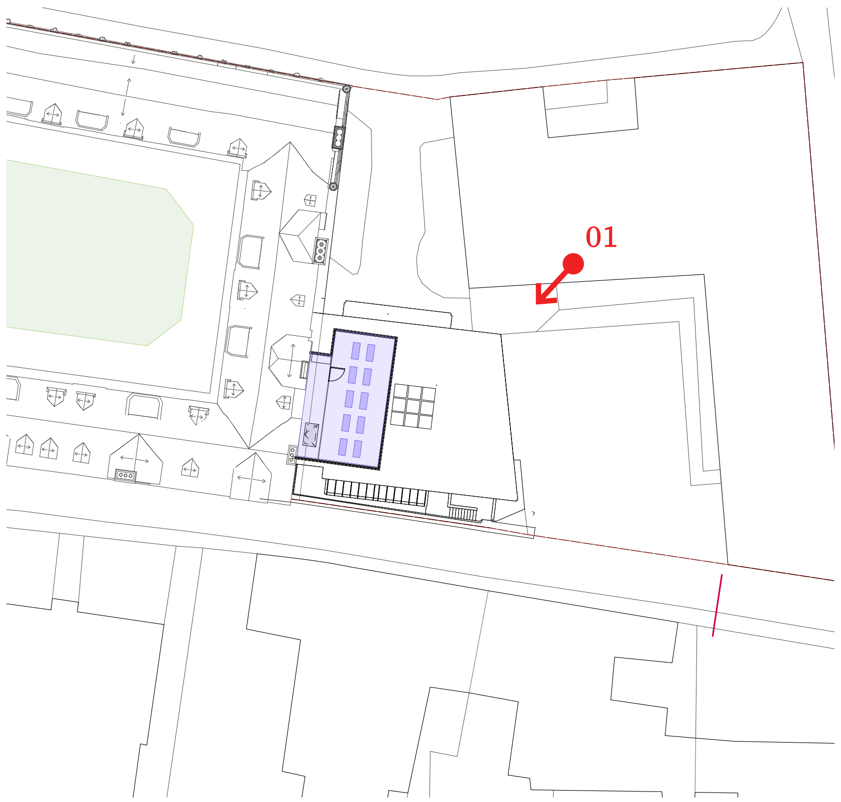
Proposed locations of air source heat pumps serving Old Quad

Air source heat pumps on McGowin Library roof
The McGowin Library roof has been identified as a suitable location for the ASHPs for Old Quad Staircases 1-6 and the Tower Staircase. This area has been chosen because it is on top of a modern building and is relatively concealed from view, which will help minimise the impact on the setting of the various listed buildings. The ASHPs would be clustered on the west side of the McGowin Library roof to minimise their visual impact and to avoid any clash with the Library's rooflights.

Visual and acoustic screening
A visual screen is proposed to ensure that plant on the roof is not visible from ground level or surrounding upper storey windows. The screen will be acoustically rated to avoid noise disturbance in the surrounding buildings, and will be louvred to allow airflow to the heat pumps. The screen would be aluminium, with a bronze finish to match the windows and doors of the McGowin Library building.



View 01 – aerial view of ASHP enclosure on McGowin Library roof; colours are for illustrative purposes only

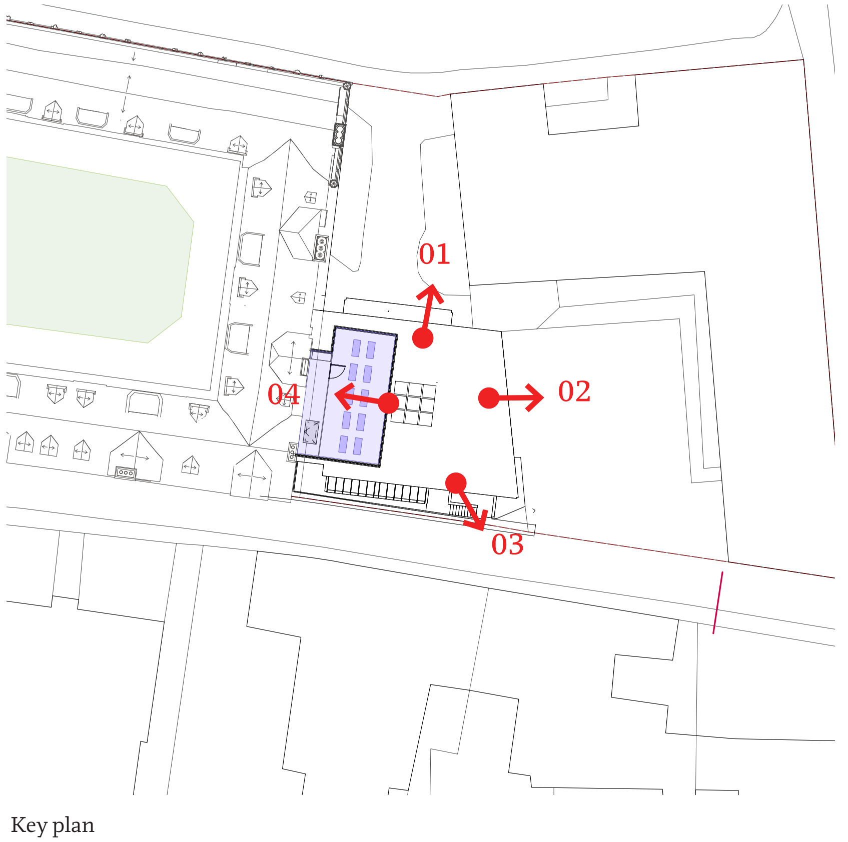


Key plan

Impact of ASHP enclosure on the city skyline
As shown in the photos to the right, the roof of the McGowin Library is screened to the north, east and south by the roofs of the surrounding buildings. It is fully screened from view to the west by the roof of Old Quad. This means that the proposed ASHP enclosure will not impact the city skyline.

View 01 – looking north from McGowin Library roof

View 02 – looking east from McGowin Library roof



Key plan

View 03 – looking south from McGowin Library roof

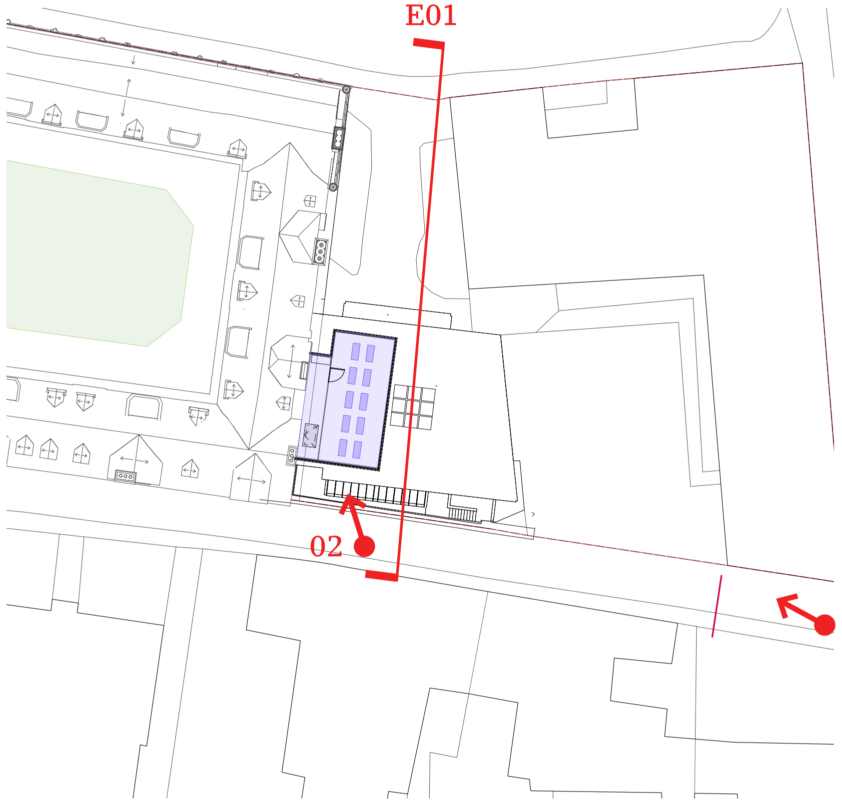
View 04 – looking west from McGowin Library roof

Visibility from Brewer Street

Because of the substantial level difference from Brewer Street and the setback from the edge of the roof, the air source heat pump enclosure would be invisible from most angles at ground level along Brewer Street. From a few angles immediately to the south of the enclosure it would be possible to catch a small glimpse of the enclosure; the visual impact of this would be very minimal.

View 01 – Photo from the east end of Brewer Street, looking towards the McGowin Library roof; the enclosure would not be visible from this angle

View 02 – Small glimpse of ASHP enclosure from Brewer Street



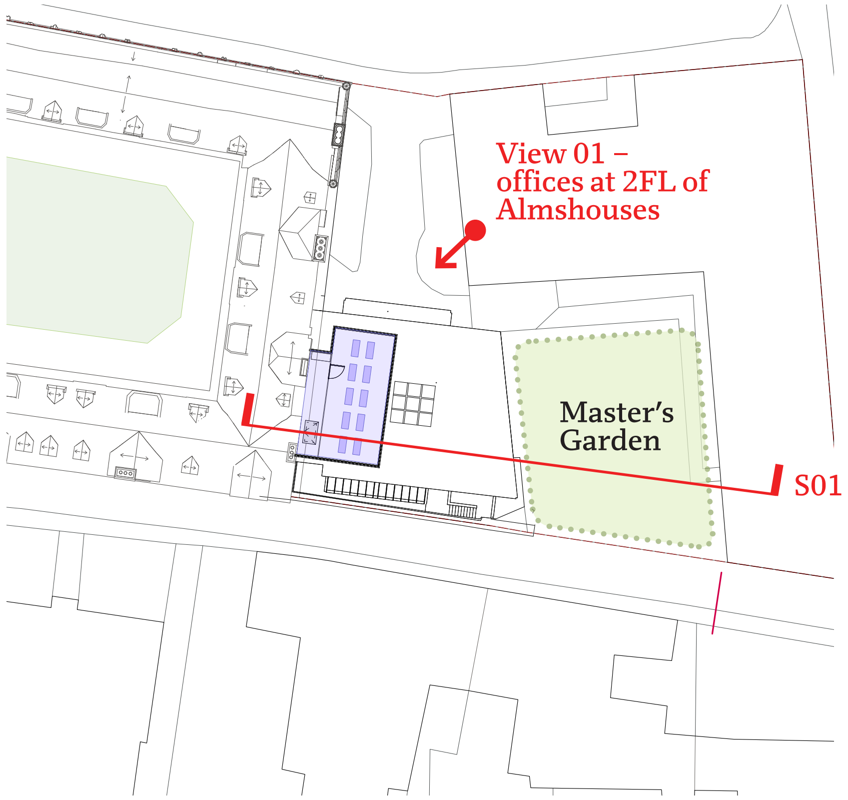
Key plan

Elevation E01 – Proposed east elevation of Old Quad, showing no sightline from street level to ASHP enclosure

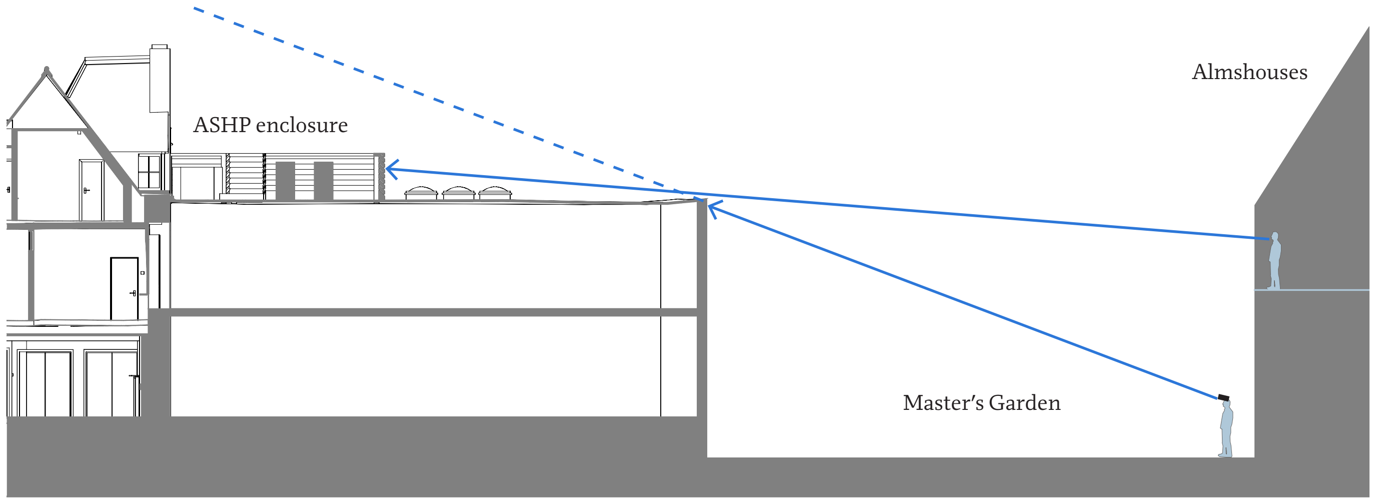
Visibility from Almshouses and the Master's Garden
Because the ASHP enclosure is set back from the east edge of the roof, it will not be visible from the Master's Garden. It will be partially visible from the Master's rooms at first floor level facing west. It will also be visible from the windows at the second floor of the Almshouses – although the windows do not face directly towards the enclosure.

View 01 – from Fellow's offices at second floor level of Almshouses
Photograph of existing view

View 01 – from Fellow's offices at second floor level of Almshouses
Indicative proposed view



Key plan

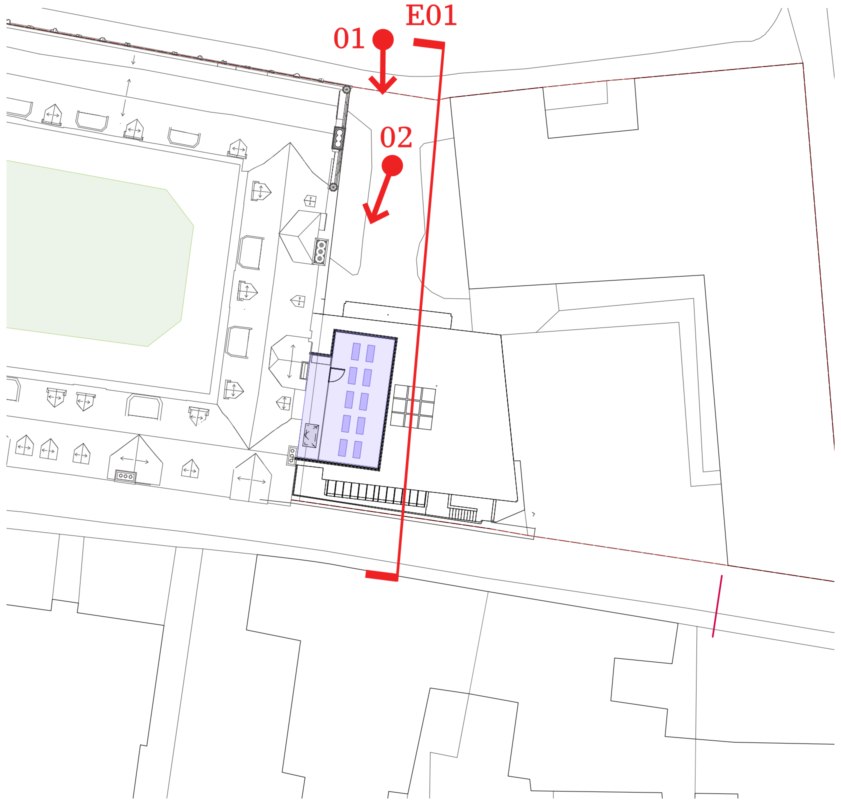


Section S01 – diagrammatic section showing no sightline from the Master's Garden and limited sightline from the Master's accommodation

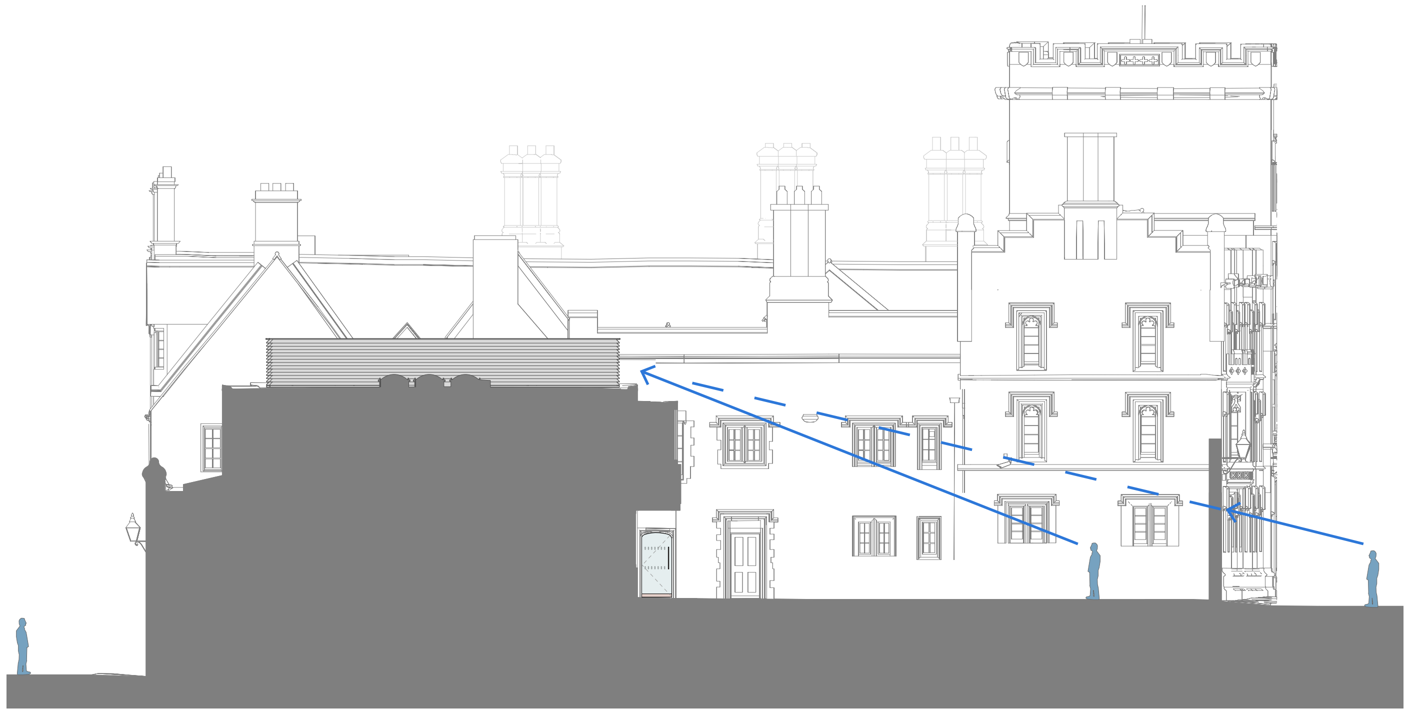
Visibility from Library Court

The air source heat pump enclosure would be visible from Library Court. The visual impact on the west facade of Old Quad is minimised by setting back the enclosure where it meets the existing building. This avoids an awkward visual relationship between the enclosure and the historic building.

View 02 – Visualisation of ASHP enclosure as seen from Library Court



Key plan

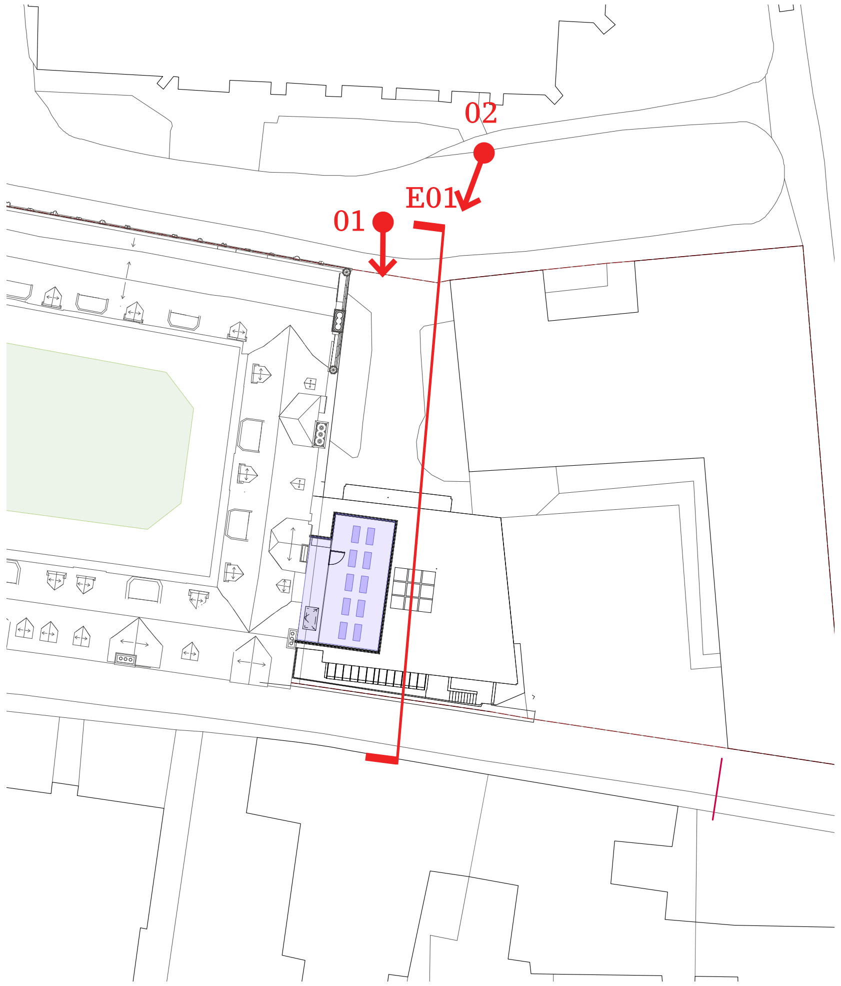


Elevation E01 – Proposed east elevation of Old Quad, showing sightlines from Pembroke Street and Library Court

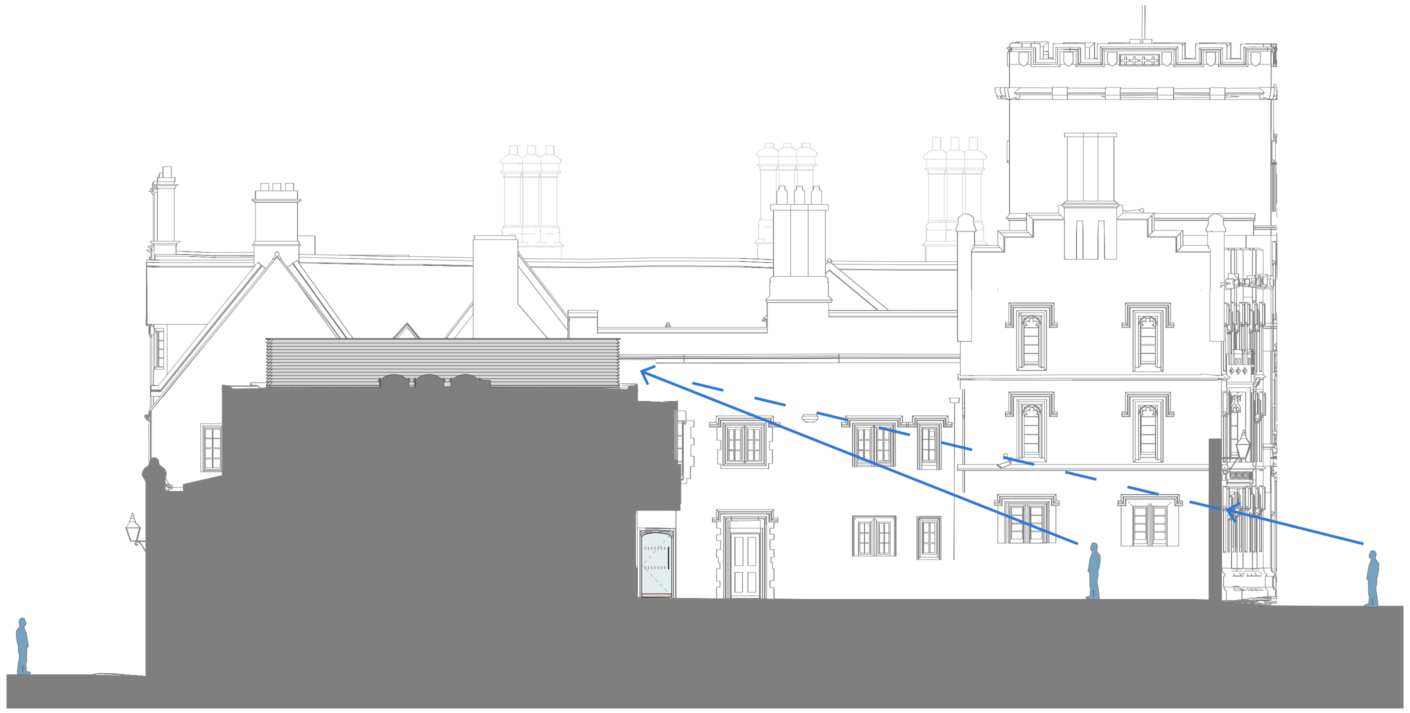
Visibility from Pembroke Square
While there would be some visibility through the gate into Library Court, the McGowin Library and the proposed enclosure on top of it are screened from most locations within Pembroke Square by a stone wall. The impact on the perception of Old Quad from the public street is therefore minimal.

View 01 - ASHP enclosure visible through gate

View 02 - ASHP enclosure screened by stone wall



Key plan



Elevation E01 – Proposed east elevation of Old Quad, showing sightlines from Pembroke Street and Library Court

North Quad ASHP enclosure – options appraisal

The proposed location for the ASHP enclosure serving Staircase 7, Staircase 8 and Broadgates Hall is within North Quad, to the south of Staircase 17. This location has been selected for the following reasons:

- North Quad as a whole is already used as a service area, with significant areas devoted to bike and bin storage
- The proposed site within North Quad is already partially used as a service area (garden storage); the rest of the site is dominated by poor quality vegetation
- The proposed location is already screened by walls on two sides
- The proposed location is close to the areas being heated, which maximises the efficiency of the system (distribution losses will be reduced).

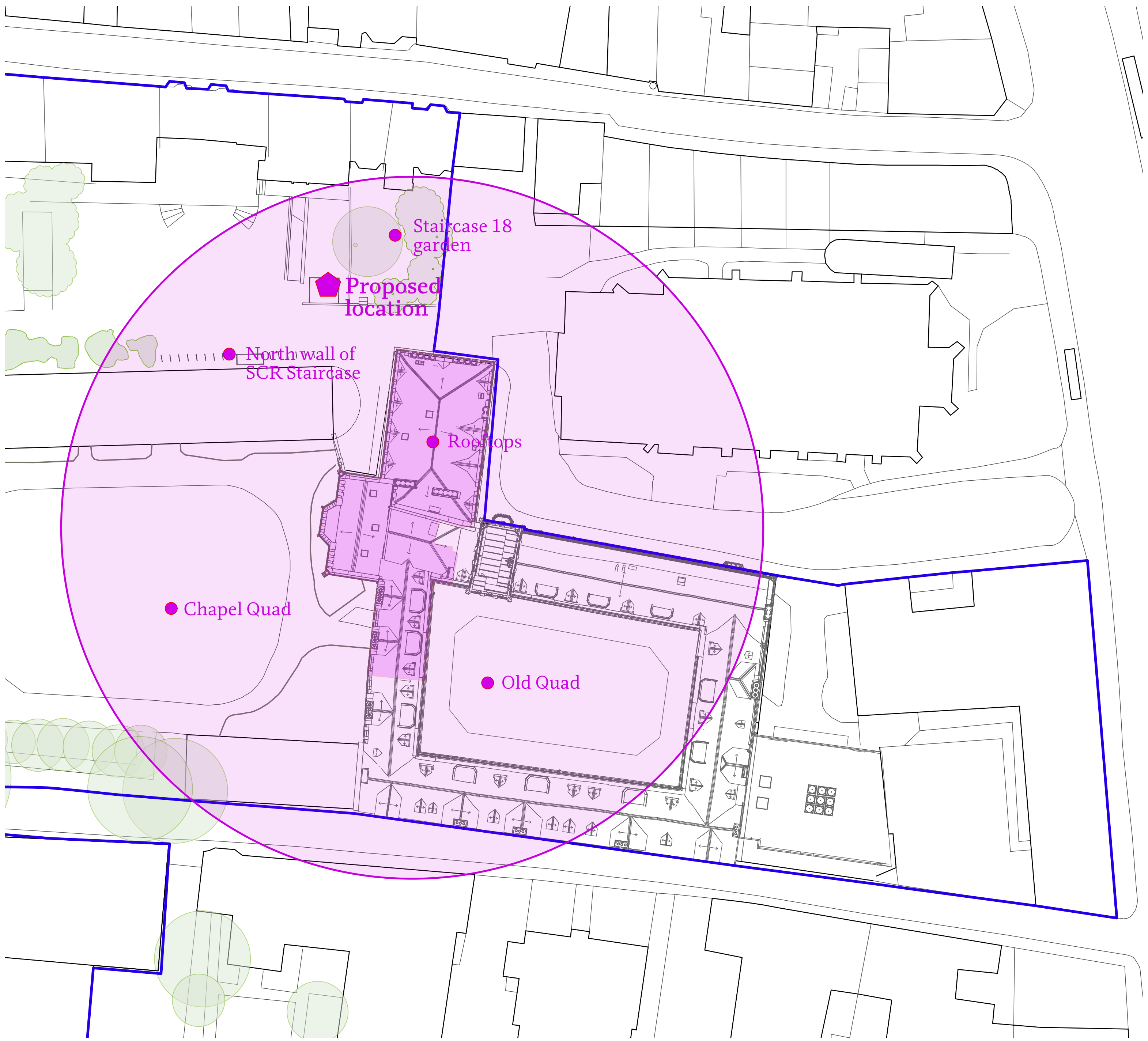
Various other locations were considered, but were judged to be unsuitable. The plan to the right shows all of the possible options within a reasonable distance of the area being served (Staircases 7, 8 and Broadgates).

Rooftops
All of the rooftops in the vicinity of Staircases 7 and 8 are pitched roofs on listed buildings. Adding air source heat pumps in these locations would have a significant visual impact on the historic buildings, and would likely require structural alterations to the roofs.

Chapel Quad or Old Quad
The central courtyard of Old Quad is at the heart of the Grade I listed building and is evidently not suitable as a location for plant. Chapel Quad is also a high quality formal courtyard. Any intervention in this area would have a significant impact on the setting of the surrounding listed buildings.

Garden of Staircase 18
The back of Staircase 18 is landscaped to a high standard and is understood to be valued by the College community as a calm and secluded garden. Any installation in this area would have an impact on the setting of Staircase 18, which is a Grade II* listed building (referred to in the listing as nos 13 and 14 Pembroke Street). Staircase 17 is Grade II listed.

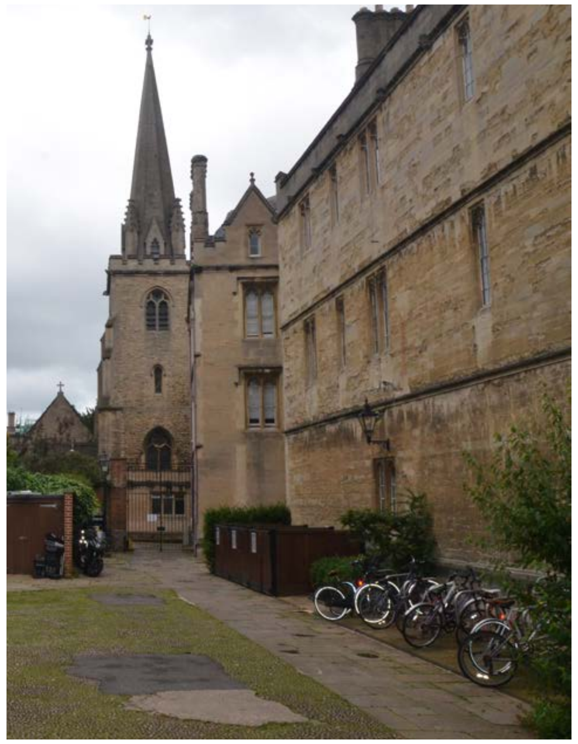
North wall of the SCR Staircase
The new ASHPs could alternatively have been arranged along the north wall of the SCR Staircase, alongside the existing bin stores. However, this would obscure a large area of the stone facade. By contrast, the proposed location outside Staircase 17 would not significantly obstruct the view of any of the surrounding listed buildings.



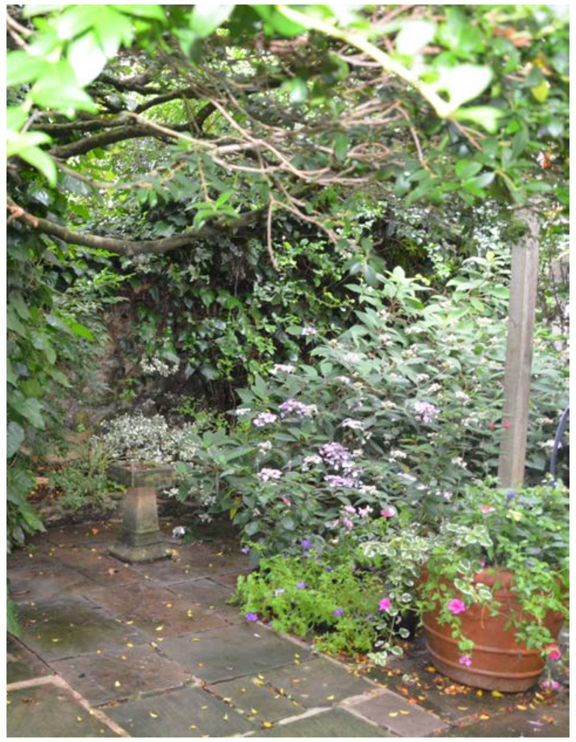
Key

- Proposed location
- Alternative location for ASHPs
- Area served by ASHPs (staircases 7, 8 and Broadgates)
- 40m radius from centre of area served
- Boundary of Pembroke College site


Chapel Quad


North wall of the SCR Staircase


Old Quad


Garden outside Staircase 18

Air source heat pumps in North Quad
The proposed location for the ASHPs for Staircases 7 and 8 and Broadgates Hall is between the garden outside Staircase 18 and the ramp to the bicycle store underneath Staircase 17. Five air source heat pumps are required for 7, 8 and Broadgates; three more will be added at a later date to support the decarbonisation of Staircase 18. All eight heat pumps are part of this application.

Addition of outdoor terrace for Staircase 17
Consultation carried out with students suggests there is a desire for more external space dedicated for student use. The remodelling of this area of North Quad presents an opportunity to provide an outdoor terrace for Staircase 17, which could be used for socialising and outdoor dining.

Visual and acoustic screening
The proposed ASHP location is already mostly screened by existing walls to the south and east; these walls will be built up so that the heat pumps are fully concealed. A new wall is required to the west. The enclosure is slightly recessed below ground level to minimise visual bulk.

Due to the airflow requirements of the heat pumps, acoustic screening is not possible. To mitigate the risk of noise breakout, a very quiet model of air source heat pump is proposed. Additionally, acoustic absorption is proposed within the enclosure. The airflow requirements also mean that visual screening to the roof is not possible.


Photograph showing the current condition of the proposed site

Aerial view of the proposed enclosure

North Quad ASHP enclosure – materials
The enclosure will be made out of brick, to match the existing brickwork to the first and second floors of Staircase 17 and the wall which runs along the south of the garden to Staircase 18. Airflow is required through the west wall to allow the heat pumps to function efficiently. This is achieved using hit and miss brickwork and a louvred gate.

West elevation of the new air source heat pump enclosure

Photograph of North Quad, facing east

New outdoor seating terrace for Staircase 17

Replacement of radiators
In order to ensure the efficient functioning of the heating system with air source heat pumps, it is necessary to replace all of the radiators.

The current radiators are often insensitively placed in front of fireplaces. None of the existing radiators have heritage significance, and the majority are panel radiators and not of the highest aesthetic quality. The replacement of the radiators can therefore provide a heritage benefit.

The proposed radiator locations have been chosen not to obscure any fireplaces or other historic features. The radiators will be simple, flat rectangles. This design has been selected because these emitters will not draw attention to themselves when seen against the plain walls, and because this style of radiator can operate efficiently without being excessively large.

In a small minority of rooms, timber panelling is present. Within Staircase 8, these rooms have trench heating installed within the floor void. It is proposed to replicate this solution wherever timber panelling is present so that the panelling is not obscured by radiators.

Low temperature hot water (LTHW) distribution
The northern areas of Old Quad (more specifically: staircases 1, 2, 7 and 8 and the lower two floors of the Tower Staircase) have an existing wet heating system. This means that there is an existing network of LTHW pipes. It is proposed that these should be re-used, although some local modifications to routing will be required due to the relocation of the radiators.

The southern areas of Old Quad are currently heated using direct electric radiators, so there is no existing distribution. The proposed strategy is to use a limited number of vertical risers, which are concealed within ancillary spaces and integrated with shelving / fixed furniture where possible. Horizontal distribution will be within the floor void, which would be accessed by carefully removing and reinstating floorboards.

The M&E drawings provided with the planning submission give a complete description of the heating system, including LTHW routing, builderswork holes and proposed radiator positions. More information is also provided in the Energy Statement.

Example of existing water-filled radiator

Example of existing direct electric radiator

Proposed simple, planar radiators

Example of existing trench heating

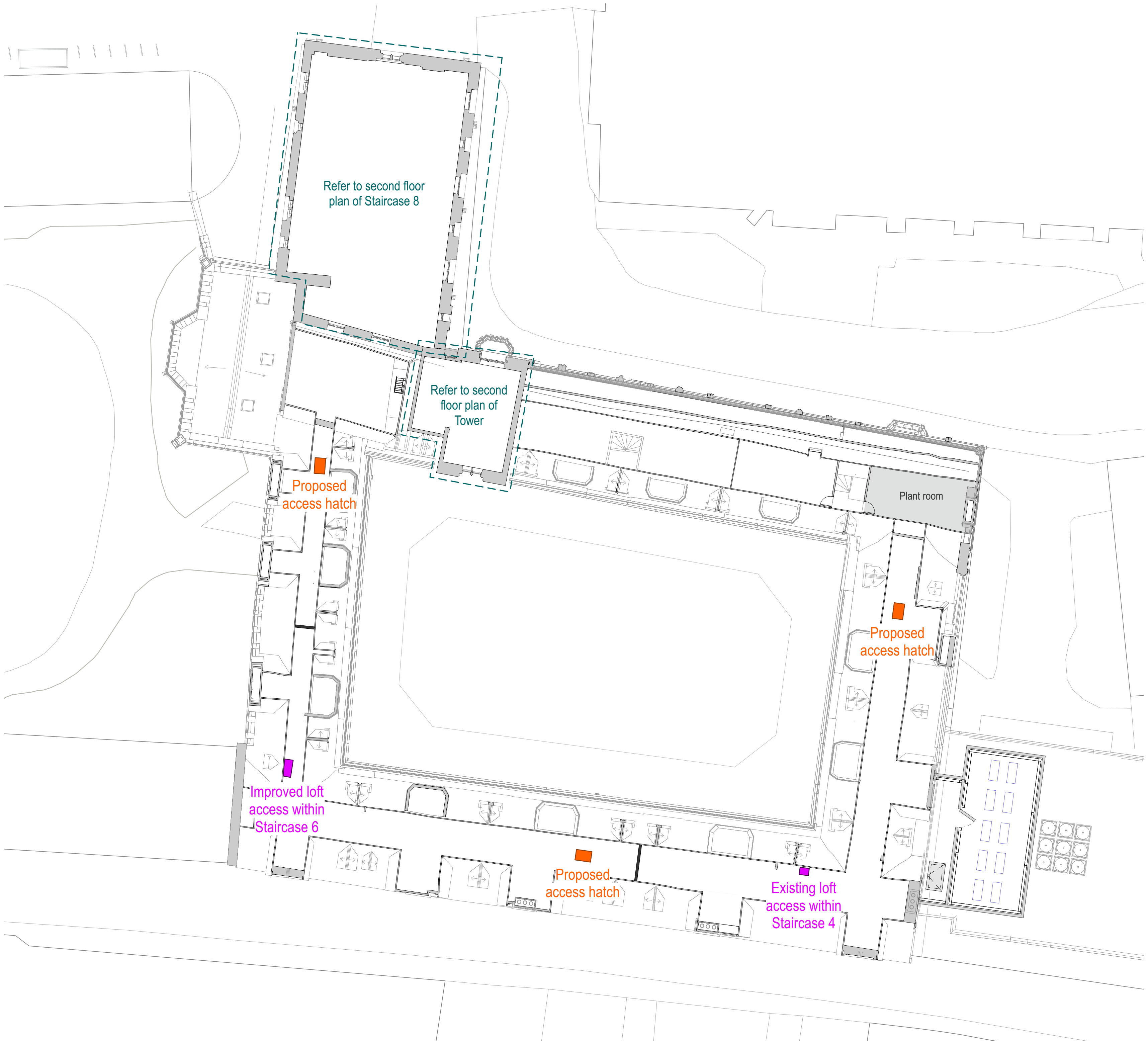
Distribution within the loft

The proposed LTHW vertical risers will be connected to the main plant room via the loft. Because the loft is largely continuous between Staircases 1-7, this minimises the need to create builderswork holes for large primary distribution routes. The loft is also used for the submains cable required for the air source heat pumps on the McGowin Library roof, and for the proposed cold water pipework distribution.

Access to the loft

The services within the loft will need to be accessible for inspection and maintenance. There is already good access into the loft within Staircases 1 and 2, but within Staircases 3-7 there is limited access, and the access which is provided is unsafe. Three new access hatches are proposed within ceilings; additionally, the existing access within Staircase 6 will be improved. Due to the limited size within the loft, the proposed access hatches would need to be located within primary rooms so that they are directly below the tallest point of the loft void.

Adding access to the loft will also help to maintain the historic fabric, because it will make it easier to inspect the condition of the roofing membrane and rafters.



Locations of existing and proposed loft access

Thermal performance of the existing building fabric
In order to minimise the number of heat pumps and to prevent thermal discomfort due to draughts and cold surfaces, some fabric improvements are proposed alongside the upgrades to the heating system. These measures are informed by a detailed analysis of the existing building.

In order to analyse the thermal performance of the historic fabric of Old Quad, a typical staircase within Old Quad was modelled using Passivhaus thermal modelling software (PHPP). This modelling shows the most significant causes of heat loss through the building fabric.

(Please note that 'Staircase' refers not only to the actual stair but all of the habitable rooms accessed from that stair.)

The main causes of heat loss can be broken down as follows:

Because the entrance to each staircase is open and does not have a door, the temperatures within the stair area are similar to the ambient external temperature. This means that a considerable amount of heat is lost through the doors and walls between the habitable rooms and the stair / circulation.

The existing windows lose a lot of heat because they are all single glazed. Additionally, the windows are draughty, which contributes to significant heat losses due to air infiltration (building leakiness).

For the typical staircase, heat loss through the roof and floor is significant, but much lower than through the walls, windows and doors.

For more information, please refer to the separate Energy Statement.

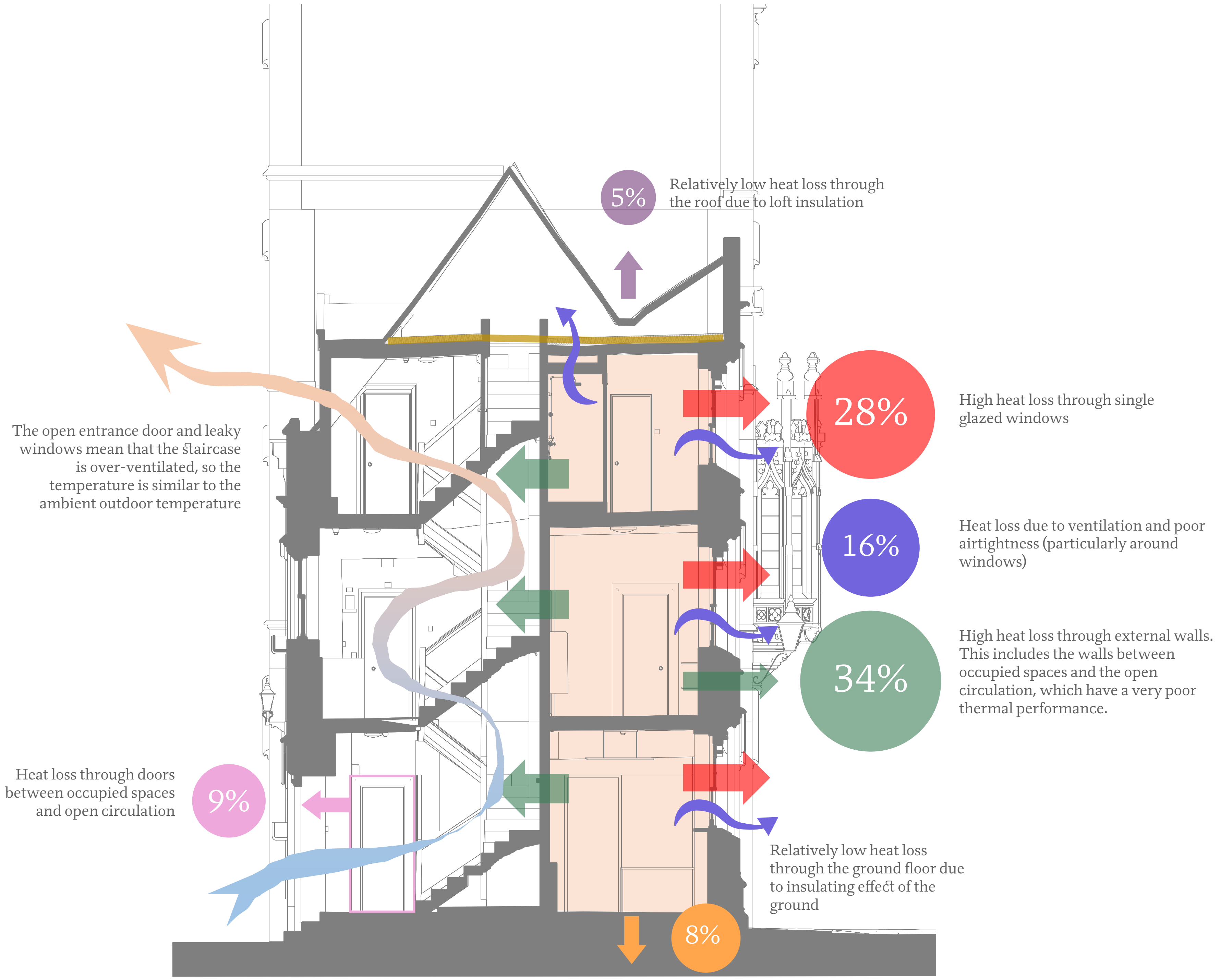


Diagram showing the percentage of the overall fabric heat loss for each thermal element

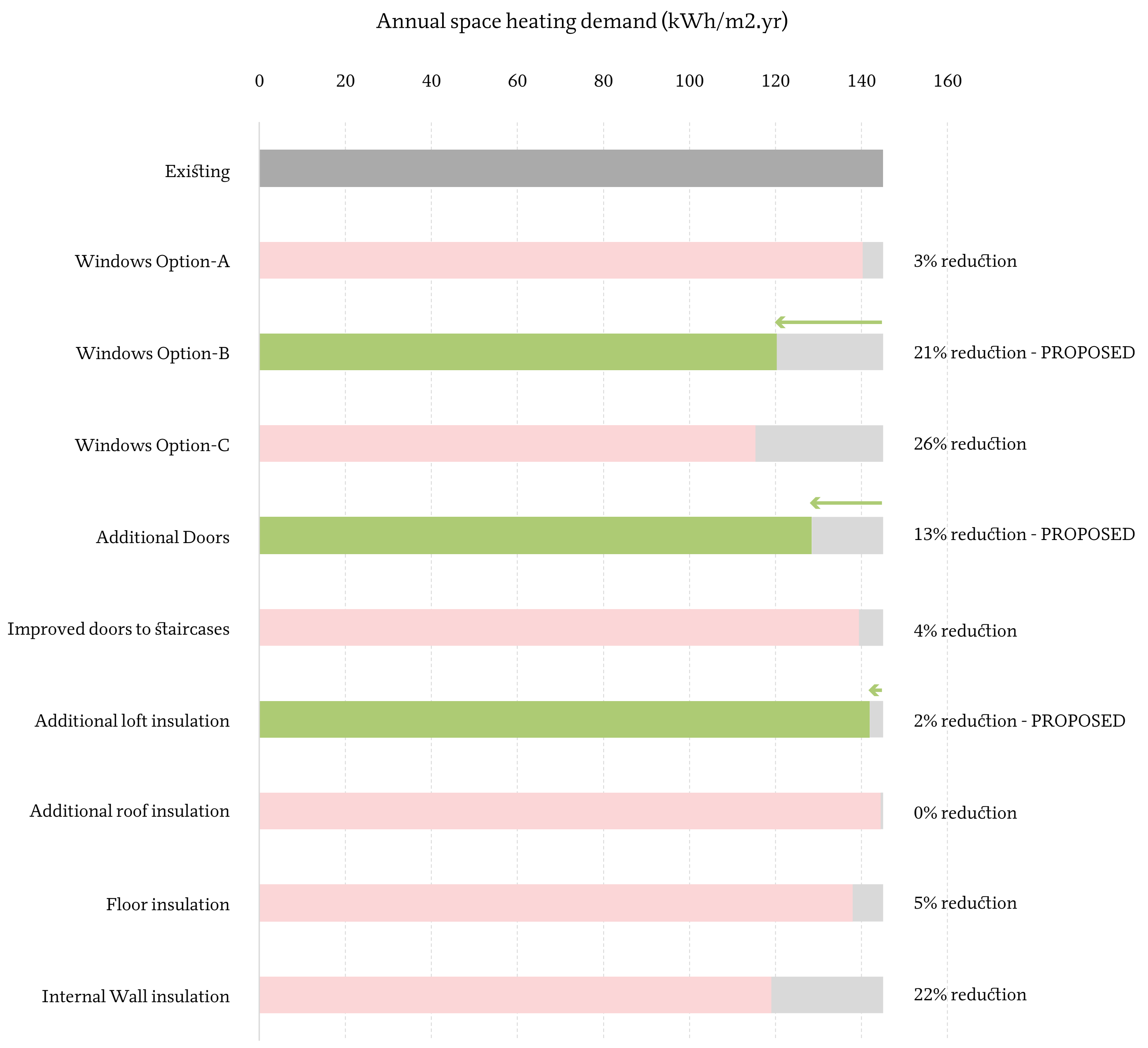
Options Appraisal - fabric improvement measures
At the concept design stage, designs were developed for a full range of fabric improvement options. For each measure, the percentage reduction in annual heating demand (assuming a good level of thermal comfort) was modelled using Passivhaus thermal modelling software (PHPP). At the same time, an assessment of the heritage impact was made for each option. This assessment takes a wide range of concerns into account, including loss of historic fabric, increased condensation risks, visual impact and reversibility. Based on this assessment, proposals have been developed that offer the greatest improvement in sustainability for the least heritage impact.

Floor insulation - not proposed
Floor insulation would be installed by carefully removing the existing floorboards, installing insulation between the joists, and carefully replacing the floorboards. This measure is considered to have some heritage impact because of the risk of damage to the floorboards, and because installing insulation between joists would increase the risk of condensation, and therefore damage to the building fabric. Because this measure only has a modest sustainability / thermal comfort benefit (5% reduction in annual space heating demand), it has not been included in the proposals.

Internal wall insulation - not proposed
Internal wall insulation would consist of 20mm lime plaster, 60mm wood fibre insulation and a 15mm dry lining board (e.g. Fermacell) applied to the inside face of the external walls. This measure would significantly improve thermal performance, but there is a potential for greater heritage harm if not detailed very carefully. The internal wall insulation would affect the appearance of internal features such as ceiling cornices, dado rails and fireplaces; internal wall insulation would increase the risk of condensation within the wall; some internal finishes (plaster) might need to be removed; and several core samples of the stone facade would need to be taken in order to complete the technical design. This measure is therefore not proposed.

Loft insulation - proposed
Some loft insulation is already present, but the amount could be increased and the insulation repaired where it is patchy or damaged. This would result in only very modest energy savings, but is still worth doing as the heritage impacts are small and the insulation would generally be very simple to install. This measure has been included within the proposed scope.

Insulation to sloped areas of roof - not proposed
In order to install insulation to the sloped areas of roof, the internal finishes would need to be removed so that insulation could be installed between rafters. This measure has a potential for greater heritage harm, as some of the ceilings that would need to be removed are likely to be historic lath and plaster. The sustainability benefits would be minimal, because only a thin layer of insulation could be installed within the available space. This measure is therefore not included within the proposed scope.



Graph showing the sustainability benefit of different fabric efficiency measures.

Glass replacement - only proposed for modern windows
The first option considered for windows was to replace the glass with thin double glazing where possible. This would only be technically possible where the windows have timber frames that could be routed out to accept the thicker glass – windows with leadwork, metal frames or stone tracery could not accept double glazing and would have secondary glazing instead. This option was assessed as having a potential for greater heritage harm, because much of the existing glass is historic cylinder glass, and was therefore ruled out except where windows are known to be modern and the whole unit can be replaced.

Window option A - only proposed where other measures are not feasible
The first option modelled in PHPP was to simply refurbish and add draught-proofing to all windows. Unfortunately, this would only result in a very minimal improvement in energy performance. This approach will be taken only where secondary glazing is not possible.

Window option B – proposed
The second option modelled is to secondary glaze with a single glazed system. This offers a substantial sustainability benefit – a 21% reduction in space heating demand. Although this option has some visual impact, this can be minimised because single secondary glazing is available with very thin frames. No historic fabric would be lost, and the measure is reasonably reversible (secondary glazing could be removed in future). The external appearance of the building would not be significantly affected by secondary glazing. On this basis, the heritage impact is assessed as being less than substantial. This is the proposed option for most windows.

Window option C – not proposed
The third option for the windows was to use thin double secondary glazing. This would require a much more substantial frame than single secondary glazing, so would have significantly more visual impact. The improvement in thermal performance would be relatively modest in comparison, so single secondary glazing was selected instead. (Note – vacuum secondary glazing was also considered, but was ruled out due to the visual impact of the vacuum port, getter and the micro pillar supports.)

Glazed doors to entrance openings - proposed
Adding glazed doors to the open entrances of staircases would result in a substantial energy saving (13% reduction in space heating demand), because this would simplify the thermal envelope of the building so that the doors and walls from the staircases to the habitable rooms (which have very limited thermal performance and cannot easily be upgraded) are no longer part of the thermal line. This measure has some visual impact, but this is minimised by using glass doors, so that it is still possible to see the inside of the building from the outside and vice versa. This measure would not require removal of any significant amount of historic fabric and is reasonably reversible. The heritage impact is therefore assessed as being less than substantial. Improvements to internal doors were considered as an alternative, but have a comparatively slight energy benefit (4% improvement). This measure has been included within the proposed scheme on the basis that the heritage impact is outweighed by the sustainability benefits.

Typical Old Quad staircase showing full set of fabric thermal improvement measures considered

Development of the selected fabric improvement measures
The following pages describe how the chosen fabric improvement measures have been developed in detail.

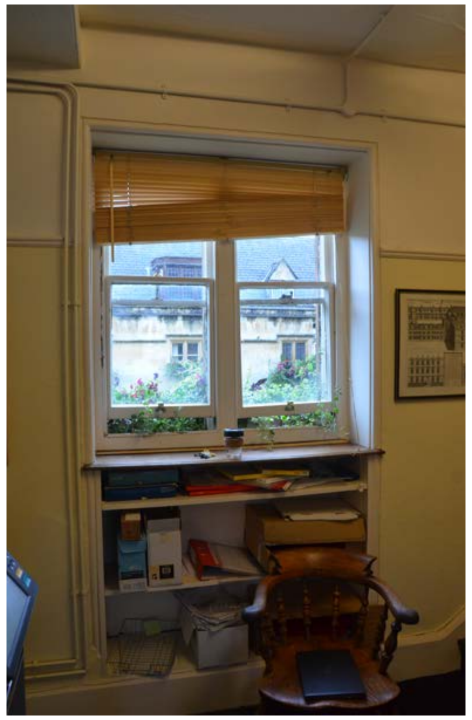
Secondary glazing – classification of windows into types
Old Quad has been through a number of renovations since it was originally built in the 17th century. Notably, the whole building was remodelled in 1830, and the dormer windows appear to have been replaced in the mid 20th century. As a result, there are numerous different window types throughout the building. All of the windows within Old Quad have been analysed and sorted into 17 different types. Each of the 17 types will require a different secondary glazing configuration. Some examples are shown on the following pages; for a full set of drawings, please refer to 2313-PD-3100 series.

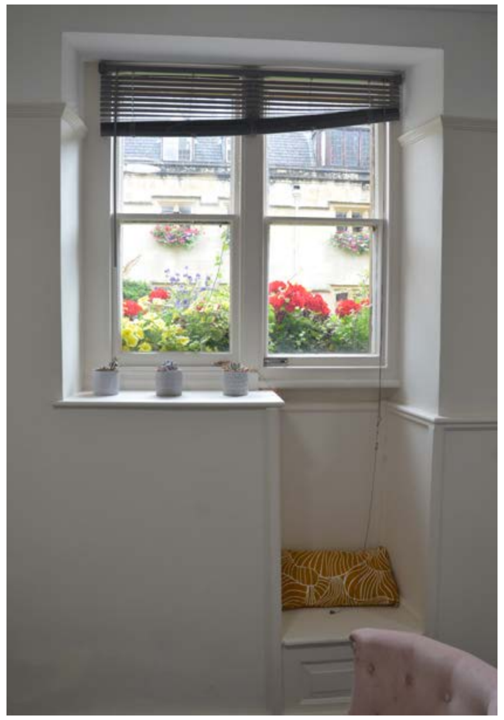
Different windows with the same general configuration may have different conditions at the jambs, head and sill. Please refer to drawing number 2313-PD-3150.

Window shades
Many windows have blinds or curtains, which will need to be removed in order to install the secondary glazing. It is proposed to completely replace the window shades in all rooms, using curtains throughout. As the existing shades are modern, this does not require listed building consent.


Leaded window


Window with cylinder glass (note the 'wobbly' effect)




Examples of windows with the same general configuration but different sill conditions. Also note the window shades, which will clash with secondary glazing positions

Secondary glazing – windows with high significance panelling and shutters in the reveals

A limited number of rooms have historic timber panelling within the window surrounds – in some case with working timber shutters. These windows are not considered to be suitable for secondary glazing as the visual impact on the timber reveals is too high. Some increase in performance can be achieved by adding draught strips to the openable windows.

Where timber panelling is present to the head of the window only, secondary glazing is proposed on the basis that this panelling is already obscured by curtain rails in the current condition.


Window in the Mackesy Room (8.23)


Window in the Mackesy Room – shutter open


Window in the Mary Hyde Eccles room (8.22)


Window in the Mary Hyde Eccles room (8.22)

Secondary glazing – bay windows
Old Quad contains a small number of stone and timber bay windows and corner windows. These are not suitable for secondary glazing, for a variety of reasons:

- They have high heritage significance
- The geometry is too complex to add glazing in an aesthetically pleasing way
- They have very thin stone mullions at the corners, where it would not be possible to install sufficiently slender secondary glazing profiles
- They have inward-opening windows that would not be useable if secondary glazing were installed
- They have decorative elements that would be obscured by secondary glazing.

Some bay windows unsuitable for secondary glazing are modern. In these instances, it is proposed that the windows be replaced with matching windows with slimline double glazing. This includes the large timber dormers facing into Old Quad, as described in chapter 2.0.


Unsuitable bay window in Mackesy Room (8.23)


Unsuitable bay window in Broadgates Hall (BR.1)


Unsuitable bay window in Bursar's office (T.08)


Unsuitable bay window in room 4.6

Secondary glazing – examples

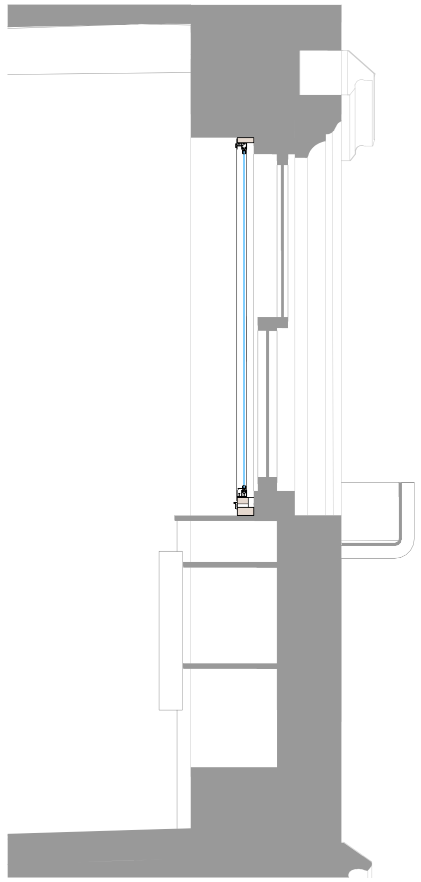
The following pages show a selection of different proposed types of secondary glazing. The examples selected are intended to give an indication of the range of different approaches required to suit the different conditions throughout Old Quad. For a complete set of drawings covering all of the different types, please refer to 2313-PD-3100 series drawings (Secondary Glazing Types).

Type TS-2: horizontal slider to existing two-part sash window

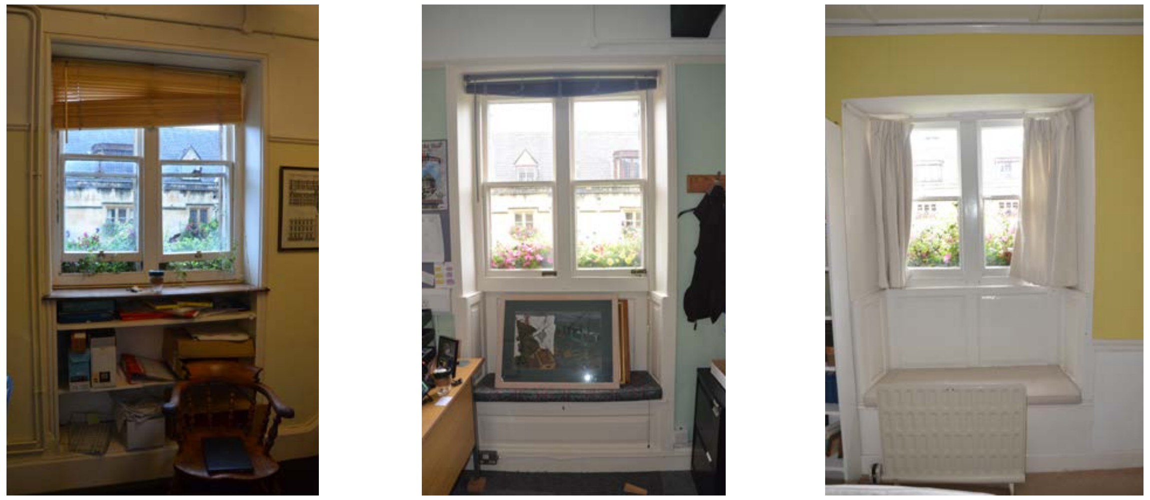
There are a number of two- and three-part sash windows throughout Old Quad. In order to minimise visual impact, it is proposed to use a horizontal sliding secondary glazing system to these windows.

Example of Selectaglaze horizontal sliding system applied to multi-part sash window

Type TS-2: Elevation



Type TS-2: Section

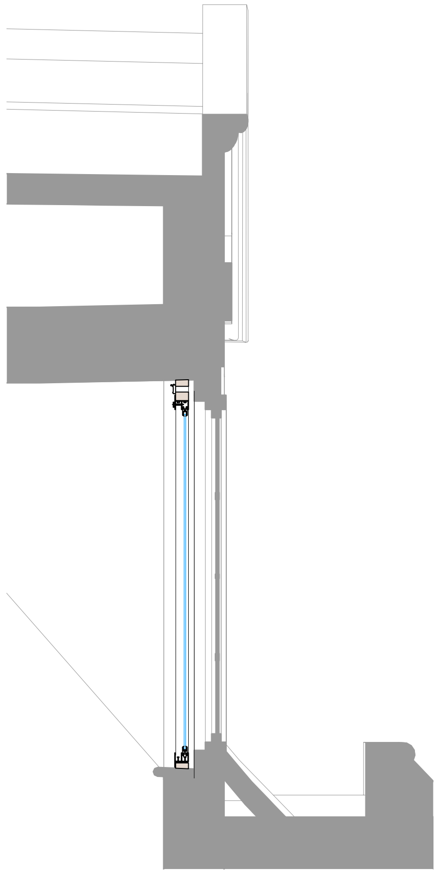


Examples of window Type TS-2

Type MC-1: metal casement window
Type MC-1 windows are modern metal casements with leaded panes. They are not suitable for glass replacement, because it is not possible to create a true leaded light with faceted reflections using double glazing. Secondary glazing is therefore proposed.

The proposed configuration is a two-part horizontal slider. This will allow full access to the openable part of the casement window behind.

Type MC-1: Internal elevation



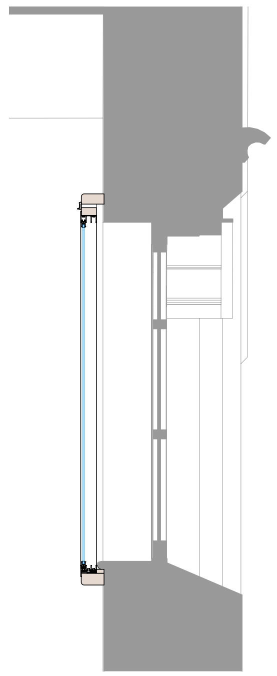
Type MC-1: Section

Example of window type MC-1

Type TH-16: three-part horizontal slider over triple casement window

Throughout Old Quad, particularly in Staircase 8, there are a number of inward-opening casement windows. There will be challenges involved in adding secondary glazing to these without making the windows inoperable. TH-16 is an example with three inward-opening casement windows next to one another. It is proposed to use a three-part sliding secondary glazing system. To allow the existing windows to be fully opened if necessary for maintenance, the secondary glazing sits on the innermost side of the reveal.

Type TH-16: Elevation



Type TH-16: Section

Example of Type TH-16

Window replacement

There are various windows that are challenging to add secondary glazing to (due to geometry, inward opening lights or lack of space around the window), and which are modern in construction. Some of these have modern designs that are insensitive to the historic building, others are in poor condition.

It is proposed to replace these windows with new timber windows with slimline double glazing. This will improve fabric performance. It will also improve the robustness of the building envelope, reducing the risk of damage to historic fabric. Finally, where the windows being replaced are modern in design, replacement with heritage-style windows could be considered to be a heritage gain. Because the windows being replaced are modern, loss of historic fabric is not a relevant concern.

All of the windows that are proposed to be replaced are on the second floor. Three are behind the parapet, facing east. The rest are at roof level, facing south onto Brewer Street. Because the windows are at high level, the visual impact of slightly deeper glazing bars and subtle double reflections will be minimal. As all of the elevations at 2FL facing Brewer Street are to be replaced, the effect will be consistent.

Modern timber corner window

Modern metal window with insensitive modern design

South elevation of Old Quad, facing Brewer Street; windows to be replaced are highlighted in green

Modern bay window, in poor condition

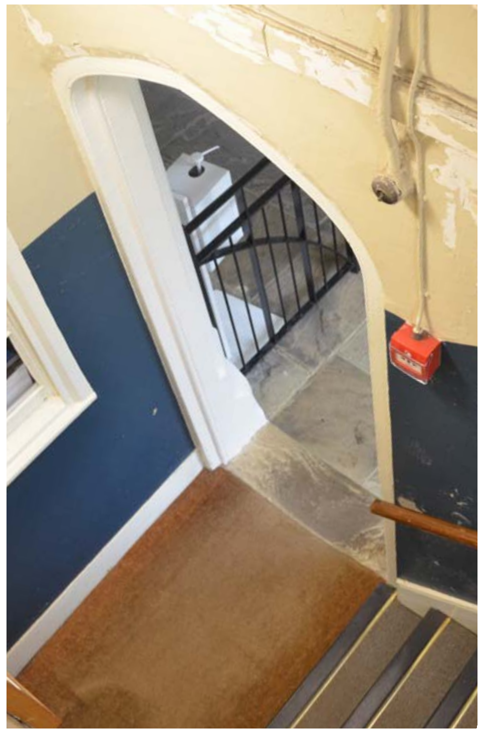
Adding doors to open entrances of staircases

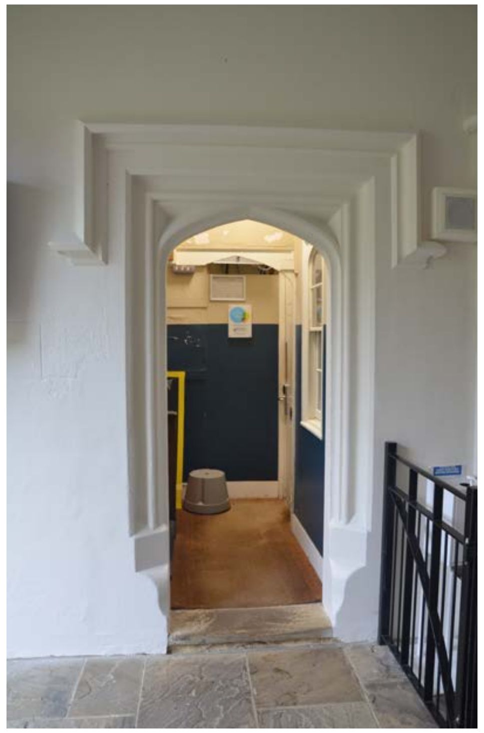
The Tower Staircase, Staircase 1 and Staircases 3-7 all lack external doors: there is simply an opening at the base of each staircase. This means there is no clear thermal line between inside and outside. It is proposed to add doors wherever possible. To preserve a sense of openness and to create a clear contrast between modern and historic fabric, frameless glass doors are suggested. More information on the design of these doors is given on the following pages.

There is already an oak door to Staircase 2, but this is a modern addition. It is proposed that this door be removed, and replaced with frameless glass. This will improve consistency around the quad.

Due to the position of steps and flights of stairs, there is no practical location for installing frameless glass doors at the bottom of Staircases 1, 6 or 7. It is proposed that these staircases remain open.

Please refer to Pages 46-8 and to the separate Energy Statement for more information on why adding doors at the bases of staircases is important from an energy-saving perspective.

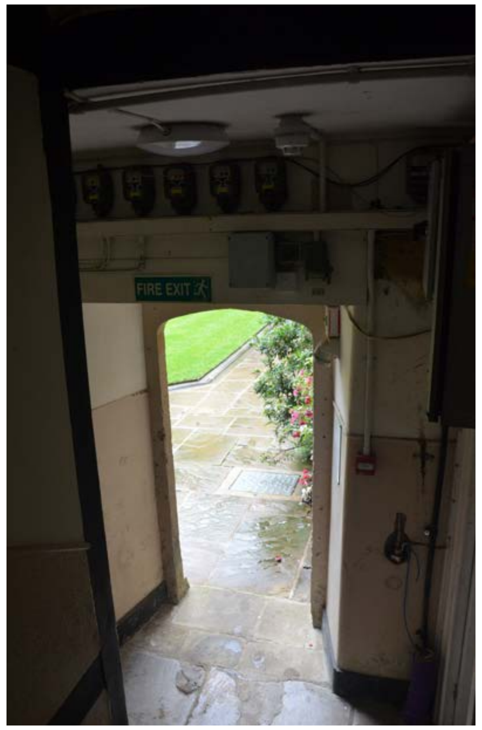


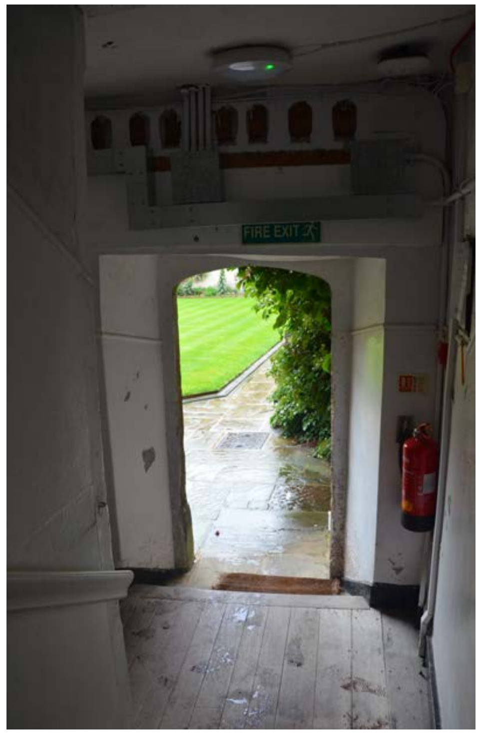


Tower Staircase

Staircase 1

Staircase 2





Staircase 3

Staircase 4

Staircase 5

Staircase 6

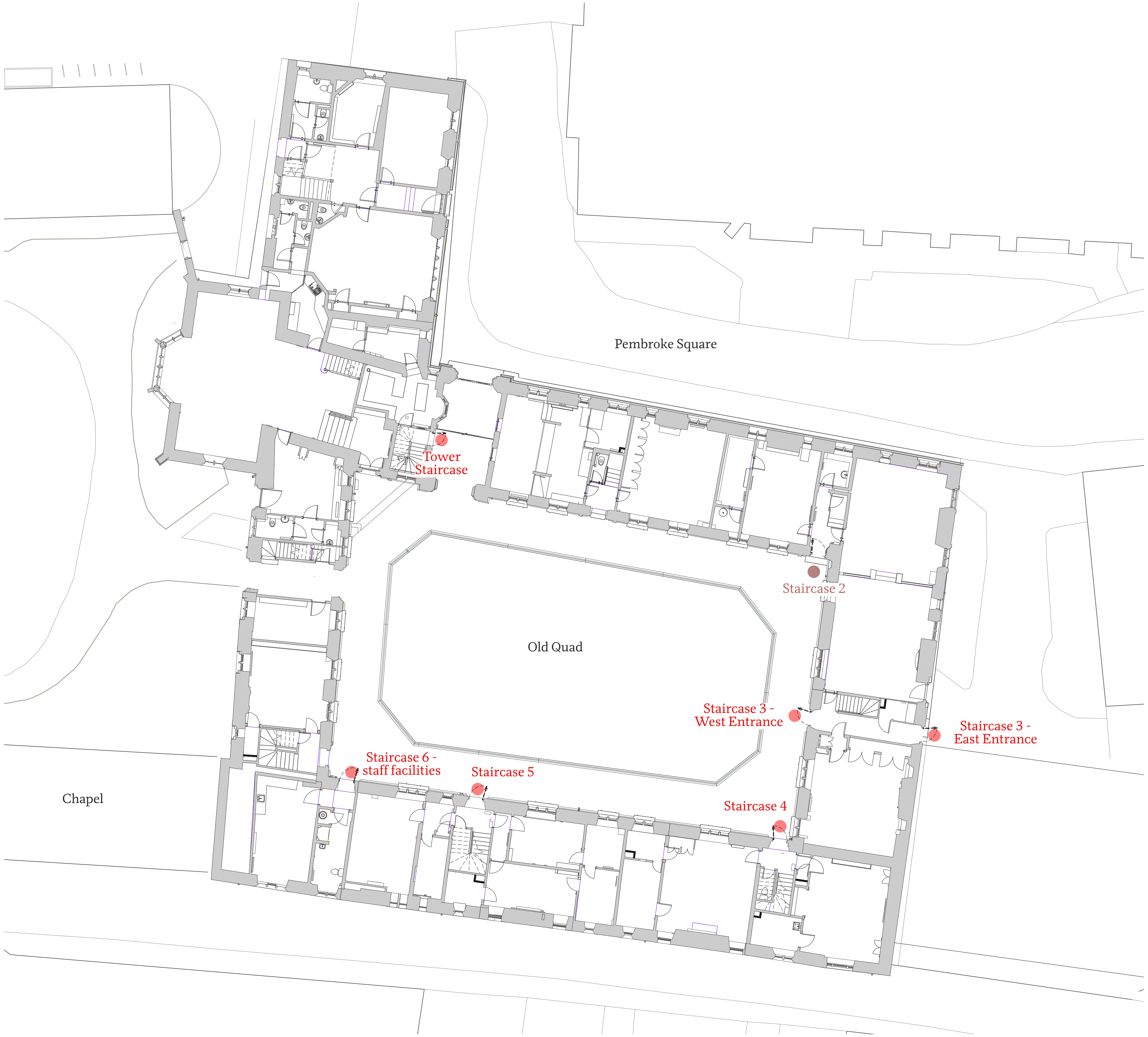
Staircase 7

Locations of doors to open entrances of staircases

The plan to the right shows the proposed locations for new frameless glass automatic doors. The doors in Staircase 3 enclose a passage that is currently open on both sides, so the addition of doors would have a particularly beneficial effect in preventing unwanted wind-driven cross-ventilation with cold air through the building. There are historic pintles to both doors in Staircase 3, indicating that doors or gates were present in the past.

- New frameless glass door
- Frameless glass door to replace modern oak door

Pintles to Staircase 3 entrance opening



Ground floor plan showing proposed locations of new frameless glass doors

Design of doors to the base of staircases

Two design options were considered for installing new doors within the open entrances to staircases. The first option was to install a timber door, possibly with glazed panels; the second was to install a frameless glass door. There are precedents for both options within the Pembroke College site and in other historic buildings in Oxford and Cambridge. Frameless glass doors are proposed, for the reasons stated below.

Distinction between historic and modern fabric

Frameless glass is clearly recognisable as a modern technology, so a clear distinction would be created between modern and historic fabric.

Consistency

Frameless glass doors are already provided to the Porters' Lodge within Old Quad. A proposal to add frameless glass doors to the entrance of the dining hall in Chapel Quad has received listed building consent. This sets a precedent for a clear and consistent language of modern interventions, which will be continued in the Old Quad proposals.

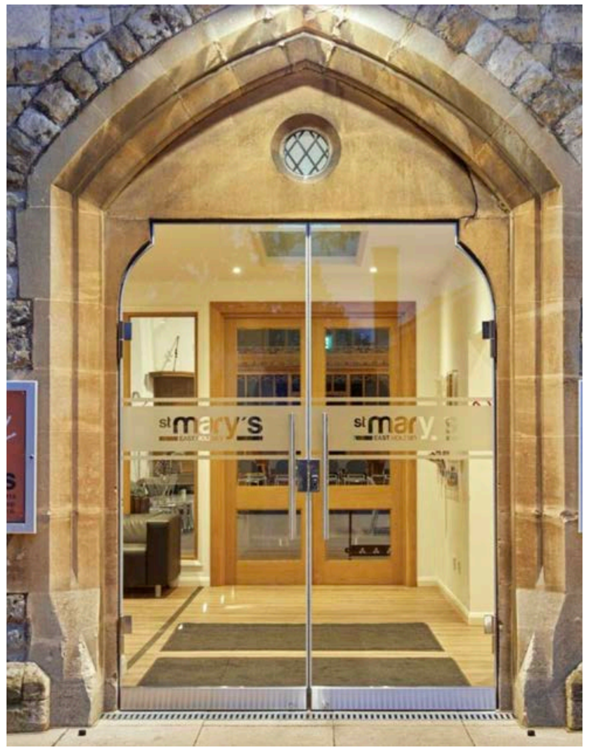
Preserving an appearance of openness

A frameless glass door preserves almost complete transparency between inside and outside, so the appearance is as close as possible to an opening with no door. By contrast, a glazed timber door would have a significant proportion of frame to glass, creating more of a visual separation between inside and outside and making the entrance lobbies to staircases darker.

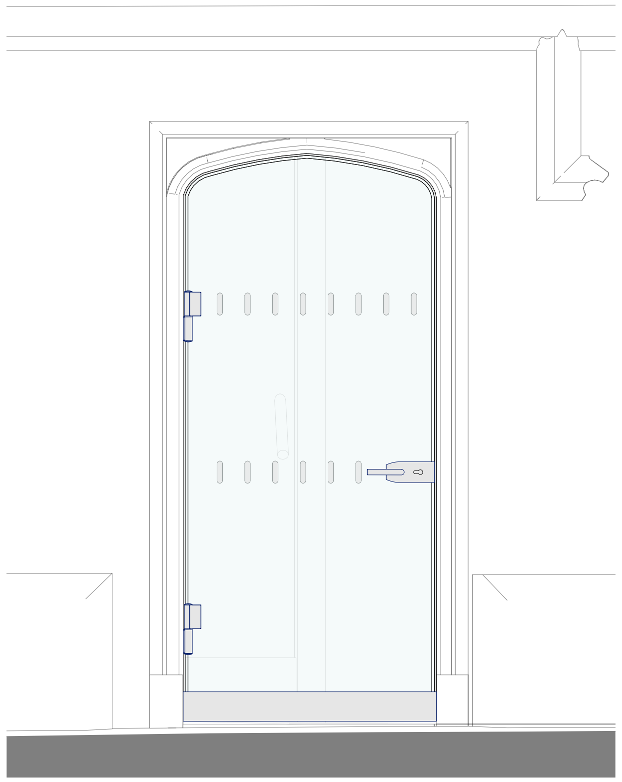
The design of the frameless glass doors has been developed based on details by Ion Glass and is as unobtrusive as possible, with minimal hinges and handle and a simple manifestation. In order to ensure that the doors can be installed consistently in all proposed locations without any negative impact on accessibility, the doors are all outward opening. This means that they need to be installed close to the exterior side of the opening to prevent a clash between the glass door and the frame when opened.

All of the proposed doors will be manually operated (not automatic). This allows the design to be kept as simple as possible, with no need for sensors, safety barriers, push buttons or concealed motors. This minimises the visual impact of the doors as well as the interventions required to the surrounding fabric.

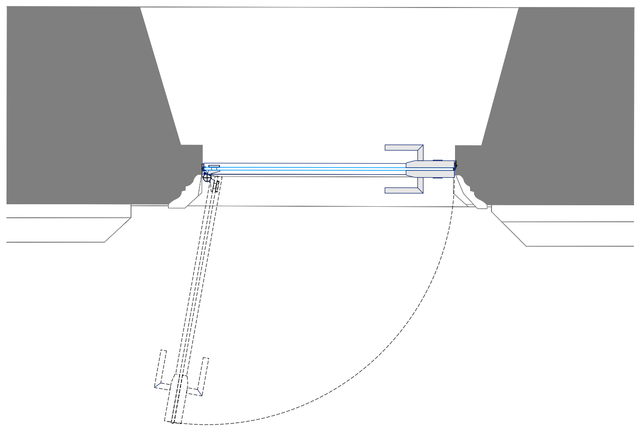
Modern timber door within a historic opening
Magdalene College, Cambridge



Examples of Ion Glass frameless glass doors within historic openings
St Mary's Church, Molesey



Proposed frameless glass door – elevation



Proposed frameless glass door – plan

Adding loft insulation

Most of Old Quad already has loft insulation, but it is relatively thin (spot checks suggest that this is generally 100mm) and is damaged in some locations. It is proposed to increase the thickness to 300mm and make good any damaged areas and weak spots.

The current insulation is glass fibre; the additional insulation will be mineral wool. Other options, including natural materials were considered, but mineral wool emerged as the best option because of its robustness and performance. In particular:

- Mineral wool is non-combustible (Euroclass A1)
- Mineral wool is not susceptible to attack by fungi, rot or pests
- Mineral wool has a relatively low thermal conductivity (lambda value).

These properties are not achievable with natural materials.

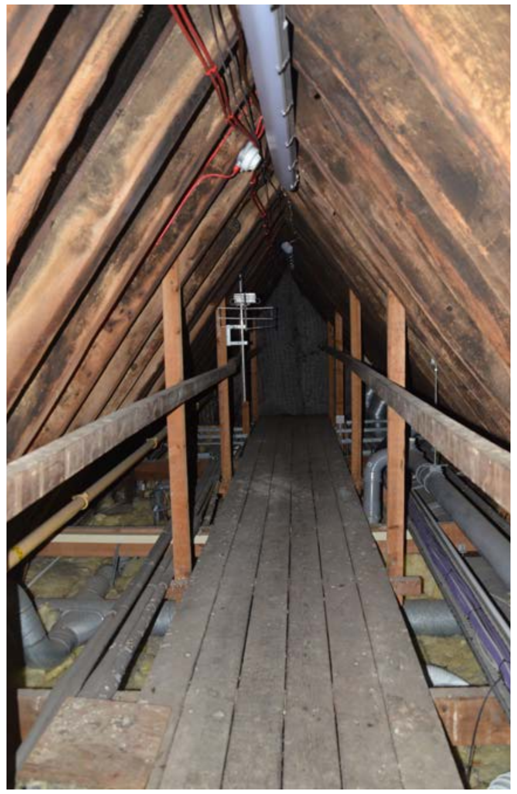
Roof vents will be added in line with British Standards (BS 5250) to prevent the risk of moisture buildup within the cold roof loft space. At present, the loft void does not appear to have any ventilation, which means that there is a condensation risk. The proposed roof vents therefore serve to improve the longevity of the fabric in the existing condition, as well as allowing the insulation depth to be increased.

Where possible, the roof vents are concealed behind features such as dormer windows or placed on areas of the roof which are not visible from ground level. The locations of all proposed roof vents can be seen on the roof plan and elevations included with this application.

Example of installation of small lead roof vent (for services penetrations)

Larger roof vent for ventilation of the loft void. Installation will be as the small roof vent shown to the left.

Loft of Staircase 8



Loft of Staircase 2

Loft of Staircase 4

Loft of lower roof area in Tower Staircase (above T.07)