Energy & Sustainability Statement

March 2024

Inhabit

Document Control

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London Office
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Revision History

Rev	Date	Document Status/Details	Document Author	Reviewed by	Approved by
00	15/03/2024	Issued for Comment	Lewis Kam	James Warne	James Warne
01	20/03/2024	Revision as per comments	Lewis Kam	James Warne	James Warne
02	22/03/2024	Final Issue	Lewis Kam	James Warne	James Warne

Index of Contents

Executive Summary

Grandpont House, Abingdon Road, Oxford is an educational and residential centre which dates back to 1759. It is a grade II* listed building and is situated in the Oxford Central (City and University) Conservation Area.

The proposed works at the site of Grandpont House involves the refurbishment of the Grade II* listed Grandpont House, including the rear wing, alterations to the stable and coach house, and the erection of a new boathouse on the grounds.

The proposals will also involve the removal of some ancillary buildings, and it is also proposed that the grounds of the site are landscaped.

The existing house is in poor condition in terms of environmental performance and living standards.

The alterations are considered to be necessary for updating the property to suit its current use, and as such, will ensure its continued maintenance and a sustained conservation.

Oxford City Council Heritage and Energy Efficiency Tool (HEET) has been consulted for guidance, as well as current Building Regulations.

Whilst it is anticipated that the development will be exempt from Building Regulations due to it's historic status, the client is committed to adapting the latest Building Regulations Part L requirements, for all existing, proposed new and upgraded thermal elements, where possible.

The new build elements will target U values significantly better than that of latest Part L requirements, including double glazed windows, secondary glazing, whilst the upgraded elements will strive to meet the Part L standards for upgraded elements, where possible.

Every care will be taken to conserve the historical nature and integrity of the façade, both internally and externally. The client is confident that the proposed alterations can largely be implemented without having a significant impact on the character of the listed building, in line with the English Heritage guidelines.

Natural ventilation via openable windows, doors, rooflights, is the preferred means of ventilation throughout the existing building.

A mixed mode strategy incorporating Mechanical ventilation with Heat recovery is proposed for the new bedrooms within the proposed area of additional extension. This allows for improved air quality within the living spaces.

Space heating and Domestic Hot Water is to be provided by highly efficient air source heat pumps, which are to be located in the service yard near to the refuse store. Air source Heat pumps will significantly reduce direct greenhouse gas emissions by eliminating the use of gas boilers.

Monocrystalline PV panels are proposed for the hidden valley roof areas of the main house. The position has been considered for little to no impact on the aesthetics. The product has less shading and lower resistive loss, and it is estimated that a maximum of 2450 kWh will be generated annually by the roof area.

The SUDS concept for the site will be carefully considered utilising the existing pond within the extensive gardens and permeable paving, where relevant, to provide significant betterment post-construction for the lifetime of the development.

Rainwater harvesting via water butts and planters is also proposed to help with rainwater attenuation, which in turn can be used for irrigation.

All materials will be selected with environmental impact considered alongside functionality, aesthetics and durability. The procurement of materials will be sourced in a responsible way and have a low embodied impact over their life.

The existing building structure and envelope will be largely re-used, with some considerate rearrangement of internal spaces for the insertion of modern facilities, such as ensuite bathrooms, foyer, and a boathouse.

Our proposals are intended to significantly improve the environmental performance of the site; providing a better functioning, more comfortable and energy efficient space for the occupant, and at the same time maximising sustainable resources, whilst minimising pollution and waste.

Planning Guidance

Planning Guidance

National Planning Policy Framework

The National Planning Policy Framework sets out the Government's planning policies for England and details how these are expected to be applied. It sets out a structure for delivering sustainable development with particular relevance for energy and carbon issues.

Building Regulations

Approved document L: Conservation of fuel and power

Part L 2021 (with 2023 amendments) are the most current Building Regulations in relation to Conservation of Power and Fuel. The 2021 revision to Part L of the Building Regulations was a key milestone towards the government's target for new and existing buildings to be zero-carbon by 2050.

The immediate objective of the interim Part L changes are higher performance targets for carbon emission are reduced by 31% for dwellings and 27% for other buildings.

There are exemptions for listed buildings, buildings in conservation areas and scheduled monuments. Paragraph 0.12 of Volume 2 states:

"Work to the following types of buildings does not need to comply fully with the energy efficiency requirements where to do so would unacceptably alter the building's character or appearance.

a. Those listed in accordance with section 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990.

For Historic & Listed Buildings, it also states:

"The energy efficiency of historic and traditional dwellings should be improved only if doing so will not cause long-term deterioration of the building's fabric or fittings."

'New extensions to historic and traditional dwellings should comply fully with the energy efficiency standards in this approved document unless there is a need to match the external appearance or character of the extension to that of the host building."

Approved Document Requirement O1: Overheating mitigation

This is relevant to new buildings only; therefore, it is not expected to be a requirement.

However, the Simplified Method guidelines for limiting solar gain and removing excess heat, will be adhered to for the new build accommodation within the extension.

Approved Document F: Ventilation Volume 2: Buildings other than dwellings

<u>Exemptions for listed buildings, buildings in conservation areas</u>

Work to the following types of buildings may not need to comply fully with the ventilation standards in this approved document.

a. Those listed in accordance with section 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990

Work to a listed building mentioned above should comply with the ventilation standards in this approved document where reasonably practicable. The work should not result in either of the following outcomes.

a. Unacceptably affect the significance of the listed building, conservation area or scheduled monument.

b. Increase the risk of long-term deterioration of the building fabric or fittings.

New extensions to historic and traditional buildings should comply with all ventilation standards in this approved document unless there is a need to match the external appearance or character of the extension to that of the host building.

The local authority's conservation officer should be consulted when undertaking work to a listed building.

Planning Guidance

Energy Improvement

Oxford City Council - Local Plan 2036

Section 4.6 – Retrofitting in existing buildings

- Oxford has a wealth of Listed Buildings and traditional buildings in conservation areas. These buildings present a considerable challenge when considering how on-site renewables can be incorporated and carbon emissions reduced. The Council supports all measures to retrofit listed and historical buildings in a sensitive manner and has produced the Heritage Energy Efficiency Tool (HEET). This guidance helps assess energy efficiency improvements for historic buildings.

Heritage Energy Efficiency Tool (HEET)

- The Oxford Heritage and Energy Efficiency Tool helps assess energy efficiency improvements for historic buildings.

Oxford City Council – Local Plan 2040 (Draft)

Draft Policy R1: Net Zero Buildings in Operation

- Proposals for conversions, extensions and change of use (where they include works to the fabric of the building to facilitate this) that would require planning permission are only expected to demonstrate accordance with criteria 1 and 4, unless they would result in the creation of a self-contained dwelling or non-residential unit, in which case all criteria apply.

- Criteria 1: Developments have been designed in accordance with the energy hierarchy. Applications should demonstrate how design has methodically followed the steps in the hierarchy, firstly through reducing energy use; using energy efficiently; and then, meeting all energy needs through renewables sources, ideally generated onsite, or else offsetting as a last resort.

- Criteria 4: No fossil fuels are being directly utilised in the operation of the development (e.g. no gas used for heating and cooking).

Draft Policy R3: Retro-fitting existing buildings

- The Council will support retrofit measures to existing buildings where they secure energy efficiency improvements or adaptation to changing climate. The expectation is that the interventions are selected in accordance with the steps of the energy hierarchy (reduce energy use, use energy efficiently, source energy renewably) as set out in Policy R1.

- A whole building approach will be taken to the retrofitting of the building, including heritage assets, whereby applications will demonstrate how the principles a) to d) have been embedded in the design rationale

Water Efficiency

Policy RE1 – Sustainable Design and Construction

Policy RE1 includes bespoke standards regarding water efficiency in new residential and non-residential developments. This principle seeks to encourage applicants of all development sizes (not just the qualifying developments set out in Policy RE1) to conserve water as well as maximising water efficiency. Thus, rainwater harvesting via watt butts and planters is proposed to help with rainwater attenuation, which in turn can be used for irrigation.

There is a linkage between Policy RE4: Sustainable and foul drainage and surface water flow.

Water efficiency – residential development:

The development belongs to non-dwelling Residential (other). Section 4.7 of Policy RE1 states:

"An optional water efficiency standard was introduced in 2015 following the Housing Standards Review. This higher option standard for new development of 110 litres per person per day as set out in Building Regulations Part G2 can be applied where there is an evidence based need that the area is water stressed . The area of South East England in which Thames Water operates and Oxford is located, has been classified by the Environment Agency as being under serious water stress. Thus to ensure adequate water supply during the plan period new development will be expected to meet higher water efficiency standards as set out in Policy RE1."

Planning Guidance

Although this project is not a new development, its location has been classified by the Environment Agency as being under serious water stress. Thus, this water efficiency target will be applicable.

Draft Policy G8 Sustainable Drainage Systems

All development proposals will be required where feasible to manage surface water through Sustainable Drainage Systems (SuDS).

Draft Policy G9: Resilient Design and Construction

- Risk of overheating, flooding (from all relevant sources), and storm extremes have been considered for the lifetime of the proposed development and that design has been tailored to function effectively within future climate scenarios.
- All non-residential development should demonstrate what measures have been incorporated to reduce water use.
- In addition to the above, other measures to conserve water use including rain/grey water harvesting/reuse where appropriate.

Carbon Reduction

The City Council is committed to a 100% reduction in total carbon dioxide (CO_2) emissions produced in the City by 2050 from 1990 levels to limit climate change.

The City Council will require all schemes to consider sustainable development principles from the start of the design process and include these in their Design and Access Statement and/or Sustainability Statement or potentially the energy statement.

Policy RE1 – Sustainable Design and Construction

Since this project is not a new development, section 4.6 – Retrofitting in existing buildings is followed instead of the method stated in **TAN 14: Sustainable Design and Construction** which is applicable for new development.

Section 4.6 mentioned about making use of the Heritage Energy Efficiency Tool (HEET). Step 5 - Generating Low Carbon Energy listed the considerations of the choice of clean energy generating technologies available to protect the historic building's character.

The considerations of the carbon reduction measurements for this project to be demonstrated at the Appendix - LZCT Options Appraisal.

Draft Policy R2: Embodied Carbon in the Construction Process

All developments are expected to demonstrate consideration of embodied carbon in the construction process and take actions to limit this as much as possible through careful design choices. Planning permission will be granted for proposals that demonstrate through their Energy and Carbon Statement. Principles a) to e) are applicable for this project, whilst principles F) and g) are for large scale new-build development.

Overheating mitigation

Draft Policy G9: Resilient Design and Construction

- Risk of overheating, flooding (from all relevant sources), and storm extremes have been considered for the lifetime of the proposed development and that design has been tailored to function effectively within future climate scenarios.
- A cooling strategy to address risks of overheating which is proportionate to the scale of the building and promotes passive cooling, energy efficient measures in the first instance (in line with requirements of Policy R1). This should consider both internal and external environments.

Climate Change Mitigation

With an already evident changing climate, designers and developers need to be clever on how to get the most out of buildings with the least energy input and waste output.

Moving towards more sustainable energy sources within a framework of upgraded, existing building stock, designed for flexibility and robustness of design is the current trend.

Minimise Carbon Emissions

As a Grade II* listed building, it is anticipated that the development will be exempt from the standard Part L requirements. This will be confirmed with the Building Control Officer at the next stage of design.

Maintaining the conservation and historic importance of the building is at the forefront of our proposals. Whilst a fabric first approach is considered the first step in minimising carbon emissions, we must be mindful of the historic nature of the building and are therefore restricted with the extent of renewing and/or upgrading thermal building elements.

That said, the client is committed to adapting the latest Building Regulations Part L requirements, for all existing, proposed new and upgraded elements, where possible.

The new build elements, particularly within the proposed area of additional extension, will target U values significantly better than that of latest Part L requirements, including addition internal insulation for walls and double-glazed windows.

The existing east and west timber stud wall façade on the Main House, will have insulation added between studs, while the masonry walls will have insulation added internally. Secondary glazing will be added to all existing windows.

Natural ventilation via openable windows, doors, rooflights, is the preferred means of ventilation throughout the existing building.

The existing chimney stacks will be utilised for fresh air supply and extract; with the addition of fans to help draw the air as required.

A mixed mode strategy incorporating Mechanical ventilation with Heat recovery is proposed for the new bedrooms within the proposed area of additional extension. This allows for improved air quality and user control.

The positioning of air intakes and outlets will be carefully considered to conserve the historical importance of facades, as well as maintaining best practise design in relation to air quality.

Space heating is to be provided by highly efficient air source heat pumps. New radiators are proposed for the existing buildings, while underfloor heating is proposed for the new build element.

Air source heat pumps generate low grade heat, therefore are an excellent solution when combined with underfloor heating. Underfloor heating also removes the need for radiators, thus maximising the wall/floor space.

The air source heat pump units will be located in the service yard, close to the refuse store. Both will be sympathetically house within a louvered timber enclosure.

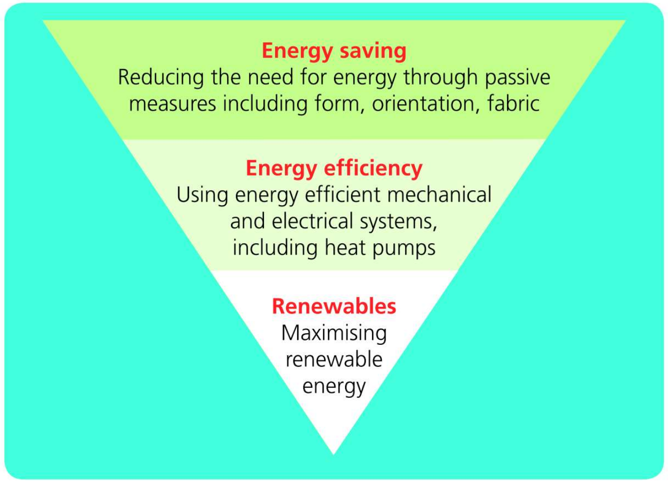
Domestic Hot Water is also to be provided by an Air Source Heat Pump, combined with heat exchanger and thermal store located within the allocated plant space.

Monocrystalline PV panels are proposed for the hidden valley roof areas of the main house. The position has been considered for little to no impact on the aesthetics. The product has less shading and lower resistive loss, and it is estimated that a maximum of 2450 kWh annually will be generated by the roof area.

Climate Change Mitigation

Energy Hierarchy

By considering Policy R1: Net Zero Buildings in Operation Criteria 1, firstly through reducing energy use; using energy efficiently; and then, meeting all energy needs through renewables sources, ideally generated onsite, or else offsetting as a last resort.



Energy Saving

Secondary glazing is proposed for all those existing windows, whilst double glazed windows will be fitted in the new build element, helping to reduce heat loss and minimise energy consumption in relation to heating.

Energy Efficiency

Energy efficiency is simply using less electricity to produce the same level of performance, comfort and convenience.

A low energy lighting strategy is proposed throughout, using light emitting diode (LED) technology and advanced controls to help reduce energy consumption.

The proposed Mechanical ventilation with heat recovery system will help reduce energy consumption associated with heating. The heat recovery system captures the heat that is usually lost when air is exhausted and preheats the incoming air.

Electric Vehicle charging points are proposed, encouraging occupants to move away from traditional diesel/petrol vehicles and ultimately reducing energy consumption and associated carbon emissions.

The use of Renewable and Low & Zero Carbon Technologies, such as Photovoltaics and Heat Pumps will help towards minimising CO_2 emissions from the development.

Air Source Heat Pumps (ASHP) absorb heat from the surrounding air and 'upgrade' it to useful heat to supply to the space. Ground source heat pumps – in a similar fashion – absorb heat from the ground and use it to heat radiators and/or underfloor heating.

Heat Pump technology does consume electrical energy, but the useful energy output is several times the input.

An operating CoP of circa 2.5 is typical for an Air Source Heat Pump, whilst a CoP of circa 3.5/4 might be achievable for a Ground Source Heat Pump.

Climate Change Adaption

Whilst there is considerable area surrounding the buildings and it is already the intention to integrate landscaping on site, it is felt that ground source heat pumps (horizontal array) would be considerably more expensive than air source heat pumps. For that reason, air source heat pumps are the preferred strategy for space heating and hot water.

Renewables

Monocrystalline PV panels are proposed for the hidden valley roof areas of the main house for generating renewables onsite. We acknowledge the importance of conserving the historic nature and importance of the building but aim to maximise the potential to generate electricity on site via renewable technologies.

The butterfly roof on the main building was considered for Photovoltaic panels but is deemed not ideal due to the reduced efficiency of an East-West facing roof, implications of shading, not to mentioned the roof mounting considerations.

Monocrystalline PV panels have less shading and lower resistive loss, and it is estimated that a maximum of 2450 kWh annually will be generated by the roof area. The photovoltaic study is proposed at the appendix of “PV Layout Proposal”.

Predicting Carbon Emissions

Whilst it is assumed at this early stage that Part L modelling is not required due to the historic/listed buildings being exempted. The project intend to achieve better performance than the Part L requirement, including energy performance of the heating equipment and the U-value of the building envelope. Carbon savings and overall improved energy performance of the building will be undertaken when equipment and materials are selected.

Flood Risk Management

The Environment Agency (EA) Flood Risk map for planning for the area shows that the site is located within a Flood Zone 3 (High risk). Land within Flood Zone 3 is classed in the NPPF as an area that has a 1% or greater chance of flooding from rivers in a year or a 0.5% or greater chance of flooding from the sea in a year.

A drainage specialist will be consulted at the next stage of design and appropriate flood defences incorporated into the proposals to mitigate possible flooding.

The existing pond within the extensive gardens will be restored and used as a flood retention pond – careful consideration given to levels, to attenuate surface run-off during rainfall events.

Plant space will be carefully considered – the existing basement level boiler room will not be used for the proposed new kit.

Sustainable Urban Drainage Systems

The SUDS concept for the site will be carefully considered utilising the existing pond within the extensive gardens and permeable paving where relevant to provide significant betterment post-construction for the lifetime of the development.

Climate Change Adaption

Landscaping and Biodiversity

Landscaping will be introduced into the extensive gardens on the site, including hard and soft landscape components, wet woodland and new boathouse lawns.

The landscaping will be developed in keeping with the historic character of the surroundings, intending to repair and strengthen the existing patterns and fabric, and at the same time enhancing the ecology on site. Refer to the landscape design statement for details.

Water Use and Supplies

To achieve a low environmental impact, water systems will be designed, used and managed efficiently, saving water and reducing associated energy and CO2 emissions.

Water saving devices, like low-flow showers and toilets will be used throughout, helping conserve water, as well as reducing energy consumption associated with generation of domestic hot water.

Rainwater harvesting with water butts and/or planters are to be encouraged to help with roof water attenuation and re-use for irrigation, further aiding with run-off from the development.

Air Quality

The proposed Air Source Heat Pumps will significantly reduce direct greenhouse gas emissions by eliminating the need for gas boilers.

Minimum of eight secure cycle parking spots will be conveniently provided towards the far Eastern end of the driveway. Electric vehicle charging points are proposed to encourage sustainable transport options and help reduce contributions to poor air quality.

Overheating and Passive Cooling

Exposed thermal mass will be maintained where possible, acting as a heat sink in summer months. The waterway features already existing will too be maintained and serve as an excellent source of natural coolth on warm summer days. Passive cooling measurements such as increased free area of the windows and cross-ventilation. To have better control of the indoor environment and security, motorized windows that can have sensors either temperature sensors or CO2 level sensors with timer closing the windows at night/ when unoccupied can also be utilised.

Internal heat generation will be minimized through the use of LED lighting with daylight linking and presence detection will be extensive.

Active cooling is not proposed, especially for any of the existing building, as it is anticipated that the addition of Fan Coil Units and associated distribution works might prove too intrusive. However, the proposed air source heat pumps do have the ability to provide highly efficient cooling and it may be seen as a measure of future proofing for extreme summertime temperatures.

Materials & Waste

Materials

Key to the selection of materials, is keeping the historical character of the building and maintaining that 'Natural beauty' of the local area.

All materials will be selected with environmental impact considered alongside functionality, aesthetics and durability. The procurement of materials will be sourced in a responsible way and have a low embodied impact over their life.

All Timber used on site will be FSC certified, and a proof of compliance will be sought before purchase.

Reuse of Materials & Structure

The key to mitigating the effects of climate change is to appropriately reuse and/or rehabilitate existing building stock (80 per cent of which will be still standing in 2050).

The existing building structure and envelope will be largely re-used, with some considerate rearrangement of internal spaces for the insertion of modern facilities, such as ensuite bathrooms and the linking of the rear wing to a covered walkway.

The changes to the listed building will see some minor loss of historic fabric and alterations to some of the historic internal arrangements but these are mainly proposed for areas where it is considered that features of considerable significance will not be affected.

Site Waste Management

A pre-demolition audit of the existing buildings, structures and hard surfaces within the scope of the refurbishment zone will be undertaken.

The results of the audit should be used to guide the design, consideration of materials that can be reused, and to set targets for waste management and ensure the contractor to be appointed is engaged in the process of maximising high grade reuse and recycling opportunities.

The client is committed to appointing a contractor who will be responsible for managing the site in an environmentally and socially considerate, responsible and accountable manner.

A Site Waste Management Plan will be produced and implemented by the appointed contractor. It will monitor the waste generated on site and set targets on resource efficiency, detail how the waste will be measured and monitored, name a person responsible for implementing the plan and show how the plan will be implemented.

Due to the nature of this development, which will include demolition and new build, the targets set in the plan will relate to each stage of construction.

Demolition waste and subsequent construction waste will either be reused or recycled on site or sorted on site and collected for recycling. Any hazardous waste will be segregated to avoid cross contamination prior to the implementation of any remediation practices.

Conservation & Local Character

Grandpont House and the adjacent wall are listed buildings, Grade II* and II respectively. The service buildings along the north boundary (with stables and coach house) are slightly later in date, and fall within the curtilage of the listed building. The site is situated in the Oxford Central (City and University) Conservation Area.

The client fully understands the importance of maintaining the historic nature of the building and is committed to adapting responsible and conservative strategies only.

Our proposals are to create a more environmental site, with functioning buildings which will meet the needs of the area. Maximising sustainable resources, whilst minimising pollution and waste has been at the forefront of our strategy.

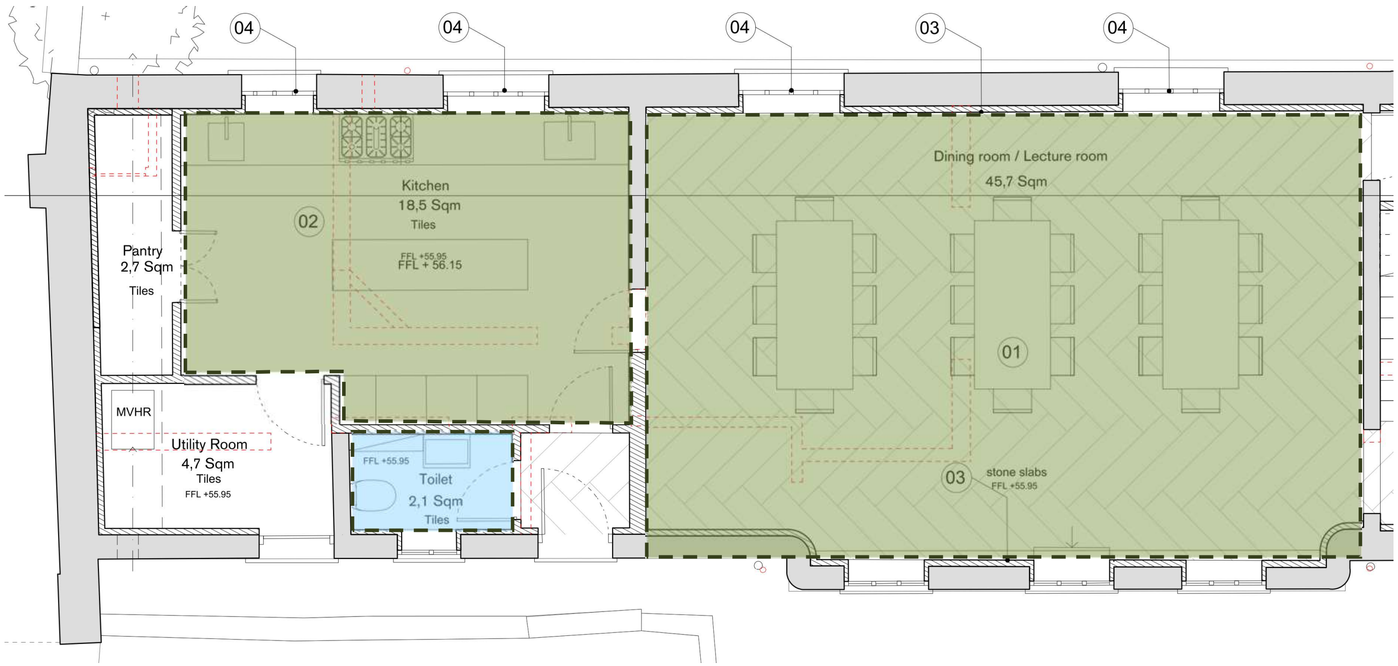
The heritage assessment undertaken by specialists, concluded that the proposed alterations can largely be implemented without having a significant impact on the character of the listed building, while the design of alterations to be reversible, together with re-use of significant elements such as Georgian doors, will ensure that there is no unnecessary loss of historic fabric.

Appendices

Temperature Control Strategy

Temperature Control Strategy – Ground Floor Service Wing 1

(green)	Room temperature maintained by LTHW underfloor heating independently controlled. No maximum temperature control.
(blue)	Room temperature maintained by electric underfloor heating independently controlled. No maximum temperature control.
(orange)	Room temperature maintained by panel radiators with independent control via TRVs. No maximum temperature control.



INTERNAL AIR TEMPERATURES:

Note the table below represents the CIBSE Recommended Design Comfort Criteria and the requirements set in the CIBSE Guide A : Environmental Design. The internal space air temperatures should reflect these figures and the seasonal weather and occupants use in the differing spaces.

*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

Room Description	Winter Temperature	Summer Temperature*
Kitchen	17-19ºC	21-25°C
Toilet	19-21°C	21-25°C
Dining Room / Lecture room	19-21°C	21-25°C

Note for kitchen:

1. Assume that the kitchen is treated as residential kitchen usage rather than commercial.

Notes for Dining room/ Lecture room:

1. Confirmation is needed for the feasibility if the stabs are suitable for underfloor heating.
2. Even underfloor heating is feasible, it may change to panel radiator subject to the usage.

Temperature Control Strategy – Ground Floor Service Wing 2

Room temperature maintained by LTHW underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by electric underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by panel radiators with independent control via TRVs. No maximum temperature control.

Notes for Seminar room, Circulation and Foyer:

1. Confirmation is needed for the feasibility if the stabs are suitable for underfloor heating.
2. Even underfloor heating is feasible, it may change to panel radiator subject to the usage

INTERNAL AIR TEMPERATURES:

Note the table below represents the CIBSE Recommended Design Comfort Criteria and the requirements set in the CIBSE Guide A : Environmental Design. The internal space air temperatures should reflect these figures and the seasonal weather and occupants use in the differing spaces.

*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

Room Description	Winter Temperature	Summer Temperature*
Toilet	19-21°C	21-25°C
Bathrooms	20-22°C	23-25°C
Bedrooms	17-19°C	23-25°C
Seminar room	19-21°C	21-25°C
Foyer	13-20°C	21-25°C
Hall/stairs/landings	19-24°C	21-25°C

Temperature Control Strategy – Ground Floor Main House 1

Room temperature maintained by LTHW underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by electric underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by panel radiators with independent control via TRVs. No maximum temperature control.

INTERNAL AIR TEMPERATURES:

Note the table below represents the CIBSE Recommended Design Comfort Criteria and the requirements set in the CIBSE Guide A : Environmental Design. The internal space air temperatures should reflect these figures and the seasonal weather and occupants use in the differing spaces.

*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

Room Description	Winter Temperature	Summer Temperature*
Chapel area	19-21°C	22-25°C
Office Area	21-23°C	22-25°C
Corridors	19-21°C	21-25°C

Notes for Chapel:

1. Confirmation is needed for the feasibility if the stabs are suitable for underfloor heating.
2. Even underfloor heating is feasible, it may change to panel radiator subject to the usage

Temperature Control Strategy – Ground Floor Main House 2

Room temperature maintained by LTHW underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by electric underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by panel radiators with independent control via TRVs. No maximum temperature control.

INTERNAL AIR TEMPERATURES:

Note the table below represents the CIBSE Recommended Design Comfort Criteria and the requirements set in the CIBSE Guide A : Environmental Design. The internal space air temperatures should reflect these figures and the seasonal weather and occupants use in the differing spaces.

*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

Room Description	Winter Temperature	Summer Temperature*
Bathrooms	20-22°C	23-25°C
Bedrooms	17-19°C	23-25°C
Visitor Room	20-22°C	22-25°C
Hall/stairs/landings	19-24°C	21-25°C

Temperature Control Strategy – Ground Floor Main House 3

- Room temperature maintained by LTHW underfloor heating independently controlled. No maximum temperature control.
- Room temperature maintained by electric underfloor heating independently controlled. No maximum temperature control.
- Room temperature maintained by panel radiators with independent control via TRVs. No maximum temperature control.

INTERNAL AIR TEMPERATURES:

Note the table below represents the CIBSE Recommended Design Comfort Criteria and the requirements set in the CIBSE Guide A : Environmental Design. The internal space air temperatures should reflect these figures and the seasonal weather and occupants use in the differing spaces.

*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

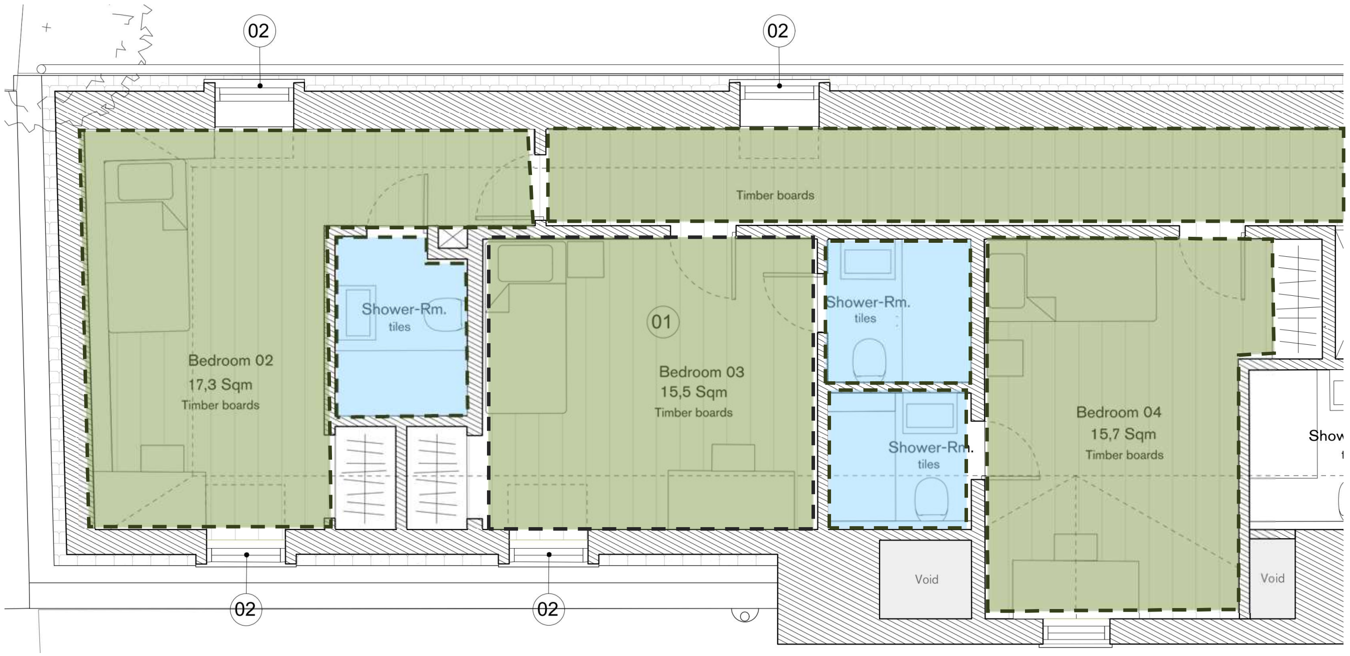
Room Description	Winter Temperature	Summer Temperature*
Lounge	20-22°C	22-25°C
Hall/stairs/landings	19-24°C	21-25°C

Temperature Control Strategy – 1st Floor Service Wing 1

Room temperature maintained by LTHW underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by electric underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by panel radiators with independent control via TRVs. No maximum temperature control.



INTERNAL AIR TEMPERATURES:

Note the table below represents the CIBSE Recommended Design Comfort Criteria and the requirements set in the CIBSE Guide A : Environmental Design. The internal space air temperatures should reflect these figures and the seasonal weather and occupants use in the differing spaces.

*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

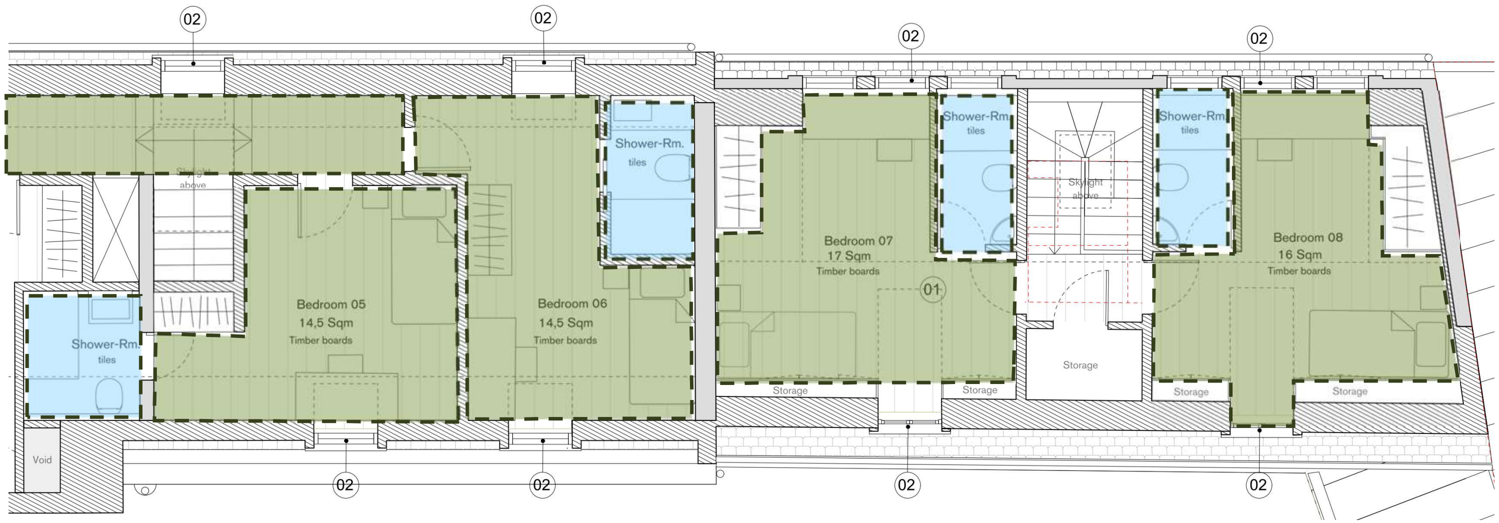
Room Description	Winter Temperature	Summer Temperature*
Bathrooms	20-22°C	23-25°C
Bedrooms	17-19°C	23-25°C
Hall/stairs/landings	19-24°C	21-25°C

Temperature Control Strategy – 1st Floor Service Wing 2

Room temperature maintained by LTHW underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by electric underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by panel radiators with independent control via TRVs. No maximum temperature control.



INTERNAL AIR TEMPERATURES:

Note the table below represents the CIBSE Recommended Design Comfort Criteria and the requirements set in the CIBSE Guide A : Environmental Design. The internal space air temperatures should reflect these figures and the seasonal weather and occupants use in the differing spaces.

*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

Room Description	Winter Temperature	Summer Temperature*
Bathrooms	20-22°C	23-25°C
Bedrooms	17-19°C	23-25°C
Hall/stairs/landings	19-24°C	21-25°C

Temperature Control Strategy – M Floor Main House

Room temperature maintained by LTHW underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by electric radiator independently controlled. No maximum temperature control.

Room temperature maintained by panel radiators with independent control via TRVs. No maximum temperature control.

INTERNAL AIR TEMPERATURES:

Note the table below represents the CIBSE Recommended Design Comfort Criteria and the requirements set in the CIBSE Guide A : Environmental Design. The internal space air temperatures should reflect these figures and the seasonal weather and occupants use in the differing spaces.

*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

Room Description	Winter Temperature	Summer Temperature*
Bathrooms	20-22°C	23-25°C
Bedrooms	17-19°C	23-25°C
Hall/stairs/landings	19-24°C	21-25°C

Temperature Control Strategy – 1st Floor Main House 1

Room temperature maintained by LTHW underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by electric radiator independently controlled. No maximum temperature control.

Room temperature maintained by panel radiators with independent control via TRVs. No maximum temperature control.

INTERNAL AIR TEMPERATURES:

Note the table below represents the CIBSE Recommended Design Comfort Criteria and the requirements set in the CIBSE Guide A : Environmental Design. The internal space air temperatures should reflect these figures and the seasonal weather and occupants use in the differing spaces.

*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

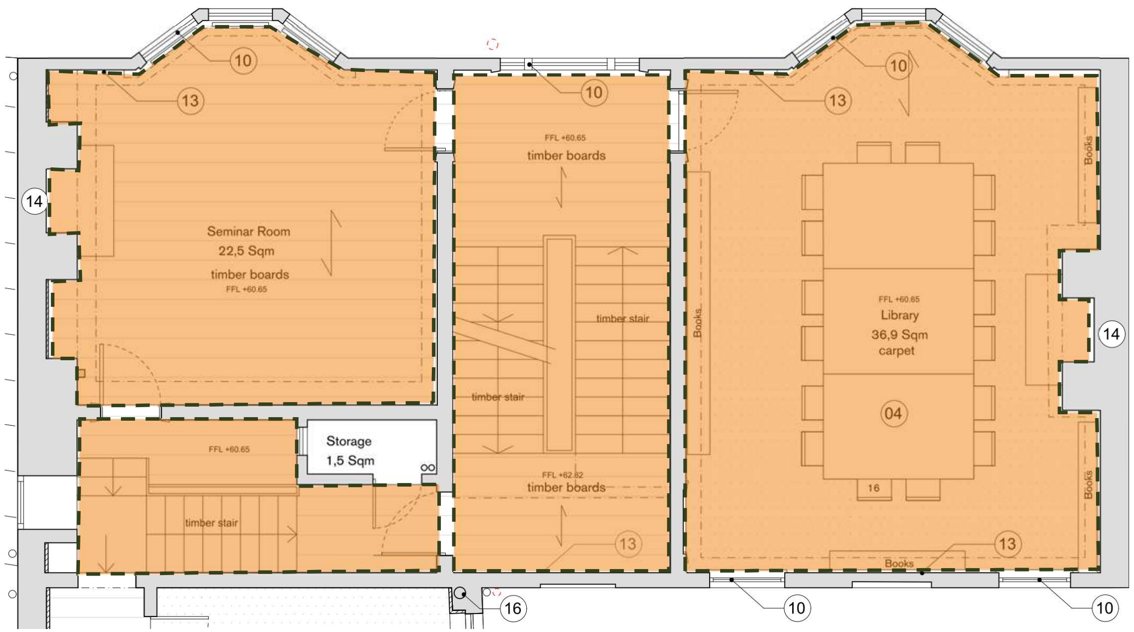
Room Description	Winter Temperature	Summer Temperature*
Bathrooms	20-22°C	23-25°C
Bedrooms	17-19°C	23-25°C
Hall/stairs/landings	19-24°C	21-25°C

Temperature Control Strategy – 1st Floor Main House 2

Room temperature maintained by LTHW underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by electric radiator independently controlled. No maximum temperature control.

Room temperature maintained by panel radiators with independent control via TRVs. No maximum temperature control.



INTERNAL AIR TEMPERATURES:

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*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

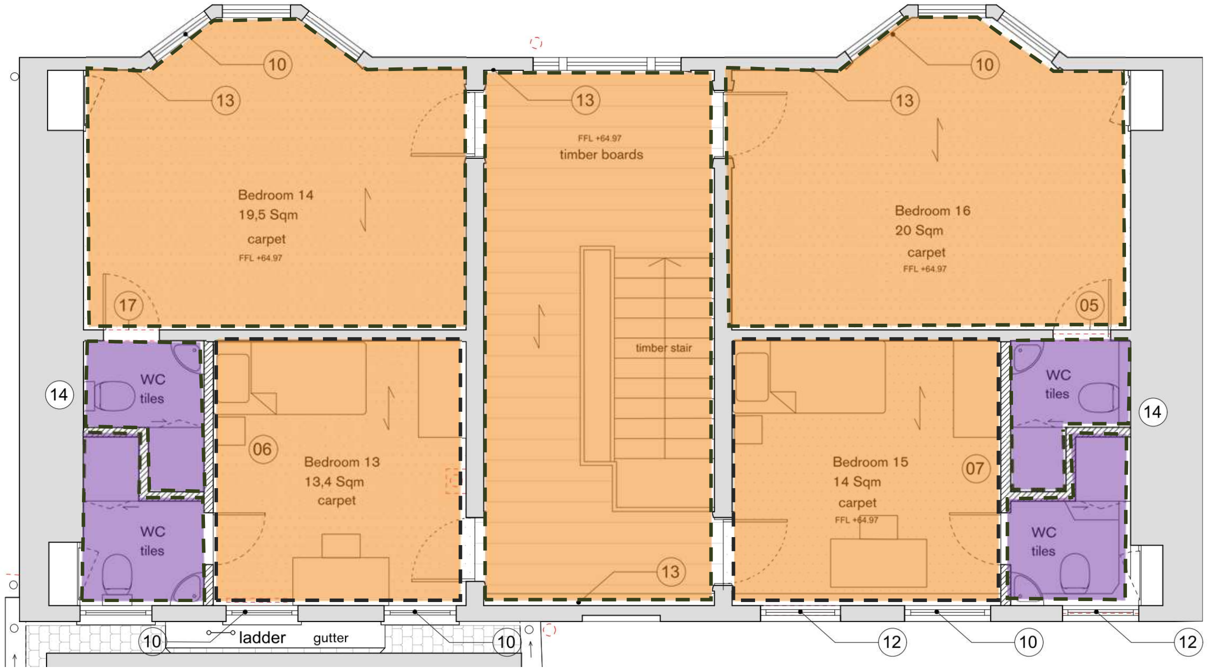
Room Description	Winter Temperature	Summer Temperature*
Seminar Room	19-21°C	21-25°C
Hall/stairs/landings	19-24°C	21-25°C
Library	22-23°C	24-25°C

Temperature Control Strategy – 2nd Floor Main House

Room temperature maintained by LTHW underfloor heating independently controlled. No maximum temperature control.

Room temperature maintained by electric radiator independently controlled. No maximum temperature control.

Room temperature maintained by panel radiators with independent control via TRVs. No maximum temperature control.



INTERNAL AIR TEMPERATURES:

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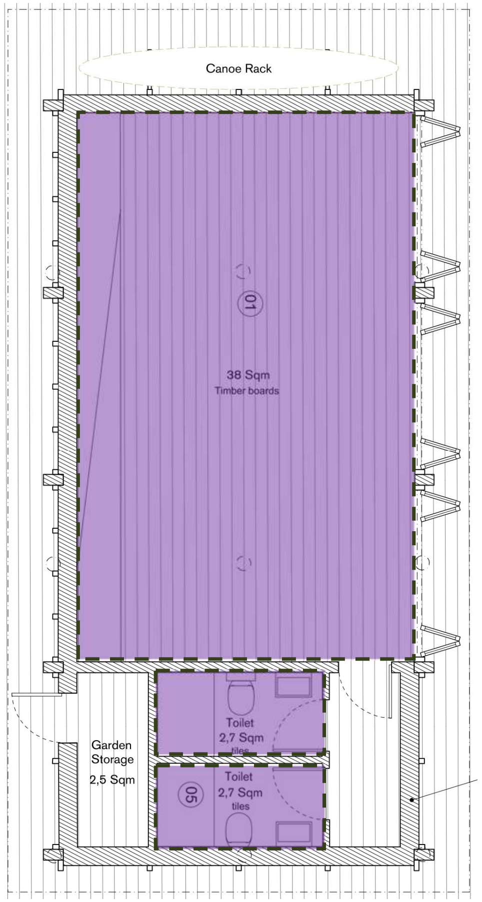
*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

Room Description	Winter Temperature	Summer Temperature*
Bathrooms	20-22°C	23-25°C
Bedrooms	17-19°C	23-25°C
Hall/stairs/landings	19-24°C	21-25°C

Temperature Control Strategy – Boathouse

Room temperature maintained by electric radiator independently controlled. No maximum temperature control.



INTERNAL AIR TEMPERATURES:

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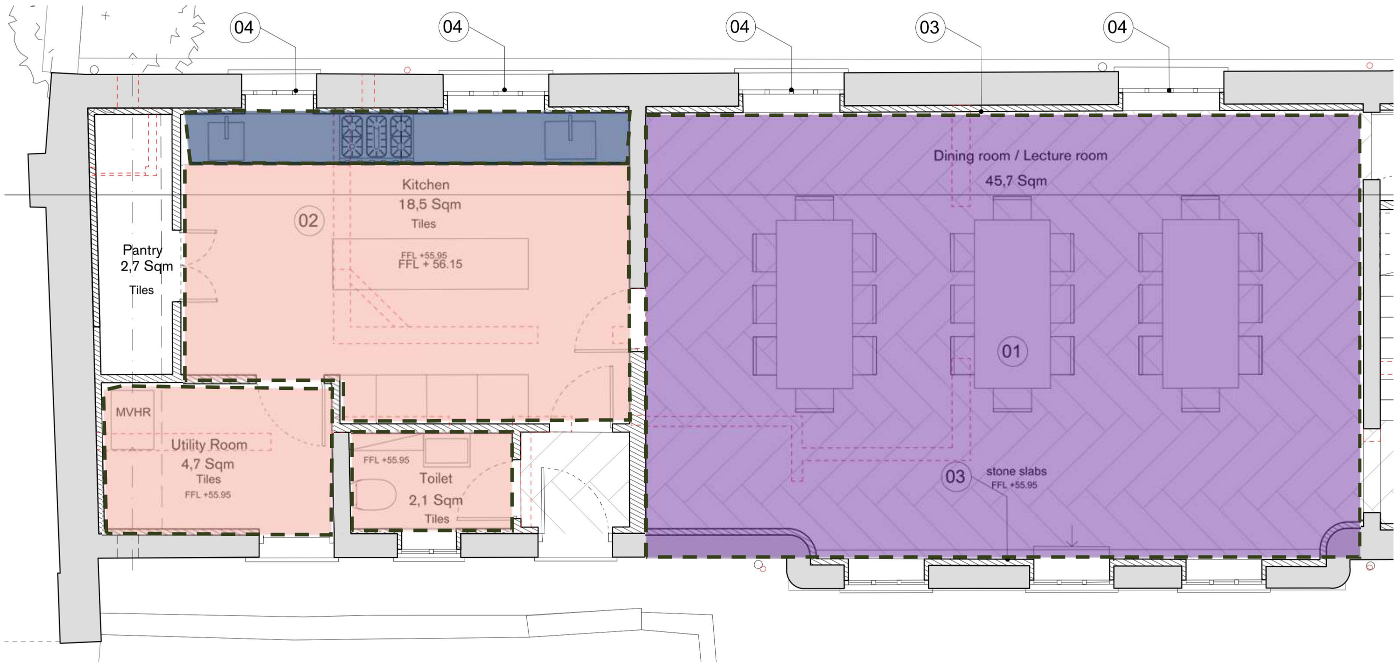
*The figures are based on controlled environment when active cooling is applied. For passive cooling, the indoor temperature is dependent on the outside temperature, and the risk of overheating may arise specially in highly dense rooms (depending on occupancy levels).

Room Description	Winter Temperature	Summer Temperature*
Toilet	19-21°C	21-25°C
Dining Room / Lecture room	19-21°C	21-25°C

Ventilation Strategy

Ventilation Strategy – Ground Floor Service Wing 1

- Mechanical Supply Ventilation via MVHR + natural ventilation from openable windows
- Mechanical Extract Ventilation to be returned to the MVHR unit
- Natural ventilation via infiltration and/or openable windows/doors/rooflights
- Ventilator adjacent to the hob/cooker extract directly outside through the façade



INTERNAL VENTILATION RATES:

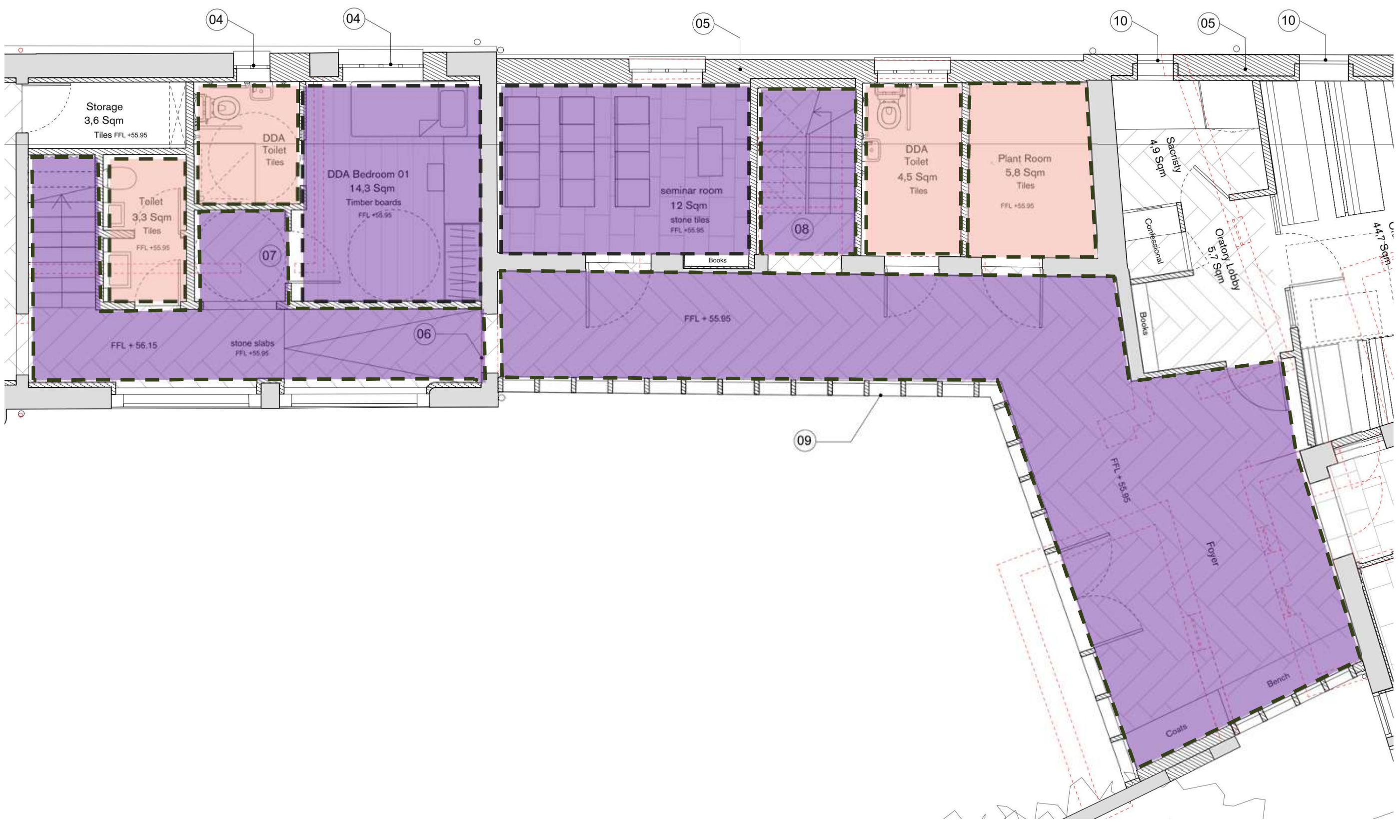
Based on the Building Regulations the various spaces require either a continuous ventilation rate, or a demand based ventilation rate intermittently. Part F : Minimum Ventilation Rates:

	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

Ventilation Strategy – Ground Floor Service Wing 2

Mechanical Supply Ventilation via MVHR + natural ventilation from openable windows

Mechanical Extract Ventilation to be returned to the MVHR unit



INTERNAL VENTILATION RATES:

Based on the Building Regulations the various spaces require either a continuous ventilation rate, or a demand based ventilation rate intermittently. Part F : Minimum Ventilation Rates:

	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

Ventilation Strategy – Ground Floor Main House 1

Mechanical Supply and Extract Ventilation via MVHR + natural ventilation from openable windows

Mechanical Supply Ventilation via MVHR + natural ventilation from openable windows

Ventilation from centralized extract fan + natural ventilation from openable windows/ doors

Natural ventilation via infiltration and/or openable windows/doors/rooflights

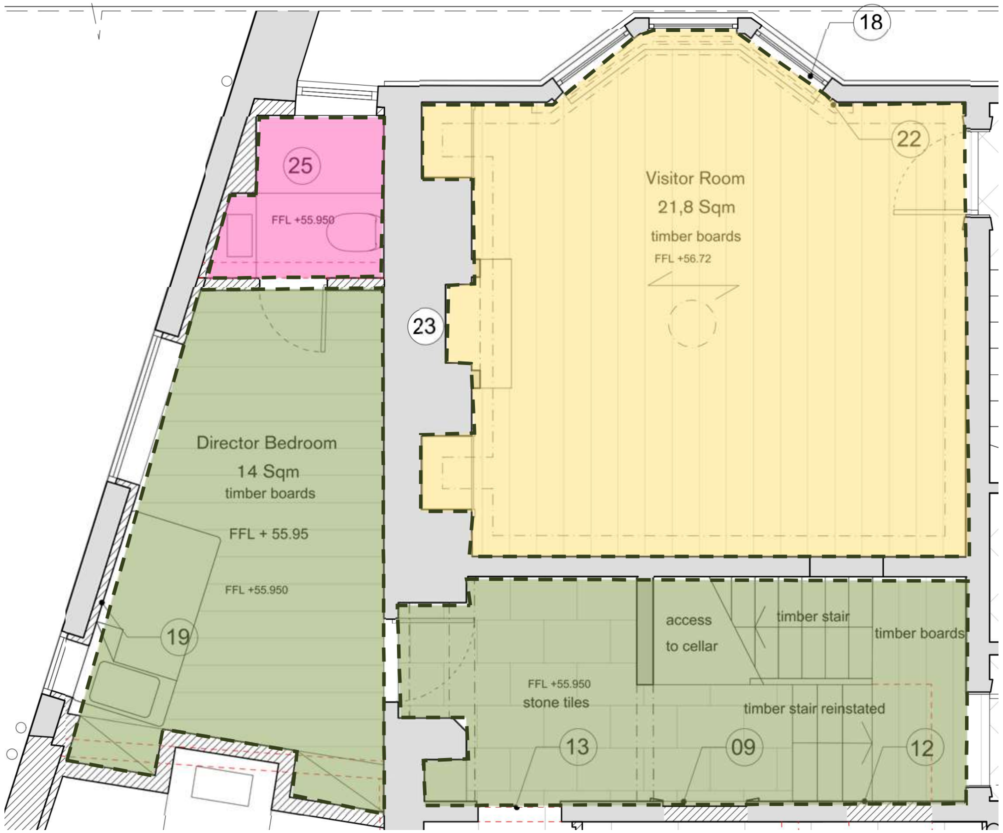
INTERNAL VENTILATION RATES:

Based on the Building Regulations the various spaces require either a continuous ventilation rate, or a demand based ventilation rate intermittently. Part F : Minimum Ventilation Rates:

	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

Ventilation Strategy – Ground Floor Main House 2

- Mechanical Supply Ventilation via MVHR + natural ventilation from openable windows
- Mechanical extract only, provided from decentralized intermittent fan
- Ventilation from centralized extract fan + natural ventilation from openable windows/ doors
- Natural ventilation via infiltration and/or openable windows/doors/rooflights



INTERNAL VENTILATION RATES:

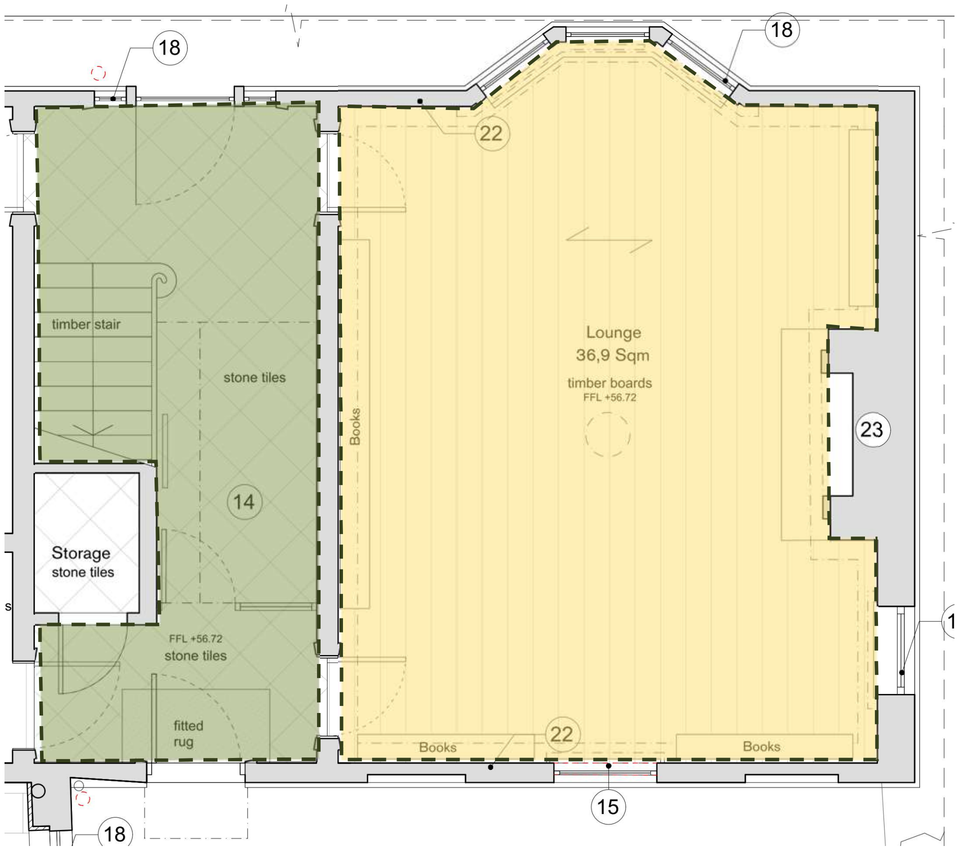
Based on the Building Regulations the various spaces require either a continuous ventilation rate, or a demand based ventilation rate intermittently. Part F : Minimum Ventilation Rates:

	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

Ventilation Strategy – Ground Floor Main House 3

Ventilation from centralized extract fan + natural ventilation from openable windows/ doors

Natural ventilation via infiltration and/or openable windows/doors/rooflights



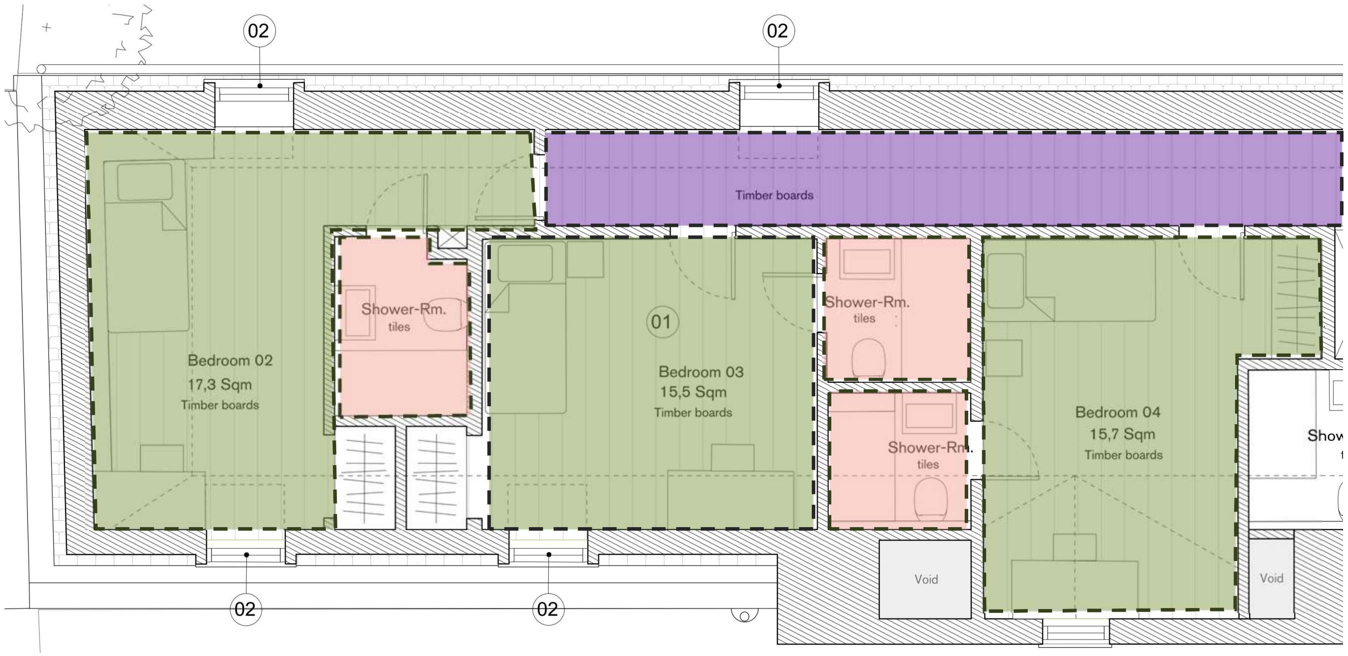
INTERNAL VENTILATION RATES:

Based on the Building Regulations the various spaces require either a continuous ventilation rate, or a demand based ventilation rate intermittently. Part F : Minimum Ventilation Rates:

	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

Ventilation Strategy – 1st Floor Service Wing 1

- Mechanical Supply Ventilation via MVHR + natural ventilation from openable windows
- Mechanical Extract Ventilation to be returned to the MVHR unit
- Natural ventilation via infiltration and/or openable windows/doors/rooflights



INTERNAL VENTILATION RATES:

Based on the Building Regulations the various spaces require either a continuous ventilation rate, or a demand based ventilation rate intermittently. Part F : Minimum Ventilation Rates:

	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

Ventilation Strategy – 1st Floor Service Wing 2

Mechanical Supply Ventilation via MVHR + natural ventilation from openable windows	(purple)
Mechanical Extract Ventilation to be returned to the MVHR unit	(pink)
Natural ventilation via infiltration and/or openable windows/doors/rooflights	(green)

INTERNAL VENTILATION RATES:

Based on the Building Regulations the various spaces require either a continuous ventilation rate, or a demand based ventilation rate intermittently. Part F : Minimum Ventilation Rates:

	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

Ventilation Strategy – M Floor Main House

Ventilation from centralized extract fan + natural ventilation from openable windows/ doors

Natural ventilation via infiltration and/or openable windows/doors/rooflights

INTERNAL VENTILATION RATES:

Based on the Building Regulations the various spaces require either a continuous ventilation rate, or a demand based ventilation rate intermittently. Part F : Minimum Ventilation Rates:

	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

Ventilation Strategy – 1st Floor Main House 1

Ventilation from centralized extract fan + natural ventilation from openable windows/ doors

Natural ventilation via infiltration and/or openable windows/doors/rooflights

INTERNAL VENTILATION RATES:

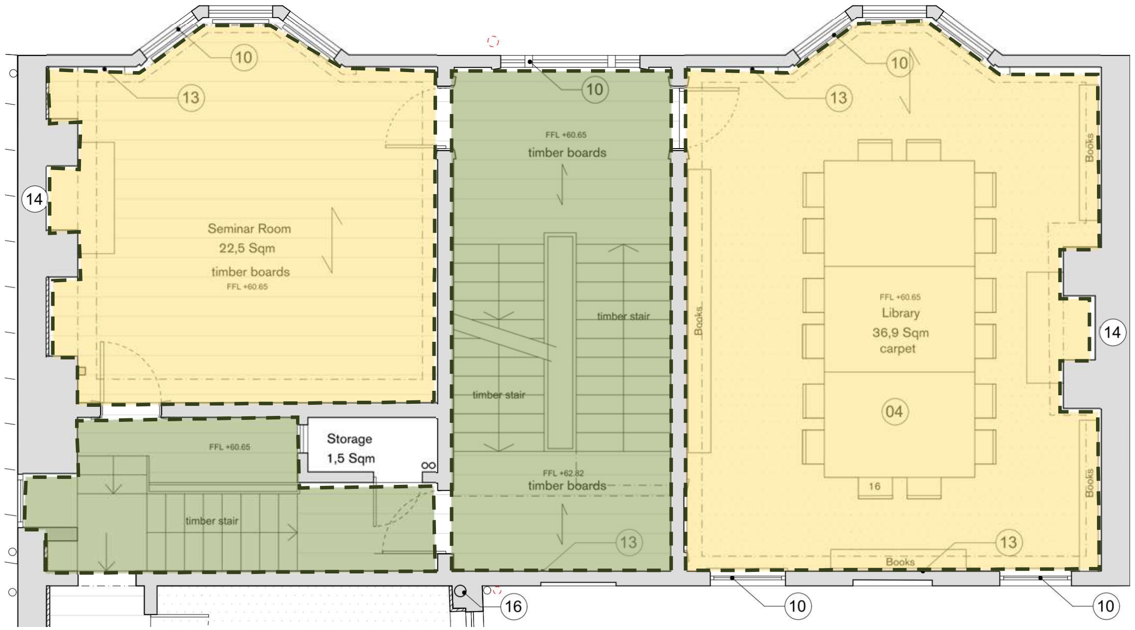
Based on the Building Regulations the various spaces require either a continuous ventilation rate, or a demand based ventilation rate intermittently. Part F : Minimum Ventilation Rates:

	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

Ventilation Strategy – 1st Floor Main House 2

Ventilation from centralized extract fan + natural ventilation from openable windows/ doors

Natural ventilation via infiltration and/or openable windows/doors/rooflights



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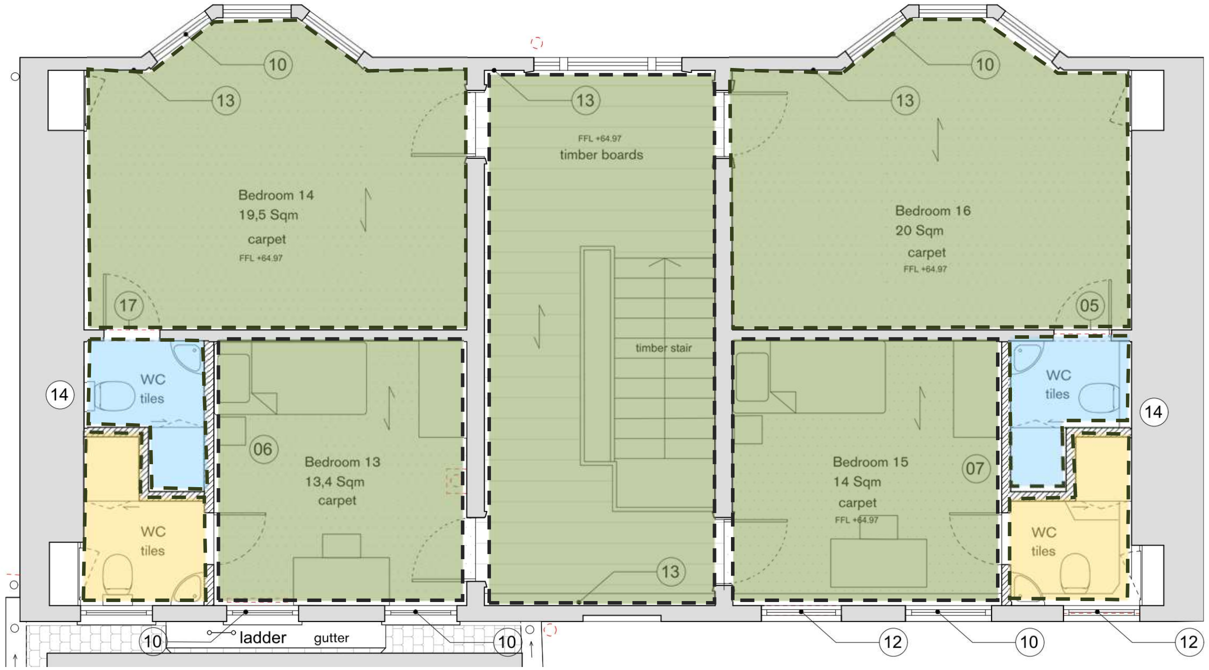
	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

Ventilation Strategy – 2nd Floor Main House

- Ventilation from centralized extract fan + natural ventilation from openable windows/ doors
- Natural ventilation via infiltration and/or openable windows/doors/rooflights
- Ventilation from centralized extract fan

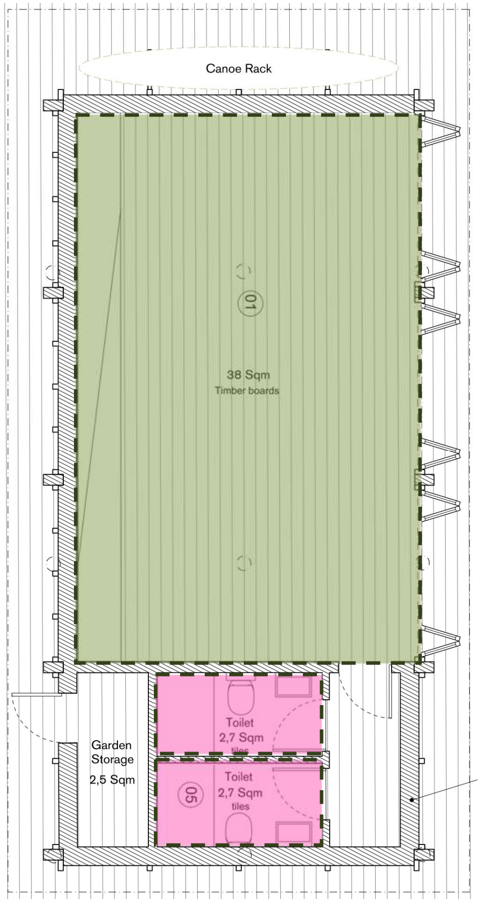


INTERNAL VENTILATION RATES:

Based on the Building Regulations the various spaces require either a continuous ventilation rate, or a demand based ventilation rate intermittently. Part F : Minimum Ventilation Rates:

	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

Ventilation Strategy – Boathouse



Natural ventilation via infiltration and/or openable windows/doors/rooflights

Mechanical extract only, provided from decentralized intermittent fan

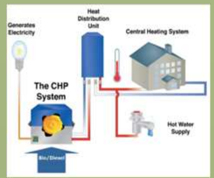
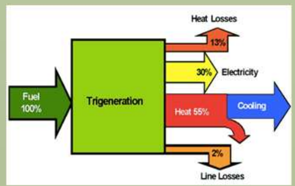
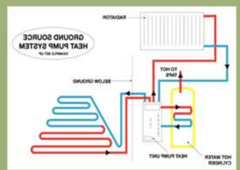
INTERNAL VENTILATION RATES:

Based on the Building Regulations the various spaces require either a continuous ventilation rate, or a demand based ventilation rate intermittently. Part F : Minimum Ventilation Rates:

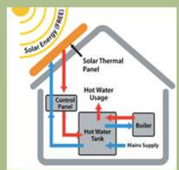
	Room Description	Intermittent Extract	Continuous Extract
Buildings other than dwellings	Bathrooms	15 l/s	8 l/s
	WC	6 l/s	6 l/s
	Kitchen	• 30 l/s adjacent to hob • 60 l/s elsewhere	13 l/s
	Utility Spaces	30 l/s	8 l/s

LZCT Options Appraisal

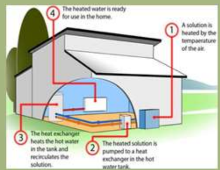
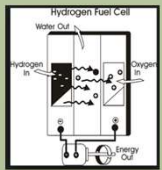
Low Zero Carbon Technologies (LZCT) Options

Renewable Technology	Advantages	Disadvantages	Viable Option
Combined Heat and Power (CHP)  	• Heat and power generation – efficient way to generate heat • Tried and tested technology • Suitable for projects with high heating and hot water loads	• Modulating decreases performance • Higher NOx emissions than condensing boiler • No RHI tariff	X (better suited to projects with high heating and hot water loads)
Tri-generation  	• Waste heat drives absorption chiller in summer months Provides low carbon cooling (depending on source of waste heat) • Chillers are quiet	• Requires source of waste heat usually from industrial process • Large plant space required for absorption chiller • Large amount of heat rejection • Still requires conventional chillers for peak cooling load • No RHI payments	X (not suited to small scale projects)
Ground Source Heat Pump 	• Can provide steady and consistent heating and cooling • RHI available	• Large area of land required as many boreholes required for good yield. • Run off electricity – high carbon factor • High capital cost	X (not suited to small area projects)
Biomass 	• Carbon neutral • Economic alternative to fossil fuels • RHIs available	• Large storage areas required with access for deliveries • Source of wood pellets • Slower start up time compared with fossil fuels • Reliability of fuel source • More expensive than regular boiler • Biomass boilers system are generally larger in size	X (not suited to small scale projects, plus air quality issues)

Low Zero Carbon Technologies (LZCT) Options

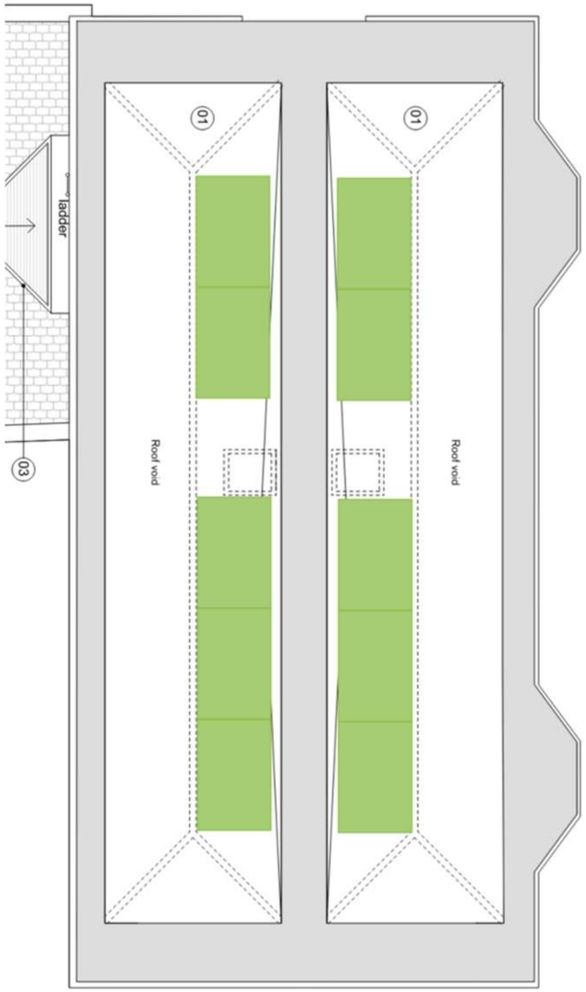
Renewable Technology	Advantages	Disadvantages	Viable Option
Wind Turbine 	• Zero carbon technology • FITs available • Turbulent wind speed at urban sites • Recorded output typically lower than manufacturer's data • Area of natural beauty - Planning permission very unlikely	• Recorded output typically lower than manufacturer's data • Planning permission difficult • Noisy, especially with gearbox	✗ (not suitable for city location)
Photovoltaics (PV) 	• Zero carbon technology • Tried and tested technology • Can be integrated/replace building fabric providing cost savings • Simple technology with no moving parts – minimal maintenance • FITs available	• Obstructions (shadowing, etc.) effects productivity • Best results produced in direct sunlight mostly over summer, south facing – do we have a south facing roof? • Needs to be carefully integrated amongst rooflights and drainage requirements • Require large areas for significant production	✓
Home PV Battery 	• Enhances PV technology and allows greater control, efficiency and reliability • Tried and tested technology • Simple technology with no moving parts – minimal maintenance • Waives the requirement for a G59 connection with the electricity grid	• Requires space	✓
Solar Thermal Panels 	• Tried and tested technology • Can be integrated into the building fabric • RHIs available	• Pumps use electricity • Obstructions effect productivity	✗ (not suitable for the existing historical roof structure)

Low Zero Carbon Technologies (LZCT) Options

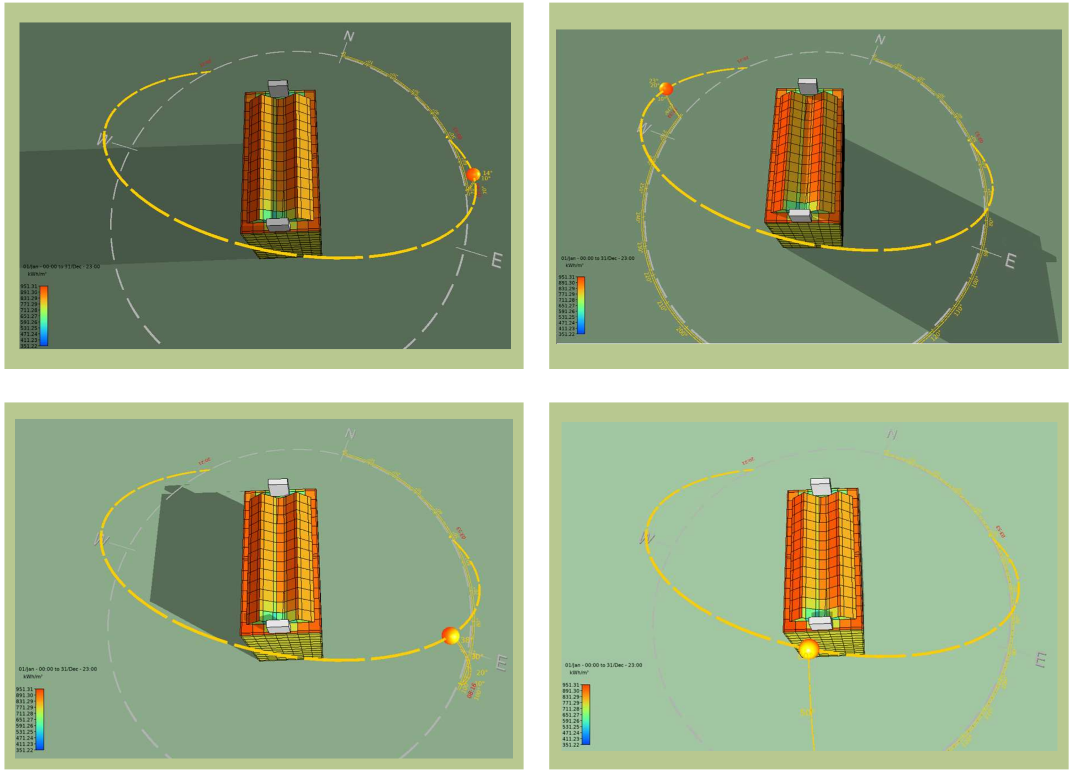
Renewable Technology	Advantages	Disadvantages	Viable Option
Air Source Heat Pump 	• RHI available • Minimum maintenance • No deliveries • Underfloor heating is ideal so not to take up floor space	• Not a zero carbon technology as it uses some electricity to run the pump • Best matched to underfloor heating • Alternative means of heating water required for summer months • Acoustics should be considered • Aesthetics should be considered	✓
Fuel Cell  	• More efficient cogeneration method than CHP • Research grants may be available	• Newly adopted technology – only a few installations in UK • Suited to development with significant heat and electricity demand • Requires large plant space • Depending on system, large delivery and storage space may be required for fuel	✗ (not suited to small scale projects and technology needing more development)
Wood Burning Stove 	• Carbon neutral • Economic alternative to fossil fuels • Aesthetically pleasing centre point in a living space • Come in various sizes, colours and finishes • Give a warm and cosy atmosphere • RHIs available (only if back boiler)	• Storage areas required • Slower start up time compared with fossil fuels • Reliability of fuel source • Requires suitable access for deliveries	✗
Anaerobic Digester  	• It turns waste into a resource • You can use waste by-products to generate energy and reduce your waste disposal costs. • It can be used in combination with a combined heat and power plant to generate both electricity and heat.	• Works best on a larger scale • Requires Planning permission • Would need community buy in	✗

PV Layout Proposal

PV Layout Proposal



Initial Shading Analysis:
Potential of shading has been identified but it can be mitigated by the use of an optimizer. Solar optimizers increase the power output of the PV system. It uses Maximum Power Point tracking MPPT to minimize the impact of shading.



PV Layout Proposal

The chosen PVs are the JAM54S30-415/MR/1000V from JA Solar.

The allocated roof space can accommodate a maximum of 10 PVs. These panels will take up a total area of 19.5m². This area of PVs will generate a maximum of 2450 kWh annually.

This value takes the following assumptions into account:

- As the PVs are East and West facing, an 80% correction factor was added to account for the orientation of the panels
- An estimated 20% losses, due to shading, has been applied, an optimizer will be fitted to minimize any associated loss.
- A Solar Factor (kk factor) for the Oxford area of 984 kWh/kWp per year has been applied to account for the site location.
- The model of PV has a maximum power generation of 415W.

Type	JAM54S30 -415/MR/1000V
Related Maximum Power [W]	415
Open Circuit Voltage [V]	37.45
Maximum Power Voltage [V]	31.61
Short Circuit Current [A]	14.02
Maximum Power Current [A]	13.13
Module Efficiency [%]	21.3