

ENERGY STATEMENT

Reddam House

Produced by XCO₂ for Inspired Education Holdings Ltd

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ENERGY STATEMENT

	01	02	03			
Remarks	Draft	Draft	For Planning			
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EXECUTIVE SUMMARY

The energy strategy for the Reddam House development has been developed in line with the energy policies of the Borough of Wokingham. The three-step Energy Hierarchy has been implemented and the estimated regulated CO₂ savings on site are 22% against a Part L 2021 compliant scheme.

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed student accommodation building at Reddam House, located in the Borough of Wokingham.

The proposed development comprises a co-educational block housing circa 100 students with ancillary staff accommodation to allow for the boarding house to be modernised in line with the premium standard of the Reddam House school.

In line with Wokingham Local Plan policies, new developments are encouraged to adopt a fabric first approach by maximising the performance of the building fabric and to generate renewable or low carbon energy from a local source.

The energy strategy outlined in this report has been done using the latest Building Regulations Part L 2021 methodology.

The methodology used to determine the expected operational CO₂ emissions for the development is in accordance with the Energy Hierarchy and the CO₂ savings achieved for each step are outlined below:

BE LEAN – USE LESS ENERGY

The first step addresses reduction in energy demand, through the adoption of passive and active design measures.

The proposed energy efficiency measures include levels of insulation beyond Building Regulation requirements, low air tightness levels, efficient lighting as well as energy saving controls for space conditioning and lighting.

By means of energy efficiency measures alone, regulated CO₂ emissions are shown to reduce by:

Regulated CO ₂ Savings at Be Lean Stage		
	%	t/yr
Site wide	1.0	0.1

BE CLEAN – SUPPLY ENERGY EFFICIENTLY

The site is located in an area where district heating is not expected to be implemented in the future. A site-wide heat network or CHP system has not been found to be feasible or viable for a development of this scale, however the apartment blocks will utilise communal ASHP systems.

BE GREEN – USE RENEWABLE ENERGY

The feasibility study carried out for the development identified photovoltaics and air source heat pumps as suitable renewable technologies for the development. The PVs can provide onsite energy supply, and the ASHPs can service heating and hot water.

The incorporation of renewable technologies will reduce CO₂ emissions by a further:

Regulated CO ₂ Savings at Be Green Stage		
	%	t/yr
Site wide	21.0	1.3

The proposed development is compliant with the Wokingham Borough Development Plan policy “CC05: Renewable energy and decentralised energy networks” which requires a 10% reduction in carbon emissions through renewable energy or low carbon technology.

ENERGY STATEMENT

CUMULATIVE ON-SITE SAVINGS

The overall regulated CO₂ savings on site against a Part L 2021 compliant scheme are therefore:

Cumulative Regulated CO ₂ Savings		
	%	t/yr
Site wide	22	1.4

DISCLAIMER

XCO2 does not endorse or recommend specific manufacturers, products or materials.

Any reference to specific materials and components is solely for the purposes of recommendation of their thermal and/or embodied carbon performance.

It will be the responsibility of other design team members to specify exact products suitable for the development to match the set performance recommendations. XCO2 is not responsible for confirming or checking any performance parameters not related to thermal conductivity and/or embodied carbon of a product or component (such as, but not limited to, structural integrity, fire risk rating, hygroscopy/hydrophoby, size or cost differences).

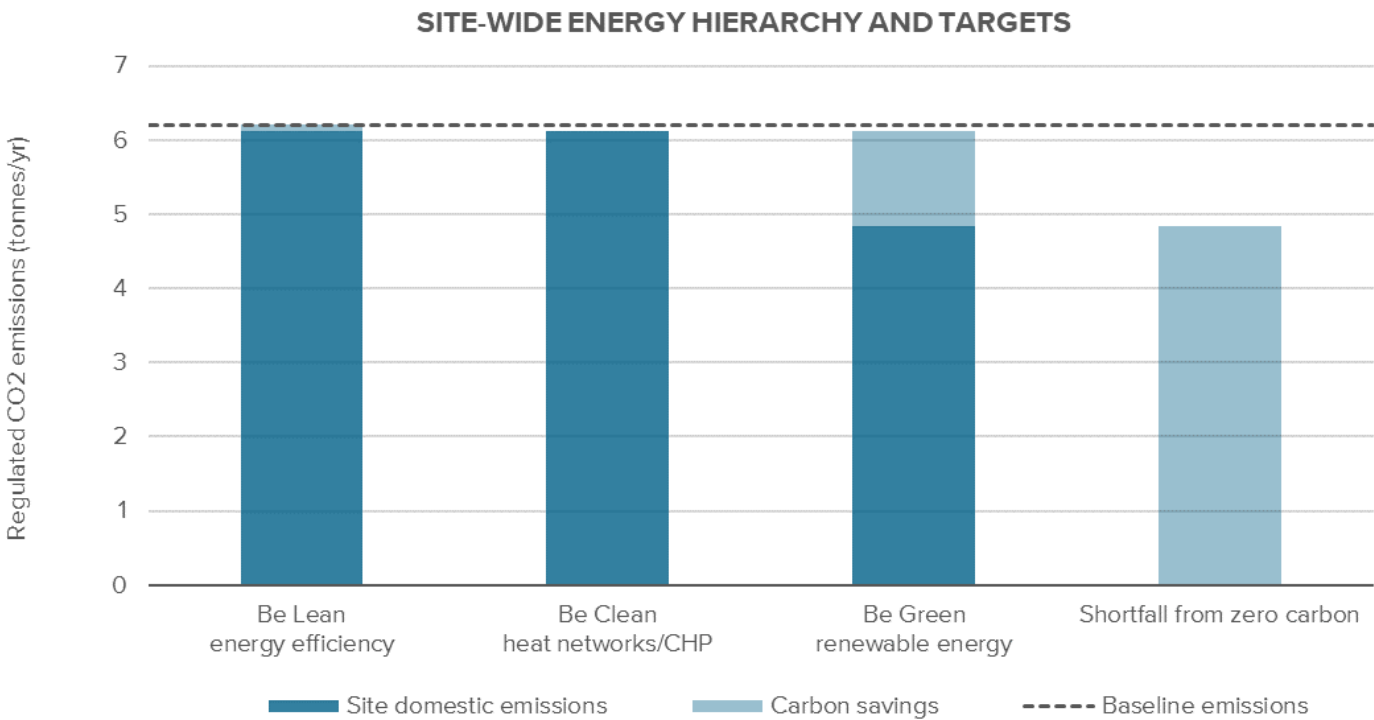


Figure 1: The Site Wide Energy Hierarchy

INTRODUCTION

This chapter presents the description of the site and of the development proposal, the energy policy framework and the methodology employed for the energy assessment.

SITE & PROPOSAL

The site is located to the south of Reading. The Reddam House site sits within a vast natural landscape. Part designed, part wild grounds and woodlands surround the buildings. The proposed site for the new boarding house sits adjacent to the current Boarding House within Reddam House, situated to the east of the site.

Within the wider school site, a study area to the east has been chosen as the preferred location for the new

boarding house (Reddam House), which is a co-educational block housing circa 100 students with ancillary staff accommodation to allow for the boarding house to be modernised in line with the premium standard of the school.

The approximate location and boundary of the application site is shown in the figure below.



Figure 2: Approximate location and boundary of the application site

POLICY FRAMEWORK

The proposal will seek to respond to the energy policies of within the Wokingham Borough Core Strategy Development Plan Document (2010) and Managing Development Delivery Local Plan (2014). The most relevant applicable energy policies in the context of the proposed development are presented below.

WOKINGHAM BOROUGH CORE STRATEGY DEVELOPMENT PLAN (2010)

The Council's Core Strategy, which was adopted 29th January 2010, for the borough is designed to guide where development will take place between 2006 and 2026. It includes policies for all forms of development including homes, shops, offices, factories, libraries, schools and health & leisure facilities.

The most relevant applicable energy policies in the context of the proposal are presented below.

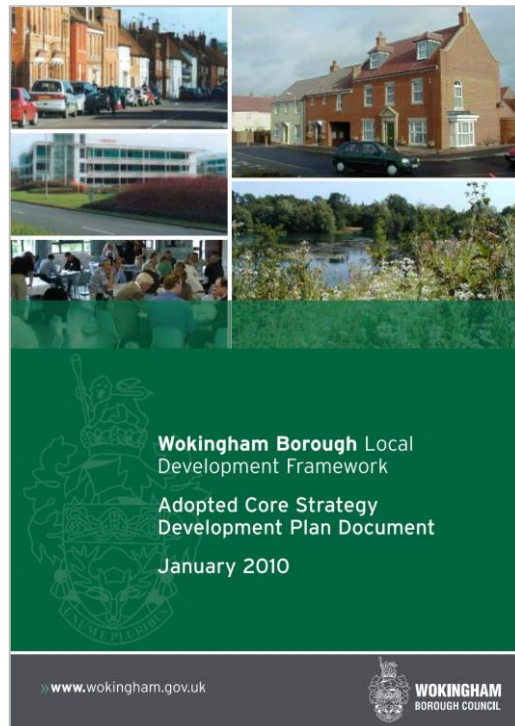
CP1: Sustainable Development

“ ...

12) *Contribute towards the goal of reaching zero-carbon developments⁴¹ as soon as possible by:*

- a. *Including appropriate on-site renewable energy features; and*
- b. *Minimising energy and water consumption by measures including the use of appropriate layout and orientation, building form, design and construction, and design to take account of microclimate so as to minimise carbon dioxide emissions through giving careful consideration to how all aspects of development form.*

... ”



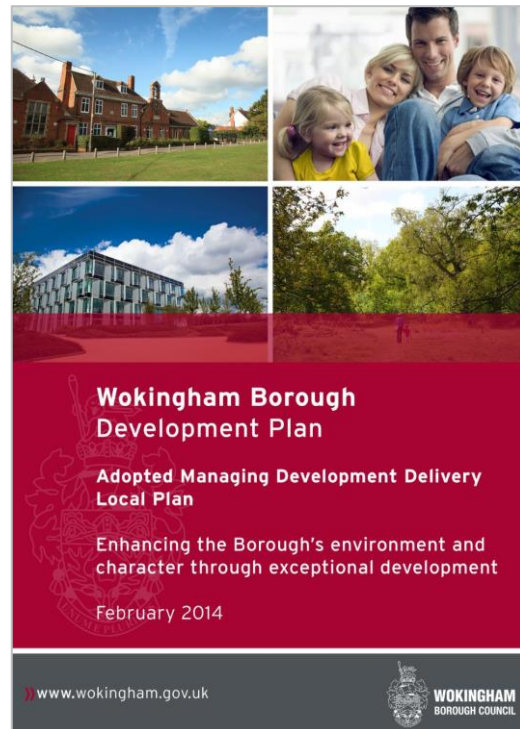
MANAGING DEVELOPMENT DELIVERY LOCAL PLAN (2014)

Managing Development Delivery Local Plan (MDD) was adopted on 21st February 2014, and is an important part of implementing the adopted Core Strategy. It adds extra detail to the policies within the Core Strategy. Together, these two documents set out how the Borough will develop up until 2026 making it an excellent place to live, work and play.

The most relevant applicable energy policies in the context of the proposal are presented below.

Policy CC05: Renewable Energy and Decentralised Energy Networks

- 1) *Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged.*
- 2) *Planning permission will only be granted for proposals that deliver a minimum 10% reduction in carbon emissions by renewable energy or low carbon technology where the development is for:*
 - a) *Schemes of more than 10 dwellings (gross),*
 - b) *Non-residential proposals of more than 1,000 sqm gross floorspace.*
- 3) *Proposals for renewable energy and decentralised energy works, including wind turbines, must demonstrate that:*
 - a) *They are appropriate in scale, location and technology type;*
 - b) *Are compatible with the surrounding area, including the impact of noise and odour;*
 - c) *Do not have a damaging impact on the local topography and landscape;*
 - d) *There is no significant impact upon heritage assets, including views important to their setting;*
 - e) *In the case of wind turbines, take account of their cumulative effect and properly reflect their increasing impact on the landscape and on local amenity.*



METHODOLOGY

The sections below present the methodology followed in determining the on-site and off-site carbon savings for the proposed scheme.

ON-SITE CARBON SAVINGS – THE ENERGY HIERARCHY

The methodology employed to develop the energy strategy for the scheme and achieve on-site carbon savings is as follows:

The **baseline** CO₂ emissions are first established, i.e. the emissions of a scheme that is compliant with Part L 2021 of the Building Regulations.

The software used to model and calculate the energy performance and carbon emissions of the building is IES Virtual Environment, using the SBEM methodology.

The same approach is followed to determine the energy performance and CO₂ emissions of the proposed scheme for each of the steps of the **Energy Hierarchy**. The CO₂ emissions are estimated based on the SBEM Building Emission Rate (BER) figures. The methodology follows a fabric first approach, before considering the use of renewable energy technologies.

The consecutive steps of the Energy Hierarchy are:

- **Be Lean** whereby the demand for energy is reduced through a range of passive and active energy efficiency measures; as part of this step the Cooling Hierarchy (see Policy SI4) is implemented and measures are proposed to reduce the demand for active cooling;
- **Be Clean** whereby as much of the remaining energy demand is supplied as efficiently as possible (e.g. by connecting to a district energy network or developing a site-wide CHP network), and,
- **Be Green** whereby renewable technologies are incorporated to offset part of the carbon emissions of the development. The uptake of renewable technologies is based on feasibility and viability considerations, including their compatibility with the energy system determined in the previous step.

The implementation of the Energy Hierarchy determines the total regulated carbon savings that can be feasibly and viably achieved on site.

The % improvement against the baseline emissions is compared to the relevant targets for each element and in case of a shortfall, savings through off-site measures should be achieved.

The relevant parties will also be made aware of their responsibilities at subsequent reporting stages.

BE LEAN – USE LESS ENERGY

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water and lighting. Measures will also be put in place to reduce the risk of overheating. The regulated carbon saving achieved in this step of the Energy Hierarchy is 1.0% over the site wide baseline level.

An air-source heat pump with heating efficiency 2.64 has been included for supply of space heating. For the provision of hot water, based on the proposed system of the actual development, an air-source heat pump with efficiency of 2.86 has been included for all commercial spaces within the scheme.

PASSIVE DESIGN MEASURES

ENHANCED U-VALUES

The heat loss of different building fabric elements is dependent upon their U-value. A building with low U-values provides better levels of insulation and reduced heating demand during the cooler months.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2021 targets and notional building specifications, in order to reduce the demand for space heating.

The tables to the right demonstrate the improved performance of the proposed building fabric beyond the Building Regulations requirements for both non-domestic uses.

AIR PERMEABILITY IMPROVEMENT

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2021 minimum standards for air tightness by targeting air permeability rates of $3\text{m}^3/\text{m}^2.\text{h}$ at 50Pa.

Table 1: Thermal Envelope U-values

Non-Domestic (U-values in $\text{W}/\text{m}^2.\text{K}$)			
Element	Building Regulations	Proposed	Improvement
Walls	0.26	0.19	27%
Floor	0.18	0.1	44%
Roof	0.16	0.1	38%
Windows	1.6	1.2	25%
Doors	1.6	1.0	38%

THERMAL BRIDGING

Thermal bridging can cause significant heat loss within buildings, whereby junctions between insulated building fabric elements provide less thermal resistance than the surrounding envelope. While repeating thermal bridges such as timber studs, rafters and wall ties are accounted for within u-value calculations, linear thermal bridges such as floor junctions, corners, roof junctions and window reveals must be included separately within the SBEM calculations.

Heat loss from linear thermal bridges is known as the Psi-value (Ψ). Psi-values can be obtained through the modelling of specific junctions based on the proposed construction details is measured in W/mK . The cumulative impact of the total heat loss expected from all the thermal bridges combined is known as the γ -value.

ENERGY STATEMENT

As the technical design of the building fabric is developed, consideration will be given to thermal bridges to ensure that best practise design can be achieved.

REDUCING THE NEED FOR ARTIFICIAL LIGHTING

The development has been designed to maximise daylight in all habitable spaces as a way of improving the health and wellbeing of its occupants.

All of the habitable areas will benefit from large areas of glazing to increase the amount of daylight within the internal spaces where possible. This is expected to reduce the need for artificial lighting whilst delivering pleasant, healthy spaces for occupants.

ACTIVE DESIGN MEASURES

HIGH EFFICACY LIGHTING

The development intends to incorporate low energy lighting fittings. All light fittings will be specified as low energy lighting, and will accommodate LED, compact fluorescent (CFLs) or fluorescent luminaires only.

HEAT RECOVERY VENTILATION

Mechanical ventilation heat recovery (MVHR) is proposed for the development. The mechanical ventilation system will include heat recovery in order to achieve ventilation in the most energy-efficient way.

CONTROLS

Advanced lighting and space conditioning controls will be incorporated, specifically:

- For the areas of infrequent use, occupant sensors will be fitted for lighting, whereas day lit areas will incorporate daylight sensors where appropriate;
- Space conditioning in the non-domestic areas will be controlled by local time control and local temperature control.

MONITORING

In addition to the above design measures, the development will incorporate monitoring equipment and systems to enable occupiers to monitor and reduce their energy use.

It is expected that the monitoring system will be capable of warning for 'out of range' values.

ENERGY STATEMENT

MINIMISING OVERHEATING

The potential risk of overheating will be mitigated by incorporating passive and active design measures, in line with the following Cooling Hierarchy.

THE COOLING HIERARCHY

MINIMISING INTERNAL HEAT GENERATION THROUGH ENERGY EFFICIENT DESIGN

The distribution of heat infrastructure within the residential parts of the development will be designed to reduce the lateral pipework lengths within the internal spaces to reduce heat loss.

Heat sources and pipework will be sufficiently insulated (following CIBSE CoP1 guidelines).

REDUCING THE AMOUNT OF HEAT ENTERING THE BUILDING IN SUMMER

External shading elements such as canopies integrated across the elevations shall significantly reduce solar gains into occupied spaces. Internal blinds may be included to further reduce the amount of heat entering the building.

USE OF THERMAL MASS AND HIGH CEILINGS TO MANAGE THE HEAT WITHIN THE BUILDING

During peak summer periods the thermal mass of the building will absorb and store excess heat. The building will release its heat in the cooler evenings to allow for cooler internal spaces dampening the peak diurnal weather conditions.

PASSIVE VENTILATION

Passive ventilation will be employed as the main strategy for providing fresh air and dissipating heat across the development. The passive ventilation strategy includes single-sided ventilation, cross ventilation and night purge ventilation through openable windows and doors, operated by the occupants. Communal corridors will also have openable windows which will be occupant controlled to maintain a comfortable temperature.

MECHANICAL VENTILATION

Mechanical ventilation with heat recovery will be implemented into all spaces within the proposed development. The MVHR will be capable of operating in summer bypass mode allowing for the dissipation of any heat build-up during peak summer conditions.

OVERHEATING RISK ASSESSMENT

An overheating assessment was undertaken for representative 'worst case' spaces in line with CIBSE TM59 and Approved Document O. Dynamic thermal modelling was conducted using three design weather years, also accounting for climate change scenarios.

As a result, all of the habitable rooms assessed at the proposed development were found to meet the requirements outlined in TM59 and Approved Document O, provided that adequate design considerations are taken into account and mitigation measures are implemented. The rooms utilise passive ventilation and solar control strategies, such as external shading and the inclusion of low g-value glazing to ensure compliance.

Generally, a g-value of 0.50 have been preferred specification to avoid overly compromising the energy performance and compliance with operational CO₂ emissions targets, whilst lower g-values of 0.33 and 0.40 are proposed to highly glazed spaces such as communal spaces to reduce cooling demand.

The Overheating Assessment can be seen in full in Appendix A.

BE CLEAN – SUPPLY ENERGY EFFICIENTLY

A review of the local heat networks shows that there are no nearby existing or proposed energy networks, and it is therefore not feasible or viable for the Proposed Development to incorporate the supply of energy from an offsite network. Therefore, no carbon savings are shown for this step of the Energy Hierarchy.

ENERGY SYSTEM HIERARCHY

The energy system for the development has been selected in accordance with the decentralised energy hierarchy. The energy systems should consider:

1. Connection to existing heating and cooling networks;
2. Site wide CHP network; and,
3. Communal heating and cooling.

Local heat and power sources minimise distribution losses and achieve greater efficiencies when compared to separate energy systems, thus reducing CO₂ emissions.

In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network of insulated pipes to surrounding residences.

CONNECTION TO AN EXISTING NETWORK

The Heat Networks Planning Database is a government website that identifies existing and potential opportunities for decentralised energy projects around the country.

An excerpt from the Heat Networks Planning Database Map can be seen on the following page.

A review of the map shows that no existing district heating network exists in close proximity of the proposed development. Proposed heat networks are over 1km from the site and therefore, high efficiency ASHPs are proposed for the development.

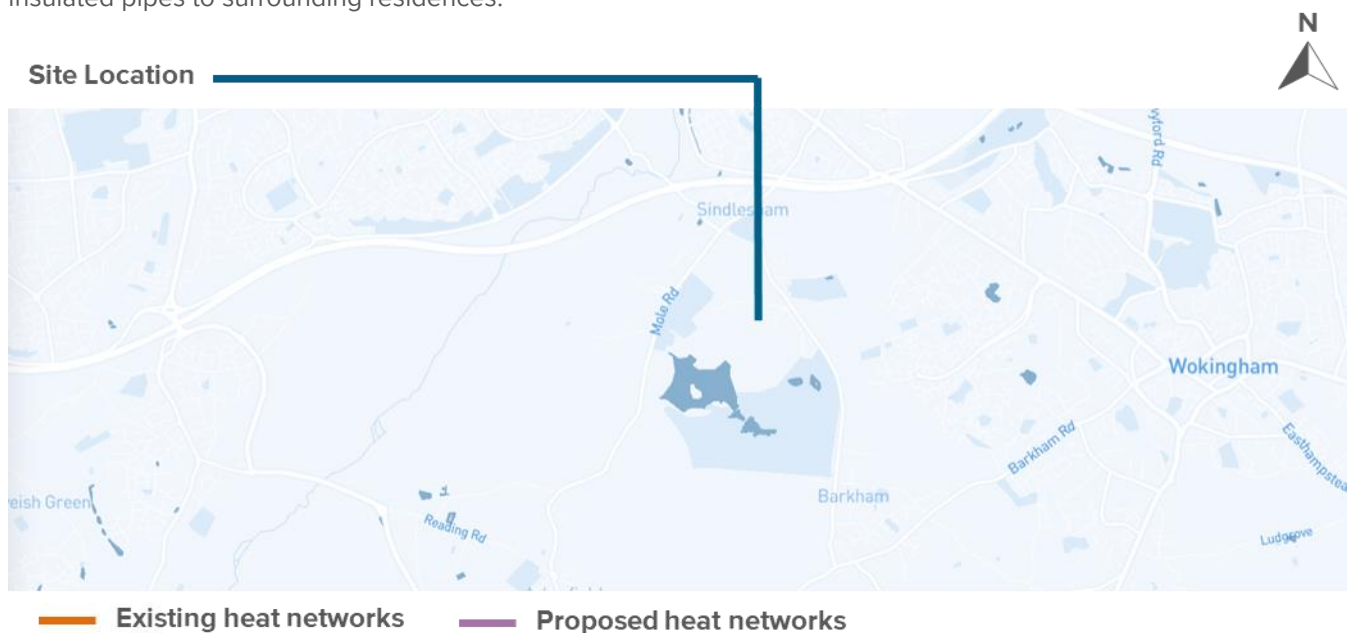


Figure 3: Excerpt from the Heat Networks Planning Database Map. Existing district networks outlined in red, proposed in purple.

BE GREEN – USE RENEWABLE ENERGY

The renewable technologies feasibility study carried out for the development identified photovoltaics and air source heat pumps as suitable technologies for the development. The regulated carbon saving achieved in this step of the Energy Hierarchy is 21% over the site wide baseline level.

RENEWABLE TECHNOLOGIES FEASIBILITY STUDY

Methods of generating on-site renewable energy (Green) were assessed, once Lean and Clean measures were taken into account.

The development of Reddam House will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance. A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Air source heat pump;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

- CO₂ savings achieved;
- Site constraints; and,
- Any potential visual impacts.

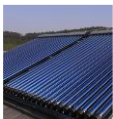
RENEWABLE ENERGY APPRAISAL SUMMARY

The table below summarises the factors taken into account in determining the appropriate renewable technologies for this project. This includes estimated capital cost, lifetime, level of maintenance and level of impact on external appearance. The final column indicates the feasibility of the technology in relation to the site conditions (10 being the most feasible and 0 being infeasible). It is important to note that the information provided is indicative and based upon early project stage estimates.

The feasibility study demonstrates that photovoltaics and ASHP would be the most feasible renewable technologies for the proposed Reddam House development. Detailed assessments for the proposed technologies can be found in the following sections.

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Table 2: Summary of renewable technologies feasibility study

		Comments	Lifetime	Maintenance	Impact on external appearance	Site feasibility
Biomass		Not adopted – burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.	20 yrs.	High	High	1
PV		Adopted - PV panels will be incorporated into the domestic element of the scheme	25 yrs.	Low	Med	8
Solar thermal		Not adopted - Solar thermal array would have a significant visual impact, and would take up space for PV & green roof	25 yrs.	Low	Med	2
GSHP		Not adopted - the installation of ground loops requires significant space, additional time at the beginning of the construction process and very high capital costs.	20 yrs.	Med	Low	2
ASHP		Adopted – ASHP evaporator units will be adopted for both domestic and non-domestic elements	20 yrs.	Med	Med	9
Wind		Not adopted - Wind turbines located at the site will have a significant visual impact on the proposed development and surrounding area.	25 yrs.	Med	High	1

DETAILED ASSESSMENT OF PHOTOVOLTAIC PANELS

Four types of solar cells are available on the market at present and these are mono-crystalline, poly-crystalline, thin film and hybrid panels. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper, but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

Photovoltaics are considered a suitable technology for this development for the following reasons:

- The development provides an extent of roof space for the installation of PV panels;
- PV arrays are relatively easy to install when compared to other renewable systems; and
- PV panels provide a significant amount of CO₂ savings.

The PV shall comprise 18 kWp (90m²) of horizontal roof mounted arrays.

The table below summarises the technical data for the proposed PV array and estimated CO₂ savings from the application of this technology. In total the PV installation would produce regulated CO₂ savings of 19.2% for the development.

An indicative area for the installation of the PV panels on the roof can be found in the following page.



Figure 4: Monocrystalline PV arrays.

Table 3: Summary of technical/operational data and estimated CO₂ savings for PVs

Photovoltaics	
Array area	90 m ²
Module Efficiency	19 %
Collector orientation	South
Carbon intensity of electricity	0.136 kgCO ₂ /kWh
Predicted site solar energy	913.9 kWh/m ² .yr
Losses	20 %
System peak power	18 kWp
Primary electricity offset by PV array	8,935 kWh/yr.
Total CO₂ savings	1.22 tCO ₂ /yr.
Regulated baseline CO₂ emissions	6.21 tCO ₂ /yr.
% Regulated CO₂ reduction from site-wide baseline	19.6 %

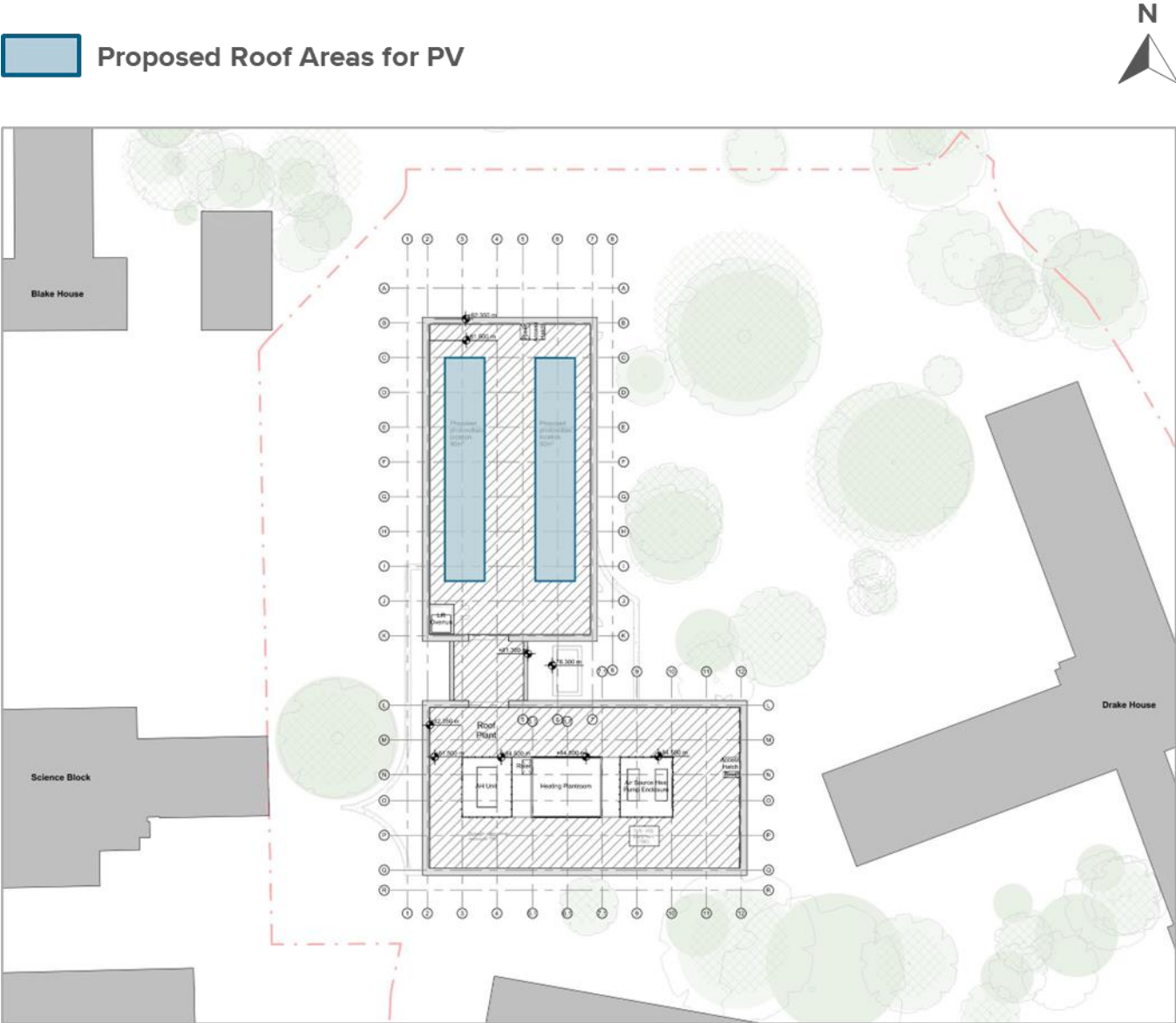


Figure 5. Proposed PV layout for Reddam House

DETAILED ASSESSMENT OF AIR SOURCE HEAT PUMPS

Air source heat pumps (ASHPs) absorb heat from the outside air into a refrigerant at low temperature. Using electricity, the pump compresses the refrigerant to increase its temperature, which is then sent to the heating circuit to heat the building.

The efficiency of heat pumps is very much dependent on the temperature difference between the heat source and the space required to be heated. As a result, ASHPs tend to have a lower COP than GSHPs. This is due to the varying levels of air temperature throughout the year when compared to the relatively stable ground temperature. The lower the difference between internal and external air temperature, the more efficient the system.

ASHP is considered a suitable technology for the development for the following reasons:

- It is a high efficiency system that can cater for the space heating and cooling of the most energy-intensive areas of the proposed development;
- Requires less capital cost than GSHP and other renewable technologies;
- It can be integrated with the proposed ventilation strategy; and,
- It is simple to install when compared to other renewable technologies and will work well alongside PV.

The table below summarises the technical data for the proposed ASHP and estimated CO₂ savings from the application of this technology. In total the ASHP technology would produce regulated CO₂ savings of 1.0% for the development.

Table 4: Summary of technical/operational data and estimated CO₂ savings for ASHP

ASHP	
COP heating	3.37
Carbon intensity of electricity	0.136 kgCO ₂ /kWh
Proportion of domestic space heating met by ASHP	100 %
Proportion of DHW met by ASHP	100 %
Energy used by ASHP	17,468 kWh/yr.
Total CO ₂ savings	0.09 t/yr.
Regulated baseline CO ₂ emissions	6.21 t/yr.
% Regulated CO ₂ reduction*	1.4 %



Figure 6: Outdoor units of ASHP.

BE GREEN CO₂ EMISSIONS

Following the measures adopted at Lean, further savings can be obtained through the incorporation of the proposed PV panels and ASHP. Through the integrated performance of the proposed measures at each step in the Energy Hierarchy, the development meets the Borough of Wokingham policies.

CONCLUSIONS

The energy strategy has been developed in line with the three-step Energy Hierarchy and the cumulative CO₂ savings on site are estimated at 22% against a Part L 2021 compliant scheme.

ON-SITE CO₂ SAVINGS

By implementing the three step Energy Hierarchy as detailed in the previous sections, the Regulated CO₂ emissions for the development have been reduced against a Part L 2021 compliant scheme through on-site measures alone by:

Cumulative Regulated CO ₂ Savings		
	%	t/yr
Site wide	22	1.4

The overall strategy aims to maximise the possible carbon savings achievable on site. The building fabric U-values and air permeability and system efficiencies have been improved as far as practically possible to exceed Part L 2021 requirements.

Finally, ASHPs are included as part of the energy strategy and PVs have been maximised on the available roofs to further reduce emissions.

The table below summarise the implementation of the Energy Hierarchy for the proposed scheme and detail the CO₂ emissions and savings against the baseline scheme for each step of the hierarchy; as well as the savings achieved through carbon offset.

Overall, the proposed development has been designed to meet energy policies set out by the Borough of Wokingham, which demonstrates the client and the design team's commitment to enhancing sustainability of the scheme.

SITE-WIDE CUMULATIVE SAVINGS

Table 5: Site wide regulated CO₂ emissions and savings

	Total regulated emissions (tonnes CO ₂ /year)	Regulated CO ₂ savings (tonnes CO ₂ /year)	Percentage saving (%)
Baseline	6.21		
Be Lean	6.14	0.1	1.0
Be Clean	6.14	0.0	0.0
Be Green	4.84	1.3	21.0
Total		1.4	22
Offset for non-domestic to zero carbon		145.2	

APPENDIX A – OVERHEATING RISK ASSESSMENT

OVERHEATING RISK ASSESSMENT

10.126 – REDDAM HOUSE

18/12/2024 by SK, reviewed by CP

All habitable rooms assessed at the proposed development at Reddam House were found to meet the requirements outlined in TM59 and Approved Document O, provided that adequate design considerations are taken into account and mitigation measures are implemented. The rooms utilise passive ventilation and solar control strategies, such as external shading and the inclusion of low g-value glazing to ensure compliance.

EXECUTIVE SUMMARY

An overheating analysis has been conducted for the proposed development at Reddam House, located in the Borough of Wokingham. The purpose of this analysis is to test the design of the proposed scheme and ensure the mitigation of any overheating risk within the occupied zones across the development. This will ensure the comfort of occupants as well as future-proof the scheme by accounting for projected increased ambient air temperatures from climate change.

In order to assess the thermal performance of the development, models were constructed within thermal simulation software. The internal temperature, lighting and ventilation conditions were estimated for all habitable internal spaces.

With the aim of giving the most robust consideration, the performance of the various occupied rooms was compared with CIBSE Technical Memorandum 59¹ performance recommendations. These are rigorous targets that determine the acceptability of overheating based on the temperature differential between the internal and the external environment (ΔT), considering the frequency of high temperature difference beyond which the level of overheating is considered unacceptable. Specifically, for bedrooms, the methodology aims to evaluate comfort during the sleeping hours by setting a maximum number of hours for which the operative temperature can exceed 26°C.

The restrictions outlined in Approved Document O² were also applied within this assessment. Approved Document Part O (AD O) was first published on 15th December 2021 and came into effect in England on 15th June 2022, with transitional arrangements in place. This document was developed to provide guidance on compliance with Requirement O1 (2) (a) of Schedule 1 to the Building Regulations 2010 which notes that:

“ ...

- (1) *Reasonable provision must be made in respect of a dwelling, institution or any other building containing one or more rooms for residential purposes, other than a room in a hotel (“residences”) to –*
 - a. *limit unwanted solar gains in summer;*
 - b. *provide an adequate means to remove heat from the indoor environment.*

¹ CIBSE TM59:2017 – Design Methodology for the assessment of overheating risk in homes

² Approved Document O – Requirement O1: Overheating Mitigation, Regulations: 40B

(2) In meeting the obligations in paragraph (1) –

- a. account must be taken of the safety of any occupant, and their reasonable enjoyment of the residence; and*
- b. mechanical cooling may only be used where insufficient heat is capable of being removed from the indoor environment without it.*

...

Part O covers the overheating mitigation requirements of the Building Regulations 2021 and is currently the most appropriate assessment methodology for assessing overheating risk in residential properties in the UK.

Compliance with AD O has been demonstrated through dynamic thermal modelling. The findings of the assessment have been outlined below.

- The proposed residential spaces and communal rooms are predicted to satisfy the overheating risk criteria for the probabilistic Design Summer Year (DSY1) weather data for Swindon through a combination of energy efficient lighting, natural ventilation and solar control strategies, including;
 - As outlined in Table 5, passive natural ventilation with up to the greatest degree of opening as is deemed feasible is recommended.
 - Integration of terrace canopy, particularly on the Southwest façade is helpful to prevent excessive solar gains.
 - It is recommended that a g-value of 0.50 is used for the glazing, except for top floor corridors and rooflight for which g-values of 0.40 and 0.33 respectively have been applied to reduce solar gains further for compliance.
- Two communal corridors were assessed, and a risk of overheating was initially identified in one of them (first floor Piazza area). To achieve compliance with TM59 criteria by mitigating the overheating risk, and to improve the resilience of the building for the future, it is recommended that the g-value of glazing for both windows and rooflight is reduced and that openable windows are introduced to allow for natural ventilation.

Based on the method of assessment adopted, XCO2 recommend the design team to consider incorporating the features, such as secure window opening measures, that allow compliance with CIBSE TM59 and Approved Document O under the Swindon Design Summer Year DSY1 (2020s, high emissions, 50% percentile scenario) weather file.

It should be noted that the findings of this assessment are related to planning stage design only and are based on a sample of units. Any changes to the ventilation strategy, façade opening areas, window operation and shading elements would impact the performance of the building and may void the results of the current assessment.

METHODOLOGY

Compliance with AD O Requirement O1 (2) can be demonstrated using one of two methods:

- a. The simplified method.
- b. The dynamic thermal modelling method.

The dynamic thermal modelling method was used to conduct the assessment presented in this note.

AD O outlines additional requirements to be applied to CIBSE's TM59 methodology in order to restrict the choices made by the modeller. To demonstrate compliance using the dynamic thermal modelling method, the following guidance was followed:

- CIBSE's TM59 methodology for predicting overheating risk.
- The limits on the use of CIBSE's TM59 methodology, as outlined in AD O.
- The acceptable strategies for reducing overheating risk set out in AD O.

3D thermal models of the proposed scheme have been developed based on the planning architectural drawings. To give a fair representation of the residential development, 2 KLDs and 52 bedrooms were analysed to provide a representative sample of the space and dwelling typologies within the development.

Shared communal rooms and common spaces of buildings containing more than one residential unit fall within the scope of AD O. Two communal corridors and one communal room were therefore analysed as part of this assessment.

Axonometric views of the model from Northeast and Southwest are presented in Figure 1 and Figure 2 below.

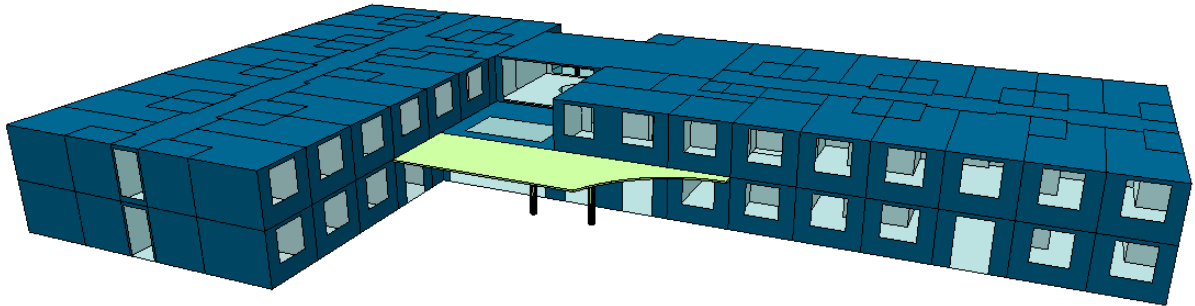


Figure 1: An axonometric view from Northeast

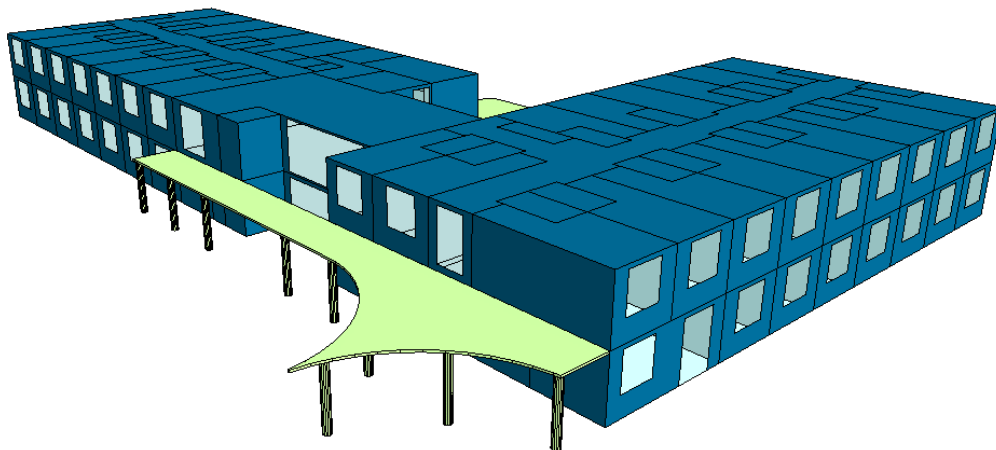


Figure 2: An axonometric view from Southwest.

The overheating risks of the spaces were assessed using the CIBSE Design Summer Year 1 (DSY1) weather file which represents a moderately warm summer. The 2020s, high emissions, 50% percentile scenario was selected in line with

methodology requirements. The 2020 period is of particular interest as this relates to the period 2011-2040, which is the period we have now entered; the 50% percentile scenario may be viewed as the ‘best guess’ level of change.

Further testing with DSY2 and DSY3 (2020s, high emissions, 50% percentile scenario) was also undertaken to test the development robustness against more severe weather patterns, although compliance with these weather files is not a requirement.

The buildings have been modelled using dynamic thermal simulation software. The software can compute operative temperatures using weather data sets, building fabric specification, window areas and opening, all aspects of solar and internal gains as well as natural ventilation flows within buildings. Compliance of the design with the criteria outlined in TM59 (with restrictions outlined in AD O) has been sought and recommendations formulated.

ASSESSMENT CRITERIA

The following two criteria were used:

- 1) **For living rooms, kitchens, communal rooms and bedrooms:**
The number of hours during which ΔT (the difference between operative and threshold comfort temperatures) is greater than or equal to one degree (K), during the period of May to September inclusive, shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).
- 2) **For bedrooms only:**
To evaluate comfort during sleeping hours, the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26°C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26°C will be recorded as a fail).

The first criterion is evaluated in terms of the ΔT , which is the difference between the operative temperature T_{op} and the limiting maximum temperature T_{max} , $\Delta T = T_{op} - T_{max}$ ³. In order to estimate T_{op} , dynamic thermal modelling is carried out to compute the predicted temperature distribution in the different thermal zones of the building. The maximum acceptable temperature is a function of the outdoor temperature and the design limits, which are shown below. The table details the suggested acceptability in terms of the temperature range of naturally ventilated buildings. For the purpose of the assessment, we have used Category II limits, as recommended within CIBSE TM52.

Table 1: CIBSE TM52 – Suggested applicability of the category and the associated acceptable temperature range for a free running building

Category	Explanation	Acceptable Range (°C)
II	Normal expectation (for new buildings and renovations)	±3

CIBSE TM59 also recommends assessment criteria for overheating risk in corridors based on exceeding an operative temperature of 28°C. Those are only applicable when there is communal heating pipework is present within the corridors. Whilst there is no mandatory target, corridors should aim to comply with the following criteria:

- 1) **For corridors:**
If an operative temperature of 28°C is exceeded for more than 3% of total annual hours, this should be flagged as a significant risk within the report.

³ Operative temperature models the combined effect of convective and radiant heat transfer. It accounts for the combined effect of the temperature of the air, the temperature of the surfaces and air speed.

⁴ T_{max} is the maximum acceptable temperature and is dependent on the outdoor running mean temperature and the building category with each associated acceptability range.

MODELLING ASSUMPTIONS

FABRIC PERFORMANCE

The assumed fabric specification for the purposes of this assessment is aligned with the proposals at planning stage.

Table 2: Building fabric assumptions

Element	Specification	
	U-value [W/m ² .K]	
External Walls	0.19	
Ground Floor	0.10	
Roof	0.10	
	U-value [W/m ² .K]	G-value
Window	1.20	0.40 (top floor corridors only) / 0.50
Rooflight	1.20	0.33
	Air permeability (@50Pa)	
	3 m ³ /m ² .h	

OCCUPANCY

The TM59 methodology specifies the hours during which spaces are anticipated to be occupied and these have been used within the overheating assessment calculations. The same occupancy assumptions apply in the dynamic thermal analysis method of Part O. Table 3 sets out the predicted occupancy patterns for the assessed rooms in line with the TM59 requirements; these are programmed into the dynamic software model to calculate the relative occupancy gains for the designated spaces.

For the communal rooms included within this assessment, CIBSE does not specify the exact hours that the spaces are occupied, and as a result the BRE estimates that are inherited for the National Calculation Methodology (NCM) are often used as a basis for the prediction of the occupied hours of different areas of occupation in overheating assessment calculations. Table 3 outlines the NCM profiles assumed for these spaces and the predicted occupation pattern associated with each profile.

Table 3: Occupancy assumptions for the room types assessed.

Area	Predicted Occupation Pattern
Single Bedroom	00:00 – 24:00, 7 days/week
Double Bedroom	00:00 – 24:00, 7 days/week
3-Bed Kitchen Living Dining	09:00 – 22:00, 7 days/week
Communal Room	09:00 – 22:00, 7 days/week

INTERNAL GAINS

For all residential units modelled, the predicted occupancy hours and internal gains (lighting, equipment, people) for occupied areas are incorporated within the model in line with the guidance set out in TM59.

Similar to occupancy hours, the BRE estimates that are inherited for the National Calculation Methodology (NCM) are often used as a basis for the prediction of internal gains (lighting, equipment, people); when information is available that is specific to the project with regards to internal gains, this is incorporated into the model to give a more accurate representation of the conditions expected in the assessed rooms. For the communal rooms assessed for the proposed development, people and equipment gains were assumed as per the NCM predictions and lighting gains were assumed based on current assumptions for the lighting specification for the development.

Table 4 sets out the various internal gains for the assessed rooms within the dwellings. Non-occupied spaces such as circulation, bathrooms and storage were modelled based on the typical internal gains specified within the TM59 methodology.

Table 4: Internal gains modelled for each room type assessed.

Area	Predicted Internal Gains		
	Lighting [W/m²]	People [peak W]	Equipment [peak W]
Double Bedroom	2.0 W/m²	150 W sensible, 110 W latent	80 W
Single Bedroom	2.0 W/m²	75 W sensible, 55 W latent	80 W
3–Bed Kitchen Living Dining	2.0 W/m²	225 W sensible, 165 W latent	450 W
Communal Room	2.0 W/m²	600 W sensible, 440 W latent	400 W

Under Part O, the inclusion of common spaces such as corridors in overheating analysis is required. As outlined in the Energy Statement, space heating and hot water to the domestic parts of the development will be provided by an Air Source Heat Pump (ASHP) system. Current design shows pipework connecting the communal system to the individual flats running through dedicated risers and directly into the bedrooms. Therefore, heat losses by the pipework will not be affecting the communal corridors.

Due to the high percentage of glazing to the communal areas and corridors of the scheme, those areas were included in the assessment, to ensure that the overheating risk is mitigated.

VENTILATION

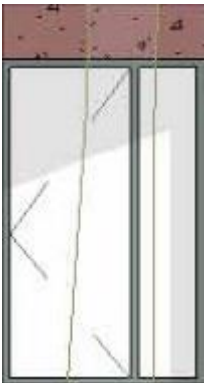
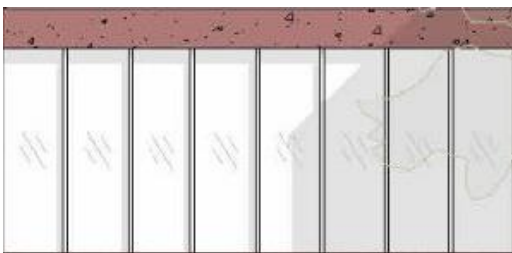
The proposed ventilation strategy for the development entails the use of Mechanical Ventilation with Heat Recovery (MVHR) for the whole year. Therefore, the estimated ventilation flow rates have been included in the model in line with Part F requirements for ventilation to provide a conservative baseline for assessment. All habitable rooms will have openable windows to provide passive natural ventilation for overheating mitigation.

The methodology outlined in Appendix D of AD O was used to calculate the equivalent area of each of the window types included within the architectural drawings received from Haptic Architects on 10th December 2024. The level of exposure and associated coefficients of discharge are set up in accordance with the relative position of each window in relation to building massing.

The equivalent areas of the different window types (with openable panes) modelled are outlined in Table 5.

Table 5: Equivalent areas for window types with openable panes modelled

Window Reference	Window Image	Window Operation	Equivalent Area
W1		Side hung (α = 90°)	33%

Window Reference	Window Image	Window Operation	Equivalent Area
W2		Side hung ($\alpha = 90^\circ$)	49%
W3		Side hung ($\alpha = 90^\circ$)	69%
W4		Side hung ($\alpha = 90^\circ$)	29%

In line with the limits on CIBSE's TM59 methodology outlined in AD O, the assumed opening profiles differ for openings to rooms at ground floor level compared to those above ground floor level that are not deemed to be easily accessible.

In order to ensure the overheating mitigation strategy is usable, AD O details further restrictions related to noise, pollution and protection from entrapment. A summary of the requirements and, where applicable, how compliance can be demonstrated for the proposed development at this stage, has been provided below.

Noise

Based on the environmental noise assessment completed by XCO2, the site is located within a "moderate risk" area as defined in Approved Document O. The received guidance indicates that the maximum equivalent area of openings permissible within the building façade during night-time would be 4% of the net floor area of the bedroom (i.e. excluding the en-suite bathroom).

XCO2 has highlighted this to the design team, so as appropriate security issues could be considered, in order to ensure safe window opening during night-time.

Pollution

Buildings located near to significant local pollution sources should be designed to minimise the intake of external air pollutants. An Air Quality Assessment has been undertaken for the proposed development at planning stage which does not identify any pollution risk for the future residents.

Security

AD O outlines requirements related to security. During sleeping hours, AD O notes that only the proportion of windows that can be opened securely should be considered to provide useful ventilation. As outlined above, for rooms unoccupied during sleeping hours (e.g., KLDs) that are at ground floor or are easily accessible, the windows have been considered safe to open to 90 degrees over daytime, while during nighttime the maximum equivalent area of openings permissible would be 4% of the net floor area of the bedroom (i.e. excluding the en-suite bathroom).

For rooms occupied during sleeping hours (e.g., bedrooms), ground floor windows and easily accessible windows should only be used for ventilation during sleeping hours where they have been made secure, specifically via the use of fixed or lockable louvred shutters or fixed or lockable window grilles or railings.

For the purpose of this assessment, the ground floor windows were assumed to open securely during nighttime. The design team will be taking into consideration the aforementioned requirements for implementation of security measures in the design.

Protection from Falling

AD O outlines specific requirements to minimise the risk of falling associated with the use of a natural ventilation strategy. Requirements are based on the degree of opening possible and guarding heights.

Protection from Entrapment

Where louvred shutters, window rails and ventilation grilles are specified in line with security requirements, these must comply with criteria to protect from entrapment related to the size of openings and the presence of child safety devices. These requirements will be considered by the design team at the next design stage, to ensure any security measures required as part of the overheating mitigation strategy comply with these requirements.

RESULTS

This section presents the results summary for each of the tests carried out for the proposed development. In total 54 habitable spaces were included in the assessment, comprising 50 double bedrooms, 2 single bedrooms and 2 KLDs. Non-habitable spaces such as bathrooms, storage rooms and circulation areas have also been included in the assessment; and their internal gains have been accounted for in the model.

Table 6 shows the modelling iterations undertaken under Swindon DSY1 weather data, the sequential improvement measures that are proposed to be incorporated for each iteration and the number of rooms that were not found to meet the CIBSE TM59 criteria at each stage. The purpose of the improvement measures proposed is to minimise the number of rooms that fail the TM59 criteria to the greatest extent possible, taking into consideration viability, feasibility and other design constraints.

RESIDENTIAL UNITS

Iteration 1, the baseline scenario, tests the performance of the building when all windows are able to open fully, 90 degrees, during both daytime and nighttime.

Iteration 2 includes a maximum window angle of 30 degrees for the ground floor bedrooms. This maximum opening angle was implemented as an assumption to allow for secure window-opening during nighttime.

Iteration 3 takes into account the acoustic restrictions to window-opening during night-time, as shown in the environmental noise assessment. The maximum equivalent area of openings permissible within the building façade during night-time would be 4% of the net floor area of the bedroom. This 4% corresponds to a larger opening area than the previously tested 30 degrees.

Detailed description of each iteration is shown in table 6 overleaf.

Table 6: Overheating assessment results for Swindon DSY1 Weather File (2020s, High, 50)

ID	Design Change	Bedrooms	KLDs	G-value	Internal Doors	Bedrooms TM59 Night-time 26°C criterion	Bedrooms TM52 Criterion 1	KLDs TM52 Criterion 1
		Window Opening Degree and Profile				No. of Rooms Not Meeting Criteria		
1	Baseline	90° Open Day & Night	90° Open During Day	0.50	Open During Day	0/52	0/52	0/2
2	Acoustic Restrictions & 30° Window Opening	90° Open Day	90° Open During Day	0.50	Open During Day	9/52	0/52	1/2
		GF 30° Open Night						
		1F Window FA 4% of Room Area at Night						
3	Acoustic Restrictions	90° Open Day & Window F.A. 4% of Room Area at Night	90° Open During Day	0.50	Open During Day	0/52	0/52	0/2

The following observations can be made from the results:

- All bedrooms and KLDs complied with both TM52 and TM59 criteria through the passive design strategy comprising the use of solar control glazing and effective use of natural ventilation with effective window opening angles and areas.
- Based on the results of iteration 2, there are 9 bedrooms failing the TM59 criteria. Those areas are located at ground floor level with a maximum window opening of 30 degrees due to security concerns at night-time.
- Iteration 3 shows that the implementation of 90 degrees opening during daytime works well with the assumption of secure opening at ground floor level, to allow for the maximum equivalent area of openings permissible at 4% of the net floor area of the bedroom. Those criteria satisfy the Part O requirements.

It should be noted that the findings of this assessment are related to planning stage design only, and any changes to the ventilation strategy, façade opening areas and window operation and shading elements will impact the performance of the building and may void the results of the current assessment.

Finally, the last iteration was applied with DSY2 and DSY3 weather types, which are more severe weather types. The results for these years are shown in the table below.

Table 7: Overheating assessment results for Swindon DSY2 and DSY3 Weather Files (2020s, High, 50)

ID	Design Change	Bedrooms	KLDs	G-value	Internal Doors	Bedrooms TM59 Night-time 26°C criterion	Bedrooms TM52 Criterion 1	KLDs TM52 Criterion 1
		Window Opening Degree and Profile				No. of Rooms Not Meeting Criteria		
4	DSY2 Weather File	90° Open Day & Window FA 4% of Room Area at Night	90° Open During Day	0.50	Open During Day	39/52	1/52	2/2

ID	Design Change	Bedrooms	KLDs	G-value	Internal Doors	Bedrooms TM59 Night-time 26°C criterion	Bedrooms TM52 Criterion 1	KLDs TM52 Criterion 1
		Window Opening Degree and Profile				No. of Rooms Not Meeting Criteria		
5	DSY3 Weather File	90° Open Day & Window FA 4% of Room Area at Night	90° Open During Day	0.50	Open During Day	52/52	29/52	2/2

The results shows that while a small portion of the assessed rooms passed overheating criteria under the DSY2 weather file, none of them passed within the DSY3 weather conditions. It is recommended that additional form of cooling to be considered in order to future-proof the building from more extreme weather conditions.

It is important to note that the performance with these criteria do not have implications in terms of compliance. The results are showing the effectiveness of the ventilation strategy at mitigating overheating during more extreme weather conditions.

COMMUNAL ROOMS

The communal room at the ground level falls within the scope of Approved Document O. To this end, this space has been assessed and the results are provided in Table 9 below.

Table 8: Communal room overheating assessment results for Swindon DSY1 Weather File (2020s, High, 50)

ID	Design Change	Weather File	G-value	% Annual Hours $T_{op} > 28^{\circ}\text{C}$	Criteria Met
1	Baseline	DSY1	0.50	4.8%	0/1
1	Reducing G-value	DSY1	0.33-0.40	3.9%	0/1
2	W4 Openable	DSY1	0.33-0.40	2.8%	1/1

The main element affecting the performance of the ground floor communal area is the adjacent corridor located directly at the floor above. Reducing the g-values of the top-floor corridor windows and rooflight to 0.40 and 0.33 respectively and considering W4 to be openable decreased overheating risk to the associated ground floor communal room. Combined, these measures are sufficient to enable compliance with the CIBSE TM52 criteria for the failing communal room at the baseline scenario.

COMMUNAL CORRIDORS

Two enclosed communal corridors were modelled to assess the overheating risk. As part of the assessed corridors, the Piazza area, located at the first floor was also tested. Although there is not a requirement for the communal corridors to be tested when there is not communal heating pipework running across the space, those particular areas were assessed. This was due to the high glazed percentage with fixed glazing of those areas, presenting high overheating risk.

Table 9: Communal corridors overheating assessment results for Swindon DSY1 Weather File (2020s, High, 50)

ID	Design Change	Weather File	Internal Gains from Communal Corridor	G-value	% Annual Hours $T_{op} > 28^{\circ}\text{C}$	Criteria Met
1	Baseline	DSY1	Y	0.50	21.6%	1/2
2	Reducing G-value	DSY1	Y	0.40	19.1%	1/2
3	W4 Openable	DSY1	Y	0.40	1.5%	2/2

Reducing the g-value of the top-floor corridor windows to 0.40 and considering W4 windows to be openable, decreased overheating risk. Together, these measures are sufficient to enable compliance with the CIBSE TM52 criteria for the failing corridor space (first floor Piazza area) at the baseline scenario.

CONCLUSIONS AND RECOMMENDATIONS

The results show that all rooms assessed are expected to achieve compliance with CIBSE TM59 and Part O for Swindon DSY1 weather data, provided that adequate design considerations are considered.

The results indicate that passive strategies enable the residential spaces to achieve full compliance with the requirements in AD O. Passive overheating risk mitigation measures include energy efficient lighting, low g-value glazing and effective use of openable windows for daytime and nighttime ventilation.

In regard to noise restrictions, the site is located within a “moderate risk” area as defined in Approved Document O. The received guidance indicates that the maximum equivalent area of openings permissible within the building façade during night-time would be 4% of the net floor area of the bedroom (i.e. excluding the en-suite bathroom). This is equivalent to 0.75m², calculated for the smallest bedroom.

Based on the results, adherence to aforementioned restrictions still allows for compliance with the TM59/Part O requirements. Essential pre-requisite includes the secure opening of the ground floor bedroom windows during night-time. XCO2 has highlighted this to the design team, so as appropriate security issues could be considered, in order to ensure safe window opening during night-time.

The communal corridors assessed were not found to present a significant risk under the DSY1 weather file through the application of passive ventilation, via openable windows. Introduction of window openings to highly glazed areas of the corridors are essential to meet the TM59 criteria. This design consideration is essential to be taken into account from the design team in order to be implemented in the scheme design.

Generally, a g-value of 0.5 should be the preferred specification to avoid overly compromising the energy performance and compliance with operational CO₂ emissions targets, whilst lower g-values of 0.33 and 0.40 are proposed to highly glazed spaces such as communal spaces to reduce solar gain and cooling demand. Table 10 summarises the design recommendations that contribute to reducing overheating risk.

Table 10: Summary of recommendations for the proposed development.

Measure	Implementation
Minimise internal heat generation through energy efficient design	
High efficiency lighting installations (LED)	Low energy LED lighting will be installed in all units.
LTHW pipework design and installations (location, configuration and insulation) to minimise heat losses.	LTHW pipework running in corridors and circulation areas to be highly insulated across the whole length, including jackets for valves and junctions. Primary distribution within the building will be vertical rather than horizontal to reduce pipe lengths.
Reduce the amount of heat entering the building	
External shade from balconies and overhangs	Slight recesses included within windows across site and terrace canopy available along certain façades.
Solar control glazing	Solar control glazing on all windows to achieve a g-value of 0.50, except for top floor corridors and rooflight for which g-values of 0.40 and 0.33 are recommended respectively.
Passive ventilation	
Natural ventilation opening	Inward opening windows, with panes openable to at least 90° for natural ventilation to KLDs and highly glazed communal areas. Ground floor and First floor windows to allow for the greatest degree of opening as is deemed feasible. Ground floor windows assumed to be able to open securely over-night.

Measure	Implementation
MVHR	Continuous background fresh air supply to each unit via MVHR systems with the following minimum flow rates: Living Spaces 13 l/s; Bedrooms 4 l/s

APPENDIX B – SBEM RESULTS

BRUKL Output Document



HM Government

Compliance with England Building Regulations Part L 2021

Project name

10.126 Drake House - Be Lean_241126

As designed

Date: Tue Nov 26 10:05:47 2024

Administrative information

Building Details

Address: Reddam House, Berkshire, RG41 5BG

Certifier details

Name: Zacharias Sifakis

Telephone number: 020 77001000

Address: 56 Kingsway Place, Sans Walk, London, EC1R 0LU

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.e.2

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.27

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 1088.54

The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	2.86
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	2.82
Target primary energy rate (TPER), kWh _{PE} /m ² annum	30.28
Building primary energy rate (BPER), kWh _{PE} /m ² annum	30.06
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.19	0.19	1F000007_W1
Floors	0.18	0.1	0.1	GF000013_F
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	0.1	0.1	1F000007_C
Windows** and roof windows	1.6	1.14	1.14	1F000001_W2_O0
Rooflights***	2.2	1.2	1.2	GR00000C_C_O0
Personnel doors^	1.6	0.98	0.98	GR000010_W1_O0
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

U_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	0.9 to 0.95

1- ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.86	0.015
Standard value	2*	N/A
* Standard shown is for all types except absorption and gas engine heat pumps.		

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard	
1F_BR1_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR1_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR2_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR2_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR3_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR3_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR4_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR4_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR5_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR5_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR6_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR6_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
1F_BR7_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
1F_BR7_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR8_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR8_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR9_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR9_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR10_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR10_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR11_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR11_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR12_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR12_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR13_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR13_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR14_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR14_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR15_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR15_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR16_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR16_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR17_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR17_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR18_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR18_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR19_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR19_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR20_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR20_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR21_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR21_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR22_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR22_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR23_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR23_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR24_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR24_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR25_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR25_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR26_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR26_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR27_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR27_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR28_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR28_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I	Zone	Standard
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1		
1F_BR29_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR29_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR30_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR30_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR31_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_BR31_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_Circulation	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_Circulation	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_Circulation	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_Circulation	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_Circulation	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_Lift	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_Luggage	-	-	-	-	1.3	-	-	-	-	0.9	N/A
1F_Piazza	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR1_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR1_Single Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR2_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR2_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR3_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR3_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR4_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR4_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR5_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR5_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR6_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR6_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR7_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR7_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR8_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR8_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR9_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR9_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR10_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR10_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR11_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR11_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR12_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR12_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR13_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR13_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR14_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR14_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A
GF_BR15_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard	
GF_BR15_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_BR16_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_BR16_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_BR17_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_BR17_Single Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_Circulation	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_Circulation	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_Circulation	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_Circulation	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_Common Room	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP1_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP1_Circulation	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP1_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP1_KLD	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP1_Single Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP1_Study Room	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP2_Bathroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP2_Circulation	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP2_Double Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP2_KLD	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP2_Single Bedroom	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_HP2_Study Room	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_Lobby	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_Office	-	-	-	-	1.3	-	-	-	-	0.9	N/A	
GF_Toilet	-	-	-	-	1.3	-	-	-	-	0.9	N/A	

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value		95	80	0.3
1F_BR1_Bathroom		125	-	-
1F_BR1_Double Bedroom		125	-	-
1F_BR2_Bathroom		125	-	-
1F_BR2_Double Bedroom		125	-	-
1F_BR3_Bathroom		125	-	-
1F_BR3_Double Bedroom		125	-	-
1F_BR4_Bathroom		125	-	-
1F_BR4_Double Bedroom		125	-	-
1F_BR5_Bathroom		125	-	-
1F_BR5_Double Bedroom		125	-	-
1F_BR6_Bathroom		125	-	-
1F_BR6_Double Bedroom		125	-	-
1F_BR7_Bathroom		125	-	-
1F_BR7_Double Bedroom		125	-	-

General lighting and display lighting		General luminaire		Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m ²]	
Standard value		95	80	0.3	
1F_BR8_Bathroom		125	-	-	
1F_BR8_Double Bedroom		125	-	-	
1F_BR9_Bathroom		125	-	-	
1F_BR9_Double Bedroom		125	-	-	
1F_BR10_Bathroom		125	-	-	
1F_BR10_Double Bedroom		125	-	-	
1F_BR11_Bathroom		125	-	-	
1F_BR11_Double Bedroom		125	-	-	
1F_BR12_Bathroom		125	-	-	
1F_BR12_Double Bedroom		125	-	-	
1F_BR13_Bathroom		125	-	-	
1F_BR13_Double Bedroom		125	-	-	
1F_BR14_Bathroom		125	-	-	
1F_BR14_Double Bedroom		125	-	-	
1F_BR15_Bathroom		125	-	-	
1F_BR15_Double Bedroom		125	-	-	
1F_BR16_Bathroom		125	-	-	
1F_BR16_Double Bedroom		125	-	-	
1F_BR17_Bathroom		125	-	-	
1F_BR17_Double Bedroom		125	-	-	
1F_BR18_Bathroom		125	-	-	
1F_BR18_Double Bedroom		125	-	-	
1F_BR19_Bathroom		125	-	-	
1F_BR19_Double Bedroom		125	-	-	
1F_BR20_Bathroom		125	-	-	
1F_BR20_Double Bedroom		125	-	-	
1F_BR21_Bathroom		125	-	-	
1F_BR21_Double Bedroom		125	-	-	
1F_BR22_Bathroom		125	-	-	
1F_BR22_Double Bedroom		125	-	-	
1F_BR23_Bathroom		125	-	-	
1F_BR23_Double Bedroom		125	-	-	
1F_BR24_Bathroom		125	-	-	
1F_BR24_Double Bedroom		125	-	-	
1F_BR25_Bathroom		125	-	-	
1F_BR25_Double Bedroom		125	-	-	
1F_BR26_Bathroom		125	-	-	
1F_BR26_Double Bedroom		125	-	-	
1F_BR27_Bathroom		125	-	-	
1F_BR27_Double Bedroom		125	-	-	
1F_BR28_Bathroom		125	-	-	
1F_BR28_Double Bedroom		125	-	-	
1F_BR29_Bathroom		125	-	-	

General lighting and display lighting		General luminaire		Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m ²]
	Standard value	95	80		0.3
1F_BR29_Double Bedroom		125	-		-
1F_BR30_Bathroom		125	-		-
1F_BR30_Double Bedroom		125	-		-
1F_BR31_Bathroom		125	-		-
1F_BR31_Double Bedroom		125	-		-
1F_Circulation		125	-		-
1F_Circulation		125	-		-
1F_Circulation		125	-		-
1F_Circulation		125	-		-
1F_Circulation		125	-		-
1F_Lift		125	-		-
1F_Luggage		125	-		-
1F_Piazza		130	-		-
GF_BR1_Bathroom		125	-		-
GF_BR1_Single Bedroom		125	-		-
GF_BR2_Bathroom		125	-		-
GF_BR2_Double Bedroom		125	-		-
GF_BR3_Bathroom		125	-		-
GF_BR3_Double Bedroom		125	-		-
GF_BR4_Bathroom		125	-		-
GF_BR4_Double Bedroom		125	-		-
GF_BR5_Bathroom		125	-		-
GF_BR5_Double Bedroom		125	-		-
GF_BR6_Bathroom		125	-		-
GF_BR6_Double Bedroom		125	-		-
GF_BR7_Bathroom		125	-		-
GF_BR7_Double Bedroom		125	-		-
GF_BR8_Bathroom		125	-		-
GF_BR8_Double Bedroom		125	-		-
GF_BR9_Bathroom		125	-		-
GF_BR9_Double Bedroom		125	-		-
GF_BR10_Bathroom		125	-		-
GF_BR10_Double Bedroom		125	-		-
GF_BR11_Bathroom		125	-		-
GF_BR11_Double Bedroom		125	-		-
GF_BR12_Bathroom		125	-		-
GF_BR12_Double Bedroom		125	-		-
GF_BR13_Bathroom		125	-		-
GF_BR13_Double Bedroom		125	-		-
GF_BR14_Bathroom		125	-		-
GF_BR14_Double Bedroom		125	-		-
GF_BR15_Bathroom		125	-		-
GF_BR15_Double Bedroom		125	-		-

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m ²]
	Standard value	95	80	0.3
GF_BR16_Bathroom		125	-	-
GF_BR16_Double Bedroom		125	-	-
GF_BR17_Bathroom		125	-	-
GF_BR17_Single Bedroom		125	-	-
GF_Circulation		125	-	-
GF_Circulation		125	-	-
GF_Circulation		125	-	-
GF_Circulation		125	-	-
GF_Common Room		130	-	-
GF_HP1_Bathroom		125	-	-
GF_HP1_Circulation		125	-	-
GF_HP1_Double Bedroom		125	-	-
GF_HP1_KLD		125	-	-
GF_HP1_Single Bedroom		125	-	-
GF_HP1_Study Room		125	-	-
GF_HP2_Bathroom		125	-	-
GF_HP2_Circulation		125	-	-
GF_HP2_Double Bedroom		125	-	-
GF_HP2_KLD		125	-	-
GF_HP2_Single Bedroom		125	-	-
GF_HP2_Study Room		125	-	-
GF_Lift		125	-	-
GF_Lobby		130	-	-
GF_Luggage		125	-	-
GF_Office		125	-	-
GF_Storage		125	-	-
GF_Storage		125	-	-
GF_Storage		125	-	-
GF_Storage		125	-	-
GF_Storage		125	-	-
GF_Toilet		125	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1F_BR1_Double Bedroom	NO (-57.2%)	NO
1F_BR2_Double Bedroom	NO (-8.3%)	NO
1F_BR3_Double Bedroom	NO (-8.2%)	NO
1F_BR4_Double Bedroom	NO (-8.2%)	NO
1F_BR5_Double Bedroom	NO (-8.3%)	NO
1F_BR6_Double Bedroom	NO (-8%)	NO
1F_BR7_Double Bedroom	NO (-8.5%)	NO
1F_BR8_Double Bedroom	NO (-68.4%)	NO
1F_BR9_Double Bedroom	NO (-78.3%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1F_BR10_Double Bedroom	NO (-36.7%)	NO
1F_BR11_Double Bedroom	NO (-36.7%)	NO
1F_BR12_Double Bedroom	NO (-36.7%)	NO
1F_BR13_Double Bedroom	NO (-36.7%)	NO
1F_BR14_Double Bedroom	NO (-36.8%)	NO
1F_BR15_Double Bedroom	NO (-5.5%)	NO
1F_BR16_Double Bedroom	NO (-41.1%)	NO
1F_BR17_Double Bedroom	NO (-54.2%)	NO
1F_BR18_Double Bedroom	NO (-4.2%)	NO
1F_BR19_Double Bedroom	NO (-3.3%)	NO
1F_BR20_Double Bedroom	NO (-3.6%)	NO
1F_BR21_Double Bedroom	NO (-3.8%)	NO
1F_BR22_Double Bedroom	NO (-3.3%)	NO
1F_BR23_Double Bedroom	NO (-3.5%)	NO
1F_BR24_Double Bedroom	NO (-66.8%)	NO
1F_BR25_Double Bedroom	NO (-67.1%)	NO
1F_BR26_Double Bedroom	NO (-3.7%)	NO
1F_BR27_Double Bedroom	NO (-4.1%)	NO
1F_BR28_Double Bedroom	NO (-3.6%)	NO
1F_BR29_Double Bedroom	NO (-4%)	NO
1F_BR30_Double Bedroom	NO (-3.9%)	NO
1F_BR31_Double Bedroom	NO (-3.5%)	NO
GF_BR1_Single Bedroom	NO (-57.2%)	NO
GF_BR2_Double Bedroom	NO (-8.3%)	NO
GF_BR3_Double Bedroom	NO (-8.2%)	NO
GF_BR4_Double Bedroom	NO (-8.2%)	NO
GF_BR5_Double Bedroom	NO (-8.3%)	NO
GF_BR6_Double Bedroom	NO (-8%)	NO
GF_BR7_Double Bedroom	NO (-36.7%)	NO
GF_BR8_Double Bedroom	NO (-36.7%)	NO
GF_BR9_Double Bedroom	NO (-3.3%)	NO
GF_BR10_Double Bedroom	NO (-3.6%)	NO
GF_BR11_Double Bedroom	NO (-3.8%)	NO
GF_BR12_Double Bedroom	NO (-3.3%)	NO
GF_BR13_Double Bedroom	NO (-4.1%)	NO
GF_BR14_Double Bedroom	NO (-3.6%)	NO
GF_BR15_Double Bedroom	NO (-4%)	NO
GF_BR16_Double Bedroom	NO (-3.9%)	NO
GF_BR17_Single Bedroom	NO (-3.5%)	NO
GF_HP1_Double Bedroom	NO (-21.6%)	NO
GF_HP1_KLD	YES (+24.6%)	NO
GF_HP1_Single Bedroom	NO (-13.1%)	NO
GF_HP1_Study Room	YES (+0.5%)	NO
GF_HP2_Double Bedroom	NO (-49.3%)	NO
GF_HP2_KLD	YES (+11.4%)	NO
GF_HP2_Single Bedroom	NO (-41.6%)	NO
GF_HP2_Study Room	YES (+52.9%)	NO
GF_Office	NO (-30.4%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	2169.9	2169.9
External area [m ²]	3417.5	3417.5
Weather	SWI	SWI
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	796.3	1118.96
Average U-value [W/m ² K]	0.23	0.33
Alpha value* [%]	31.07	19.68

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area Building Type

Retail/Financial and Professional Services
 Restaurants and Cafes/Drinking Establishments/Takeaways
 Offices and Workshop Businesses
 General Industrial and Special Industrial Groups
 Storage or Distribution
 Hotels
 Residential Institutions: Hospitals and Care Homes

92 Residential Institutions: Residential Schools

Residential Institutions: Universities and Colleges
 Secure Residential Institutions

8 Residential Spaces

Non-residential Institutions: Community/Day Centre
 Non-residential Institutions: Libraries, Museums, and Galleries
 Non-residential Institutions: Education
 Non-residential Institutions: Primary Health Care Building
 Non-residential Institutions: Crown and County Courts
 General Assembly and Leisure, Night Clubs, and Theatres
 Others: Passenger Terminals
 Others: Emergency Services
 Others: Miscellaneous 24hr Activities
 Others: Car Parks 24 hrs
 Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	3.67	6.12
Cooling	0	0
Auxiliary	6.88	3.85
Lighting	3.57	4.87
Hot water	5.71	5.35
Equipment*	10.7	10.7
TOTAL **	19.82	20.2

* Energy used by equipment does not count towards the total for consumption or calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>0</i>	<i>0</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	96.78	91.71
Primary energy [kWh _{PE} /m ²]	30.06	30.28
Total emissions [kg/m ²]	2.82	2.86

HVAC Systems Performance										
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	32.8	64	3.7	0	6.9	2.48	0	2.64	0
	Notional	58.2	33.5	6.1	0	3.4	2.64	0	----	----

Key to terms

- Heat dem [MJ/m2] = Heating energy demand
- Cool dem [MJ/m2] = Cooling energy demand
- Heat con [kWh/m2] = Heating energy consumption
- Cool con [kWh/m2] = Cooling energy consumption
- Aux con [kWh/m2] = Auxiliary energy consumption
- Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
- Cool SSEER = Cooling system seasonal energy efficiency ratio
- Heat gen SSEFF = Heating generator seasonal efficiency
- Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
- ST = System type
- HS = Heat source
- HFT = Heating fuel type
- CFT = Cooling fuel type

BRUKL Output Document



Compliance with England Building Regulations Part L 2021

Project name

10.126 Drake House - Be Green with PV

As designed

Date: Mon Nov 25 18:59:24 2024

Administrative information

Building Details

Address: Reddam House, Berkshire, RG41 5BG

Certifier details

Name: Zacharias Sifakis

Telephone number: 020 77001000

Address: 56 Kingsway Place, Sans Walk, London, EC1R 0LU

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.e.2

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.27

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 1088.54

The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	2.86
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	2.23
Target primary energy rate (TPER), kWh _{PE} /m ² annum	30.28
Building primary energy rate (BPER), kWh _{PE} /m ² annum	23.28
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.19	0.19	1F000007_W1
Floors	0.18	0.1	0.1	GF000013_F
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	0.1	0.1	1F000007_C
Windows** and roof windows	1.6	1.14	1.14	1F000001_W2_O0
Rooflights***	2.2	1.2	1.2	GR00000C_C_O0
Personnel doors^	1.6	0.98	0.98	GR000010_W1_O0
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

U_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	0.9 to 0.95

1- ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.37	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	3.37	0.015
Standard value	2*	N/A
* Standard shown is for all types except absorption and gas engine heat pumps.		

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1			
1F_BR1_Bathroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR1_Double Bedroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR2_Bathroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR2_Double Bedroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR3_Bathroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR3_Double Bedroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR4_Bathroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR4_Double Bedroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR5_Bathroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR5_Double Bedroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR6_Bathroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR6_Double Bedroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A
1F_BR7_Bathroom	-	-	-	-	1.5	-	-	-	-		0.83	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I	Zone	Standard
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1		
1F_BR7_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR8_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR8_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR9_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR9_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR10_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR10_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR11_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR11_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR12_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR12_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR13_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR13_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR14_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR14_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR15_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR15_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR16_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR16_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR17_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR17_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR18_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR18_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR19_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR19_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR20_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR20_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR21_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR21_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR22_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR22_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR23_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR23_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR24_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR24_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR25_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR25_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR26_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR26_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR27_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR27_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR28_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR28_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
1F_BR29_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR29_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR30_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR30_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR31_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_BR31_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_Circulation	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_Circulation	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_Circulation	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_Circulation	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_Circulation	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_Lift	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_Luggage	-	-	-	-	1.5	-	-	-	-	0.83	N/A
1F_Piazza	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR1_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR1_Single Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR2_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR2_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR3_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR3_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR4_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR4_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR5_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR5_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR6_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR6_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR7_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR7_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR8_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR8_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR9_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR9_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR10_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR10_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR11_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR11_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR12_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR12_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR13_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR13_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR14_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR14_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR15_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
GF_BR15_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR16_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR16_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR17_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_BR17_Single Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_Circulation	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_Circulation	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_Circulation	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_Circulation	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_Common Room	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP1_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP1_Circulation	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP1_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP1_KLD	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP1_Single Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP1_Study Room	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP2_Bathroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP2_Circulation	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP2_Double Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP2_KLD	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP2_Single Bedroom	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_HP2_Study Room	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_Lobby	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_Office	-	-	-	-	1.5	-	-	-	-	0.83	N/A
GF_Toilet	-	-	-	-	1.5	-	-	-	-	0.83	N/A

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value		95	80	0.3
1F_BR1_Bathroom		125	-	-
1F_BR1_Double Bedroom		125	-	-
1F_BR2_Bathroom		125	-	-
1F_BR2_Double Bedroom		125	-	-
1F_BR3_Bathroom		125	-	-
1F_BR3_Double Bedroom		125	-	-
1F_BR4_Bathroom		125	-	-
1F_BR4_Double Bedroom		125	-	-
1F_BR5_Bathroom		125	-	-
1F_BR5_Double Bedroom		125	-	-
1F_BR6_Bathroom		125	-	-
1F_BR6_Double Bedroom		125	-	-
1F_BR7_Bathroom		125	-	-
1F_BR7_Double Bedroom		125	-	-

General lighting and display lighting		General luminaire		Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m ²]	
Standard value		95	80	0.3	
1F_BR8_Bathroom		125	-	-	
1F_BR8_Double Bedroom		125	-	-	
1F_BR9_Bathroom		125	-	-	
1F_BR9_Double Bedroom		125	-	-	
1F_BR10_Bathroom		125	-	-	
1F_BR10_Double Bedroom		125	-	-	
1F_BR11_Bathroom		125	-	-	
1F_BR11_Double Bedroom		125	-	-	
1F_BR12_Bathroom		125	-	-	
1F_BR12_Double Bedroom		125	-	-	
1F_BR13_Bathroom		125	-	-	
1F_BR13_Double Bedroom		125	-	-	
1F_BR14_Bathroom		125	-	-	
1F_BR14_Double Bedroom		125	-	-	
1F_BR15_Bathroom		125	-	-	
1F_BR15_Double Bedroom		125	-	-	
1F_BR16_Bathroom		125	-	-	
1F_BR16_Double Bedroom		125	-	-	
1F_BR17_Bathroom		125	-	-	
1F_BR17_Double Bedroom		125	-	-	
1F_BR18_Bathroom		125	-	-	
1F_BR18_Double Bedroom		125	-	-	
1F_BR19_Bathroom		125	-	-	
1F_BR19_Double Bedroom		125	-	-	
1F_BR20_Bathroom		125	-	-	
1F_BR20_Double Bedroom		125	-	-	
1F_BR21_Bathroom		125	-	-	
1F_BR21_Double Bedroom		125	-	-	
1F_BR22_Bathroom		125	-	-	
1F_BR22_Double Bedroom		125	-	-	
1F_BR23_Bathroom		125	-	-	
1F_BR23_Double Bedroom		125	-	-	
1F_BR24_Bathroom		125	-	-	
1F_BR24_Double Bedroom		125	-	-	
1F_BR25_Bathroom		125	-	-	
1F_BR25_Double Bedroom		125	-	-	
1F_BR26_Bathroom		125	-	-	
1F_BR26_Double Bedroom		125	-	-	
1F_BR27_Bathroom		125	-	-	
1F_BR27_Double Bedroom		125	-	-	
1F_BR28_Bathroom		125	-	-	
1F_BR28_Double Bedroom		125	-	-	
1F_BR29_Bathroom		125	-	-	

General lighting and display lighting		General luminaire		Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m ²]
	Standard value	95	80		0.3
1F_BR29_Double Bedroom		125	-		-
1F_BR30_Bathroom		125	-		-
1F_BR30_Double Bedroom		125	-		-
1F_BR31_Bathroom		125	-		-
1F_BR31_Double Bedroom		125	-		-
1F_Circulation		125	-		-
1F_Circulation		125	-		-
1F_Circulation		125	-		-
1F_Circulation		125	-		-
1F_Circulation		125	-		-
1F_Lift		125	-		-
1F_Luggage		125	-		-
1F_Piazza		130	-		-
GF_BR1_Bathroom		125	-		-
GF_BR1_Single Bedroom		125	-		-
GF_BR2_Bathroom		125	-		-
GF_BR2_Double Bedroom		125	-		-
GF_BR3_Bathroom		125	-		-
GF_BR3_Double Bedroom		125	-		-
GF_BR4_Bathroom		125	-		-
GF_BR4_Double Bedroom		125	-		-
GF_BR5_Bathroom		125	-		-
GF_BR5_Double Bedroom		125	-		-
GF_BR6_Bathroom		125	-		-
GF_BR6_Double Bedroom		125	-		-
GF_BR7_Bathroom		125	-		-
GF_BR7_Double Bedroom		125	-		-
GF_BR8_Bathroom		125	-		-
GF_BR8_Double Bedroom		125	-		-
GF_BR9_Bathroom		125	-		-
GF_BR9_Double Bedroom		125	-		-
GF_BR10_Bathroom		125	-		-
GF_BR10_Double Bedroom		125	-		-
GF_BR11_Bathroom		125	-		-
GF_BR11_Double Bedroom		125	-		-
GF_BR12_Bathroom		125	-		-
GF_BR12_Double Bedroom		125	-		-
GF_BR13_Bathroom		125	-		-
GF_BR13_Double Bedroom		125	-		-
GF_BR14_Bathroom		125	-		-
GF_BR14_Double Bedroom		125	-		-
GF_BR15_Bathroom		125	-		-
GF_BR15_Double Bedroom		125	-		-

General lighting and display lighting		General luminaire	Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m ²]
	Standard value	95	80	0.3
GF_BR16_Bathroom		125	-	-
GF_BR16_Double Bedroom		125	-	-
GF_BR17_Bathroom		125	-	-
GF_BR17_Single Bedroom		125	-	-
GF_Circulation		125	-	-
GF_Circulation		125	-	-
GF_Circulation		125	-	-
GF_Circulation		125	-	-
GF_Common Room		130	-	-
GF_HP1_Bathroom		125	-	-
GF_HP1_Circulation		125	-	-
GF_HP1_Double Bedroom		125	-	-
GF_HP1_KLD		125	-	-
GF_HP1_Single Bedroom		125	-	-
GF_HP1_Study Room		125	-	-
GF_HP2_Bathroom		125	-	-
GF_HP2_Circulation		125	-	-
GF_HP2_Double Bedroom		125	-	-
GF_HP2_KLD		125	-	-
GF_HP2_Single Bedroom		125	-	-
GF_HP2_Study Room		125	-	-
GF_Lift		125	-	-
GF_Lobby		130	-	-
GF_Luggage		125	-	-
GF_Office		125	-	-
GF_Storage		125	-	-
GF_Storage		125	-	-
GF_Storage		125	-	-
GF_Storage		125	-	-
GF_Storage		125	-	-
GF_Toilet		125	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1F_BR1_Double Bedroom	NO (-57.2%)	NO
1F_BR2_Double Bedroom	NO (-8.3%)	NO
1F_BR3_Double Bedroom	NO (-8.2%)	NO
1F_BR4_Double Bedroom	NO (-8.2%)	NO
1F_BR5_Double Bedroom	NO (-8.3%)	NO
1F_BR6_Double Bedroom	NO (-8%)	NO
1F_BR7_Double Bedroom	NO (-8.5%)	NO
1F_BR8_Double Bedroom	NO (-68.4%)	NO
1F_BR9_Double Bedroom	NO (-78.3%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1F_BR10_Double Bedroom	NO (-36.7%)	NO
1F_BR11_Double Bedroom	NO (-36.7%)	NO
1F_BR12_Double Bedroom	NO (-36.7%)	NO
1F_BR13_Double Bedroom	NO (-36.7%)	NO
1F_BR14_Double Bedroom	NO (-36.8%)	NO
1F_BR15_Double Bedroom	NO (-5.5%)	NO
1F_BR16_Double Bedroom	NO (-41.1%)	NO
1F_BR17_Double Bedroom	NO (-54.2%)	NO
1F_BR18_Double Bedroom	NO (-4.2%)	NO
1F_BR19_Double Bedroom	NO (-3.3%)	NO
1F_BR20_Double Bedroom	NO (-3.6%)	NO
1F_BR21_Double Bedroom	NO (-3.8%)	NO
1F_BR22_Double Bedroom	NO (-3.3%)	NO
1F_BR23_Double Bedroom	NO (-3.5%)	NO
1F_BR24_Double Bedroom	NO (-66.8%)	NO
1F_BR25_Double Bedroom	NO (-67.1%)	NO
1F_BR26_Double Bedroom	NO (-3.7%)	NO
1F_BR27_Double Bedroom	NO (-4.1%)	NO
1F_BR28_Double Bedroom	NO (-3.6%)	NO
1F_BR29_Double Bedroom	NO (-4%)	NO
1F_BR30_Double Bedroom	NO (-3.9%)	NO
1F_BR31_Double Bedroom	NO (-3.5%)	NO
GF_BR1_Single Bedroom	NO (-57.2%)	NO
GF_BR2_Double Bedroom	NO (-8.3%)	NO
GF_BR3_Double Bedroom	NO (-8.2%)	NO
GF_BR4_Double Bedroom	NO (-8.2%)	NO
GF_BR5_Double Bedroom	NO (-8.3%)	NO
GF_BR6_Double Bedroom	NO (-8%)	NO
GF_BR7_Double Bedroom	NO (-36.7%)	NO
GF_BR8_Double Bedroom	NO (-36.7%)	NO
GF_BR9_Double Bedroom	NO (-3.3%)	NO
GF_BR10_Double Bedroom	NO (-3.6%)	NO
GF_BR11_Double Bedroom	NO (-3.8%)	NO
GF_BR12_Double Bedroom	NO (-3.3%)	NO
GF_BR13_Double Bedroom	NO (-4.1%)	NO
GF_BR14_Double Bedroom	NO (-3.6%)	NO
GF_BR15_Double Bedroom	NO (-4%)	NO
GF_BR16_Double Bedroom	NO (-3.9%)	NO
GF_BR17_Single Bedroom	NO (-3.5%)	NO
GF_HP1_Double Bedroom	NO (-21.6%)	NO
GF_HP1_KLD	YES (+24.6%)	NO
GF_HP1_Single Bedroom	NO (-13.1%)	NO
GF_HP1_Study Room	YES (+0.5%)	NO
GF_HP2_Double Bedroom	NO (-49.3%)	NO
GF_HP2_KLD	YES (+11.4%)	NO
GF_HP2_Single Bedroom	NO (-41.6%)	NO
GF_HP2_Study Room	YES (+52.9%)	NO
GF_Office	NO (-30.4%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m ²]	2169.9	2169.9
External area [m ²]	3417.5	3417.5
Weather	SWI	SWI
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	796.3	1118.96
Average U-value [W/m ² K]	0.23	0.33
Alpha value* [%]	31.07	19.68

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area Building Type

Retail/Financial and Professional Services
 Restaurants and Cafes/Drinking Establishments/Takeaways
 Offices and Workshop Businesses
 General Industrial and Special Industrial Groups
 Storage or Distribution
 Hotels
 Residential Institutions: Hospitals and Care Homes

92 Residential Institutions: Residential Schools

Residential Institutions: Universities and Colleges
 Secure Residential Institutions

8 Residential Spaces

Non-residential Institutions: Community/Day Centre
 Non-residential Institutions: Libraries, Museums, and Galleries
 Non-residential Institutions: Education
 Non-residential Institutions: Primary Health Care Building
 Non-residential Institutions: Crown and County Courts
 General Assembly and Leisure, Night Clubs, and Theatres
 Others: Passenger Terminals
 Others: Emergency Services
 Others: Miscellaneous 24hr Activities
 Others: Car Parks 24 hrs
 Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	3.21	6.12
Cooling	0	0
Auxiliary	8.02	3.85
Lighting	3.57	4.87
Hot water	4.84	5.35
Equipment*	10.7	10.7
TOTAL **	19.65	20.2

* Energy used by equipment does not count towards the total for consumption or calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	4.41	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>4.41</i>	<i>0</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	97.97	91.71
Primary energy [kWh _{PE} /m ²]	23.28	30.28
Total emissions [kg/m ²]	2.23	2.86

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	36.6	61.4	3.2	0	8	3.17	0	3.37	0
Notional	58.2	33.5	6.1	0	3.4	2.64	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

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