

RIDGE

PROPERTY & CONSTRUCTION CONSULTANTS

Cover Storey

A r c h i t e c t s

VAHNEA STUDENT RESIDENCES
BOGNOR REGIS
SUSTAINABILITY AND ENERGY EFFICIENCY REPORT
16 February 2018

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VERSION CONTROL

University of Chichester Student Accommodation, Bognor Regis

Project No. 5003588

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1. INTRODUCTION

1.1 Overview

Ridge & Partners LLP have been appointed by Cover Storey Architects to complete a Sustainability and Energy Efficiency Report for the Vahnea Student Residences development, Bognor Regis.

The proposed scheme is a part conversion and extension of an existing building to provide 6 additional storeys over the existing rooftop, to provide for up to 104 student residential units, with access from Bedford Street, associated servicing and ancillary accommodation. The scheme also includes an entrance and staircore extension to the existing building to provide access from Bedford Street.

In order to demonstrate that energy and sustainability requirements set out in the Building Regulations and local planning policy will be met- analysis has been undertaken using energy modelling software to identify the most appropriate, commercially viable strategies to meet the site low carbon targets.

1.2 Project Background

The scheme is a new student residences development that is proposed to include two main connected cores - a 6 storey block and a 1 storey block, with a shared courtyard.

The development plot is shown in Figure 1.1, below. The Application Site is located on Bedford Street within the retail district of Bognor Regis.



Figure 1.1 – Aerial View of Application Site (with boundary line indicated in red)

The development proposals are shown illustratively in the section included as Figure 1.2, below.

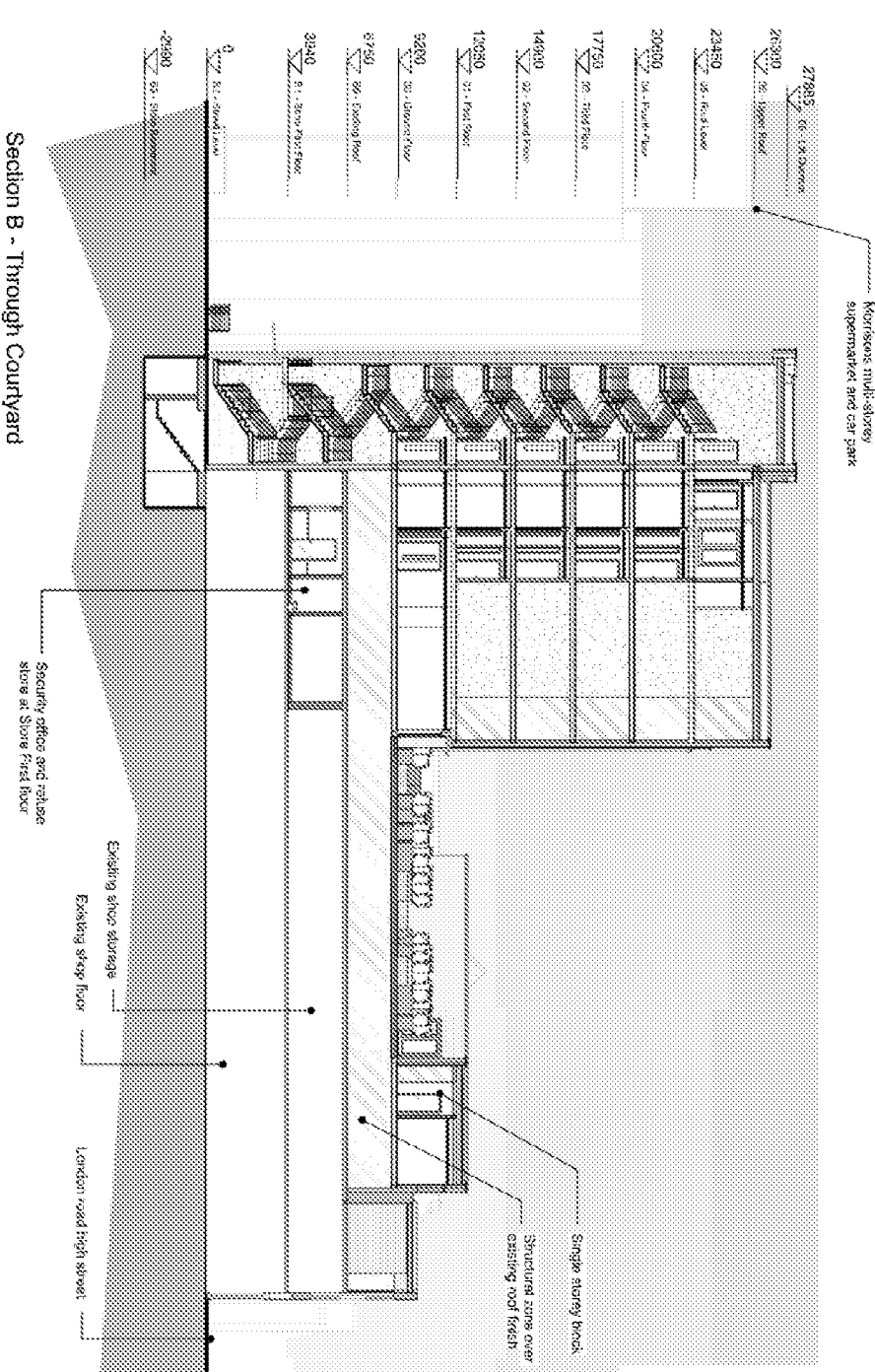


Figure 1.2 – Section (Image Source: Drawing produced by Cover Storey Architects)

1.3 Objectives

The overarching objectives of this report are:

- To demonstrate to the Planning Authority, Arun District Council, that the proposed development will comply with their core policies.
- To provide an initial assessment of the measures required to comply with the Building Regulations Part L 2013, "Conservation of Fuel and Power";
- To demonstrate how many BREEAM ENE01 credits are achievable with the proposed energy strategy for the site; and
- To contribute to the development of a low carbon strategy for the site which will be carried through to detail design, construction and operation.

2. POLICY CONTEXT

2.1 Overview

This report supplements the planning application for the proposed Vahnea Student Residence development, Bognor Regis, and aims to address strategic issues raised by local, regional and national policies relating to climate change and sustainability.

There is increasing awareness and legislation regarding low and zero carbon (LZC) technologies in the built environment. Rather than considering alternative energy sources at the end of a development, stakeholders are increasingly recognising the benefits of an early appraisal of such technologies.

Against a context of the relevant planning policies, this report focuses on minimising energy consumption during the life of the development, supplemented by on-site LZC energy sources where feasible.

The proposed development site is located within the jurisdiction of Arun District Council. The energy and sustainability strategy for the Vahnea Student Residences scheme, Bognor Regis, has been developed in accordance with the requirements set out in the *Arun Local Plan 2011-2031*. These energy performance requirements are above and beyond the standards outlined within the 2013 revision of Part L of the Building Regulations (Conservation of Fuel and Power).

2.2 Arun Local Plan 2011-2031

The *Arun Local Plan 2011 – 2031* sets out Arun District Council's vision for the development of Arun up to 2031. The Plan contains strategic and development management planning policies that will shape the future of the area and will inform the consideration of planning applications.

The Arun District Council promotes sustainable development to reduce the effects of global warming. There are a number of key policies within the *Arun Local Plan 2011-2013* that outline Arun District Council's approach to low carbon development.

The *Arun Local Plan 2011-2031* stipulates that development in the District must be designed to mitigate against the impacts of climate change by reducing the greenhouse gas emissions in line with the Energy Hierarchy. The Energy Hierarchy is outlined below:

1. Reduce the use of energy;
2. Use energy more efficiently;
3. Move to energy from renewable sources; and
4. Use remaining fossil fuels cleanly.

Three key policies relating to energy usage are Policy ECC SP1 – Adapting to Climate Change, Policy ECC SP2 – Energy and Climate Change Mitigation and Policy ECC DM1 – Renewable Energy. These policies are detailed below:-

Policy ECC SP1 – Adapting to Climate Change

The Council will support development which is located and appropriately designed to adapt to impacts arising from climate change such as the increased probability of tidal and fluvial flooding; water stress; health impacts as a result of extreme temperatures and a decline in the quality of habitats and richness of biodiversity.

In order to achieve this, development must be designed to take account of the following issues:

- a. Location (in relation to flood risk and vulnerability to coastal erosion);
- b. Water efficiency;
- c. Shade, cooling, ventilation, solar gain;
- d. Connectivity to the green infrastructure network;
- e. Layout and massing;
- f. Resilience of buildings and building material to extreme weather events; and
- g. Capacity of drainage systems and incorporation of Sustainable Urban Drainage Systems (SuDS)

Policy ECC SP2 – Energy and Climate Change Mitigation

All new residential and commercial development (including conversions, extensions and changes of use) will be expected to be energy efficient and to demonstrate how they will:

- a. Achieve energy efficiency measures that reflect the standards in Part L of the Building Regulations (or any documentation which supersedes this), or the level of the Code for Sustainable Homes or appropriate BREEAM rating, applicable at the time of submission;
- b. Use design and layout to promote energy efficiency; and
- c. Incorporate decentralised, renewable and low carbon energy supply systems, for example small scale renewable energy systems such as solar panels.

All major developments must produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site, unless it can be demonstrated that this is unviable. Energy efficiency measures will be taken into consideration when the total predicted energy requirements are calculated. The Council will consider "allowable solutions" where it is clearly demonstrated that the provision of onsite renewable or low carbon energy generation is unviable or not feasible.

Policy ECC DM1 – Renewable Energy

The Council will support renewable energy development subject to the criteria in this Policy. Schemes will be expected to contribute to the social, economic and environmental development and overall regeneration of the District.

Within areas of protected or sensitive landscapes, areas or buildings, development should generally be small scale or community based.

The Council will support proposals for appropriately located renewable energy development, and their ancillary development where they meet the following criteria:

- a. The proposal is located and designed to minimise adverse impacts to landscape, habitats, the historic environment and residential amenity including visual, noise and odour impacts;
- b. The location and design of proposals will need to take account of the Council's landscape assessment and landscape sensitivity studies (or successor documents) and proposals for large scale renewable energy projects will need to be supported by a zone of theoretical visibility and viewpoint assessment;
- c. Proposals will need to demonstrate that there are no detrimental cumulative impacts on landscape character, biodiversity, key species or residential amenity;

- d. *Proposals located within or close to the boundaries of areas designated for their landscape, ecological, or historic interest should demonstrate that development will not impact upon the purposes of designation;*
- e. *Proposals will need to demonstrate the potential benefits of the development to the host communities and identify opportunities for environmental enhancement;*
- f. *Priority should be given to proposals that integrate with existing or new development where appropriate to do so having regard to (a);*
- g. *For proposals that make use of biomass or energy crops, applicants will need to demonstrate the proposal is appropriately located so that it will not result in the loss of high grade agricultural land and to the local transport network and that the network has sufficient capacity to safely absorb additional traffic resulting from the development; and*
- h. *All proposals will need to demonstrate a suitable connection to the electricity distribution network, or appropriate energy storage facility, and provide evidence to demonstrate that the connection will not result in unacceptable impacts upon the landscape, natural and historic environment or visual and residential amenity.*

Scheme falling within landscape or nature designations will be considered where there are no alternatives and where a considerable community benefit is demonstrated and considered to outweigh the landscape impact.

2.3 Key Planning Policy Energy Performance Targets

In summary, the key energy performance targets outlined in the core policies of the *Arun Local Plan 2011 – 2031* are as below:

- Development of an energy strategy in line with the principles outlined in the Energy Hierarchy; and
- Demonstrate that 10% of the building energy requirements for the scheme will be met from renewable or low carbon sources.

3. ENERGY HIERARCHY – REDUCE THE USE OF ENERGY

3.1 Overview

In line with the energy hierarchy referenced in the *Arun Local Plan 2011-2031*, in the first instance passive energy saving measures have been assessed for their applicability to the site. Some of the factors that can affect the energy requirements of a building include:

- Location and orientation;
- Building layout and form;
- Building occupancy type;
- Construction methods; and
- Properties of the building envelope.

3.2 Application of Passive Design Principles

Passive design uses local climatic conditions to reduce the amount of applied energy required to heat, cool or light a building. For example, passive solar gain via south facing windows can reduce the heating requirements of a space, although this must be balanced against the risk of excessive solar gains in summer. Passive design centres around the building envelope and its relationship with its surroundings. Some of the key passive design measures will be detailed within this section of the report.

3.3 Building Form

The building disposition has been largely dictated through the size and form of the Wilko store below, and the need to integrate the massing of the scheme with the surrounding context of the development.

The provision of glazing to occupied spaces can aid in allowing beneficial solar gains in the heating season, but extensive glazing could also increase overheating risk. A balance has been struck on this scheme, with the aim of providing sufficient glazing to provide adequate daylighting and beneficial solar heat gains, whilst not providing excessive glazing that could lead to occupant comfort issues. Dynamic thermal modelling will be undertaken as the design for the scheme progresses to develop the thermal comfort strategy for the scheme further.

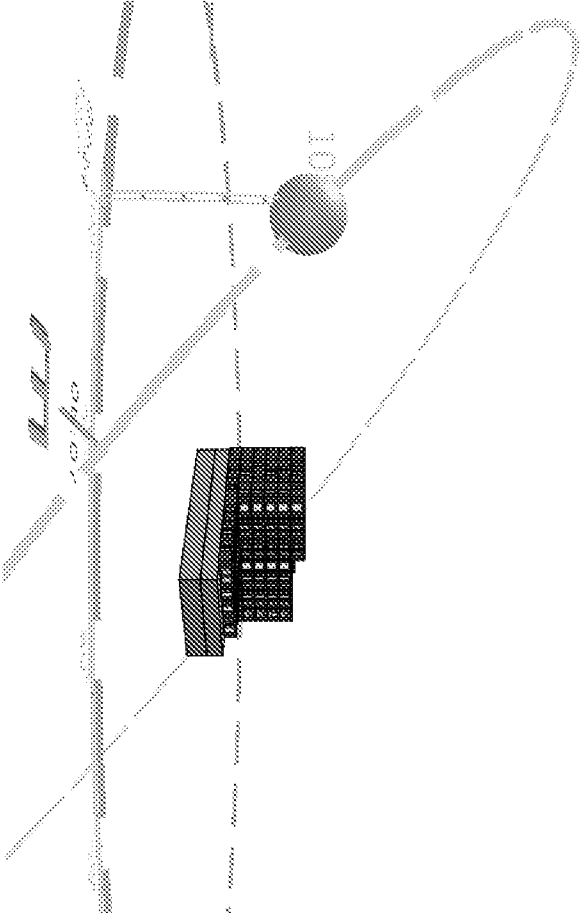


Figure 3.1 – IES Model Visual

Additionally, it is proposed to install glazing with performance in line with the properties detailed in Table 3.1. Solar control glazing with a G value of 0.4 will aid in controlling solar heat gains, whilst a visible light transmittance of approximately 65% will aid in ensuring that adequate daylighting is still maintained.

Table 3.1 – Further Glazing Properties

ELEMENT	PERFORMANCE TARGET
Glazing Solar Transmission (%)	40
Visible Light Transmittance (%)	65

3.4 Part L Compliance

Part L of the Building Regulations sets out the minimum standards for the energy performance of new and existing buildings.

The extension areas of the proposed scheme will constitute the majority of the new halls of residence. As the extension to the building is over 100m² in size and constitutes more than 25% of the total useful floor area of the existing building, it will be assessed for compliance against Part L2A of the Building Regulations.

The material change of use areas of the scheme (within the existing shell of the Wilkinsons building) will form a significantly smaller proportion of the works and will be assessed against Part L2B of the Building Regulations.

The approach that is proposed for the material change of use areas of the scheme is outlined below:

- Fixed building services are to meet the efficiency requirements stipulated in the Non-Domestic Building Services Compliance Guide.
- Fabric improvements/ renovations will meet the requirements and threshold limits detailed in Section 5 of Part L2B.

3.5 Building Envelope Thermal Performance

The specification of building elements with low U values on a scheme can facilitate significant energy savings by reducing the heat loss from the building during the heating season, and therefore the associated energy usage of the heating system.

Table 3.2 demonstrates the improvements that are proposed for the building fabric thermal performance of the extension areas of the scheme over Part L2A limiting standards.

Table 3.2 –Building Fabric Performance Targets for Extension

ELEMENT	PERFORMANCE TARGET	PART L2A LIMITING VALUES	IMPROVEMENT
External Wall U Value (W/m ² K)	0.18	0.35	48.6%
Glazing U Value (W/m ² K)	1.4	2.2	36.4%
Heat Loss Floor U Value (W/m ² K)	0.16	0.25	36%
Roof U Value (W/m ² K)	0.16	0.25	36%
Glazing Solar Transmission (%)	0.4		
Air Permeability (m ³ /hr.m ² @ 50Pa)	5	10	50%

For the material change of use areas of the scheme- the fabric improvements and renovations will meet the requirements of Part L2B. Further analysis of the existing building fabric at detailed design stage will determine where Part L1B threshold levels are currently met and therefore inform the finalised approach for these areas of the scheme.

4. ENERGY HIERARCHY – USE ENERGY MORE EFFICIENTLY

4.1 Overview

In line with the energy hierarchy outlined in the *Arun Local Plan 2011-2031*, the second step is assessing methods of efficiently using energy within the scheme.

The Building Regulations Part L2A document the 'Non-Domestic Building Services Compliance Guide (2013)' states the minimum requirements for fixed building services. It is proposed that the efficiency of the proposed fixed building services plant for this scheme will meet/exceed the minimum standards set out in this Guide. This section of the report will address the energy reducing strategy to be adopted for primary system energy uses within the development.

4.2 Boiler Technology

All boilers will be specified to achieve a seasonal efficiency in excess of 95%. The specification will also ensure that the flue gas emissions from boilers will reflect the most stringent criteria for NO_x (nitrous oxide) in the pollution category of BREEAM. The NO_x levels for the boilers will be ≤40mg/kWh.

4.3 Reduction of Domestic Hot Water Loads

BREEAM water conservation credits have been targeted in the BREEAM Pre-Assessment undertaken for the scheme. Therefore, the domestic hot water (DHW) consumption will be reduced and a saving in DHW system energy requirements will be achieved.

It is proposed that the DHW storage cylinder/s will come equipped with factory installed insulation and that all DHW service flow, return and secondary return pipework will be fully insulated to reduce heat losses.

4.4 Heat Recovery Ventilation Systems

For an air tight building with air permeability equal to or less than 5.0m³/m².hr it would be appropriate for heat recovery systems to be installed- it is therefore proposed to incorporate Mechanical Ventilation with Heat Recovery (MVHR) systems within the student clusters that comprise the scheme. These systems have the capability to recoup heat from the extracted warmed air and transfer it to the incoming fresh air supply stream. This reduces heat lost in the heating season and therefore can reduce the overall heating load of a development significantly. In the summer condition, MVHR systems can be equipped with a bypass function when the heat recovery function is not required.

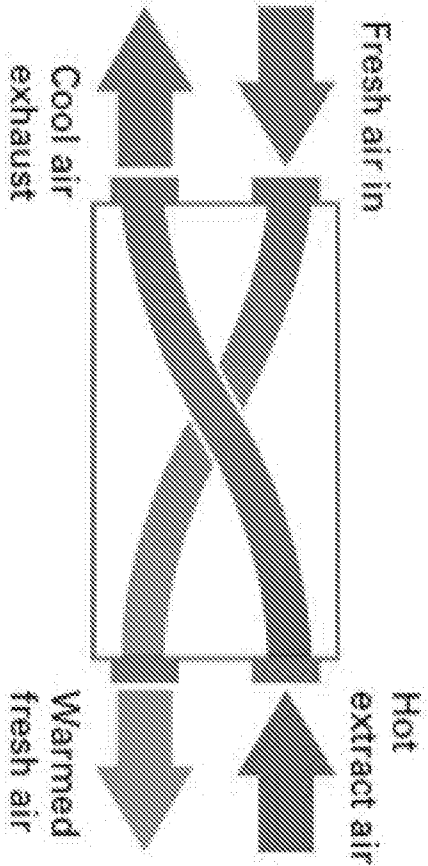


Figure 4.1 – MVHR Diagram (Image Source: www.nfan.co.uk)

4.5 Lighting

It is proposed to install energy efficient lighting systems throughout the scheme to aid in reducing the electrical loads associated with these systems.

External Lighting

In line with the requirements of BREEAM, it is proposed that the following criteria will be met for the external lighting design:-

1. The average initial luminous efficacy of the external light fittings within the construction zone is not less than 60 luminaire lumens per circuit Watt.
2. All external light fittings are automatically controlled for prevention of operation during daylight hours and presence detection in areas of intermittent pedestrian traffic.

Internal Lighting

Energy efficiency will be an important consideration in the detailed design of the internal lighting systems on the scheme. It is proposed to install LED light fittings throughout.

Additionally, it is proposed to install occupancy sensing lighting controls, as detailed in Table 4.1, below, to reduce the use of energy in these spaces when they are unoccupied.

Table 4.1 – Absence Sensing Lighting Controls

SPACE TYPE	SWITCHING TYPE
Flat Kitchens	Man-on-auto-off
Office/ Post Room	Man-on-auto-off
Laundry	Auto-on-auto-off
Cycle Store	Auto-on-auto-off
Bin Store	Auto-on-auto-off
Corridors/ Circulation Areas	Auto-on-auto-off

4.6 Reduction of Non-Building Regulations Loads

Loads associated with equipment other than fixed building services are not regulated as part of the Part L2A energy performance calculations that have been undertaken for the scheme. It is proposed to mitigate the energy usage of unregulated energy systems as detailed below.

Lifts

In line with the BREEAM requirements, it is anticipated that an analysis of the transportation demand and usage patterns will be undertaken at detailed design stage to determine the optimum no. of and size of lifts and that the energy consumptions reported within this analysis will be calculated in line with BS EN ISO 25745.

Further in line with the BREEAM requirements, it is proposed that the following energy saving measures are specified at detailed design stage:

1. The lifts operate in a standby position during off peak periods. For example, the power side of the lift controller and other operating equipment such as lift car lighting, user displays and ventilation fans switch off when the lift has been idle for a prescribed length of time.
2. The lift car lighting and display lighting provides an average lamp efficacy, (across all fittings in the car) of >55 lamp lumens/ circuit Watt.
3. The lift uses a drive controller capable of variable speed, variable voltage, and variable-frequency control of the drive motor.

General

All other non-regulated equipment loads are to meet the requirements of the targeted BREEAM Ene08 credits. For small power plug in equipment, the requirements set out for this credit are as below:

1. For office equipment, supplementary electric heating and other small powered equipment it will be necessary for these items to be Energy Star rated OR procured in accordance with the Government Buying Standards.
2. For domestic scale white goods that are provided the following ratings should be achieved in the EU Energy Efficiency Labelling Scheme:

Fridges/ Fridge-freezers: A+
Washing Machines: A++
Dishwashers: A+
Washer-dryers: A

4.7 Building Services Controls Systems

An automatic controls system will be specified at detailed design stage to operate, control and monitor all central plant. It is anticipated that its performance will exceed the requirements of Part L and will optimize energy use. A controls interface will be allowed for which will allow monitoring and logging of the building's energy use via sub-metering systems.

4.8 Log Book

A Building Log Book will be provided to the Client as required by the Building Regulations. This document will contain information on the operation and predicted energy use of various systems and will assist the building management team in operating an energy efficient building. A Building User Guide will be supplied in the format set out by the BREEAM assessment requirements.

5. ENERGY HIERARCHY – LZC TECHNOLOGIES

5.1 Overview

In line with the Energy Hierarchy, after the feasibility of lean measures have been assessed, the next step is to consider the application of renewable technologies to a scheme. Renewable energy is generated from natural resources – such as sun, wind, water, geothermal heat – utilising technology to harness the energy without compromising the ability of the energy stores to naturally replenish.

This section of the report will assess the feasibility of the adoption of a range of renewable technologies to the Vahnea Student Residences development.

The Low and Zero Carbon (LZC) technologies listed below have been assessed for their applicability to this development:

- Small scale hydro
- Tidal power/ wave power
- Wind turbines
- Biomass boilers
- Biomass single room heaters/ stoves
- Ground Source Heat Pumps (GSHP's)
- Water Source Heat Pumps (WSHP's)
- Air Source Heat Pumps (ASHP's)
- Fuel cells
- Photovoltaics
- Solar hot water
- CHP
- Decentralised energy network

A series of assessments have been undertaken to assess the viability of the above technologies from an initial feasibility assessment through to final selection.

5.2 Preliminary Assessment

5.2.1. Small-Scale Hydropower

The requirement of a suitable river system with a significant drop reduces the feasibility of small-scale hydropower and therefore it will not be considered further.

5.2.2. Tidal/ Wave Power

The development site is set back from the coastline and the size of the development is small relative to the significant technology infrastructure costs that would be associated with implementing either of these forms of technology. These technologies have therefore been disregarded at a preliminary stage.

5.2.3. Wind Turbines

The site is located in a built up, urban area. It is therefore likely that turbulence from surrounding trees and buildings would have an impact on wind turbines were they to be installed on/ in the close vicinity of the building.

Wind turbines may also have a negative acoustic and visual impact on site. It is a possibility therefore that there may be planning objections to the adoption of this form of LZC technology on site.

These factors, in addition to the high capital cost associated with the installation of turbines, have resulted in this technology being discounted.

5.2.4. Biomass Boilers

One of the major drawbacks of the utilisation of biomass boiler technology is the space requirements for the biomass boilers and the fuel stores. A space allocation for back up boilers would also be necessary. The total plant area would need to be (approximately) treble that of a standard boiler room containing equivalent gas fired boilers only. There may also be issues with the reliability of the biomass fuel supply, and delivery vehicles may encounter access issues. This technology has therefore been discounted as the form of LZC most appropriate for the site.

5.2.5. Single Room Biomass Heaters/ Stoves

The need for single room biomass heaters is not applicable to the Vahnea Student Residences development due to the proposed centralised heating system. This technology has therefore not been considered further.

5.2.6. Ground Source Heat Pumps (GSHP)

Heat pumps use electrical energy - usually grid supplied - to upgrade the energy collected by a ground loop; typically one unit of electricity will produce 3 to 4 units of useful heat. However, the output temperature is normally limited to between 40 and 45°C, or the unit efficiency will drop considerably. Therefore GSHP's are best suited to applications where the building heat load is small and the heat delivery system is either underfloor heating or air heating with coils sized to suit.

The ground heat exchanger that forms part of this system is a sealed loop of pipe buried either vertically or horizontally in the ground. Horizontal arrays tend not to be feasible on restricted sites, as the length of the loops can include multiples of pipework up to 50m in length. Vertical arrays require a series of boreholes which accommodate the pipework and are infilled with a heat conducting grout. Although the external space requirements for a vertical array would be less than for a horizontal array, due to the very restricted site this is still deemed to be an unfeasible solution in this instance.

5.2.7. Water Source Heat Pumps (WSHP)

WSHP's upgrade the residual heat stored within a water source to a more suitable temperature and are ideally used within a low-temperature heating system i.e. underfloor heating.

A substantial local water source would be required such as an aquifer or lake to provide the residual heat and so the technology has been disregarded.

5.2.8. Air Source Heat Pumps (ASHP)

An air source heat pump has much smaller space requirements than a ground source heat pump and has lower associated installation costs. However, it does also have a lower Coefficient of Performance (CoP). The units tend to be located externally, and therefore consideration needs to be given to their placement as they may pose a noise issue when operational.

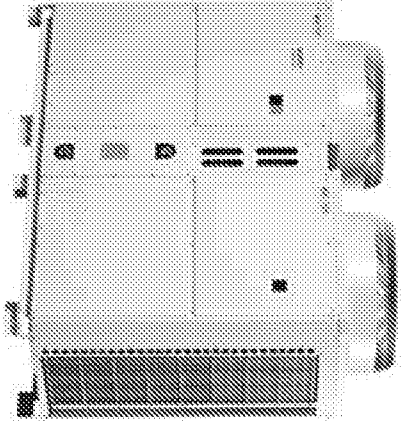


Figure 5.1 – Air Source Heat Pump (Image Source: www.mitsubishielectric.co.uk)

This technology could be a potential option for the Vahnea Street Student Residences development.

5.2.9. Fuel Cells

Fuel cell technology utilising hydrogen produced from LZC technologies is at an early stage of development with the cost and limited availability of plant being the major limiting factor. Fuel cells will therefore not be considered further.

5.2.10. Photovoltaics

Photovoltaics have been identified as an appropriate technology for application to this scheme. There is a large roof area available for the mounting of PV panels, and there are likely to be consistent daytime electrical loads to utilise the generated electricity. **This technology could be a potential option for the Vahnea Student Residences development.**

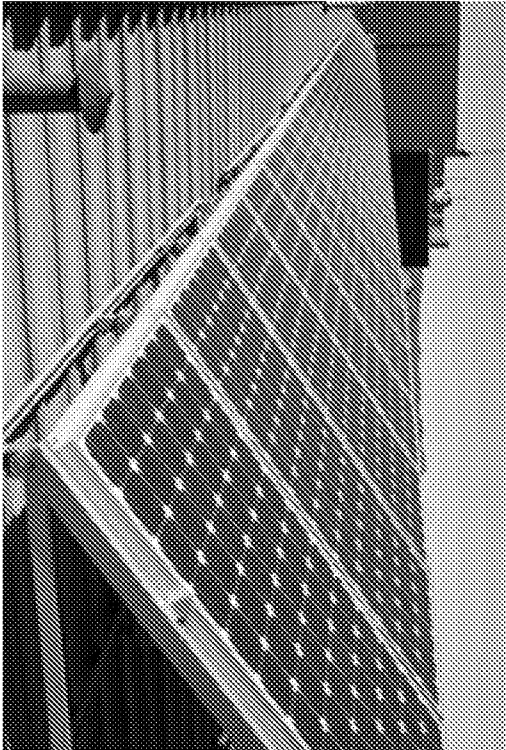


Figure 5.2 – PV Array (Image Source: www.segen.co.uk)

5.2.11. Solar Thermal

Solar thermal technology could be adopted in the scheme to utilise solar energy to contribute to the domestic hot water loads on the scheme. This technology would require an area of roof to house the solar thermal array. Experience on previous schemes has demonstrated that significant carbon emission savings cannot be demonstrated through the

implementation of this form of technology, relative to the impact that can be demonstrated with other forms of LZC technology. Therefore, at this stage this technology shall not be considered further.

5.2.12. CHP/ Decentralised Energy Network

The applicability of these forms of low energy technologies will be considered further in Section 6.

5.3 Summary

A roof mounted photovoltaic array and air source heat pumps have been identified as the most appropriate forms of LZC technologies for application to the Vahnea Student Residences development.

Following the assessment of the applicability of a decentralised energy network or a CHP engine installation, the relative performance of these technologies will be assessed to determine the most appropriate energy strategy for the scheme.

6. ENERGY HIERARCHY – CLEAN

6.1 Overview

In line with the Energy Hierarchy, after passive design, energy efficiency and LZC applications have been investigated, the next step is to consider the connection to a low carbon heat distribution network/ the installation of CHP in order to facilitate the clean usage of fossil fuels.

6.2 Decentralised Energy Production

A decentralised energy network is a network in which energy is generated in the vicinity of where it is to be used – rather than at a large centralised plant where it is then distributed through the national grid.

Decentralised energy generation may be via combined heat and power (CHP), solar energy, geothermal or biomass. The generation of energy locally can reduce transmission losses and carbon emissions from energy generation.

The Association for Decentralised Energy (ade) have produced an online District Heating Installation map. This map can be used to find decentralized energy systems in the vicinity of new developments, and categorizes them into residential/ commercial, university and hospital systems.

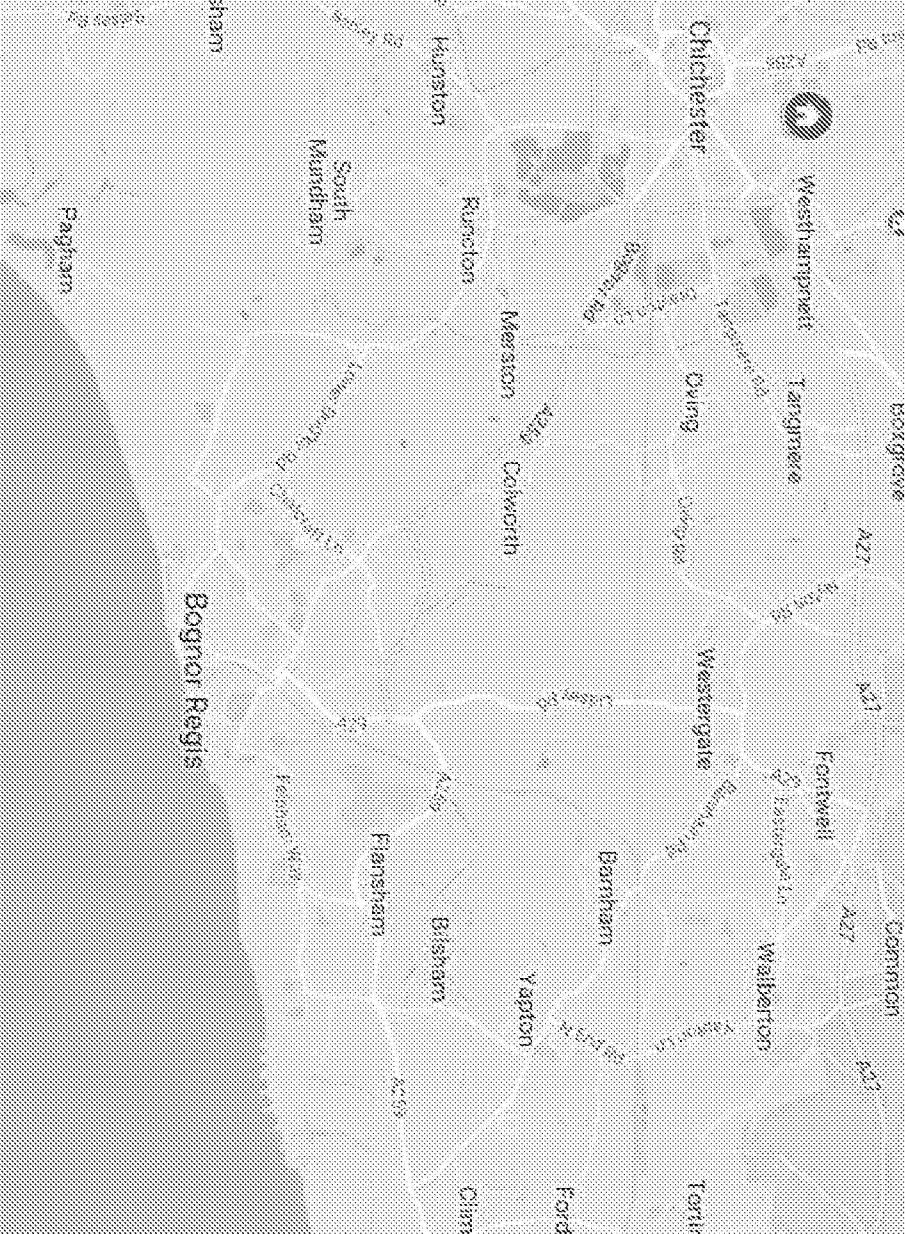


Figure 6.1 – District Heating Installation Map (Source: www.ade.co.uk)

This database has been accessed for the purposes of this energy strategy review. Figure 6.1 shows the area in the vicinity of the development site. The closest established network is shown to be the Graylingwell Park District Heating Scheme (blue marker in Figure 6.1)- with no schemes located at present in Bognor Regis. Given the significant distance from this network to the development site – it is not considered to be a feasible potential connection.

6.3 Combined Heat and Power (CHP)

A CHP engine generates electricity and heat in a single process from a single fuel (typically natural gas). This cogeneration process facilitates greater fuel efficiencies being achieved and reduces transmission losses. This is illustrated in Figure 6.2. below.

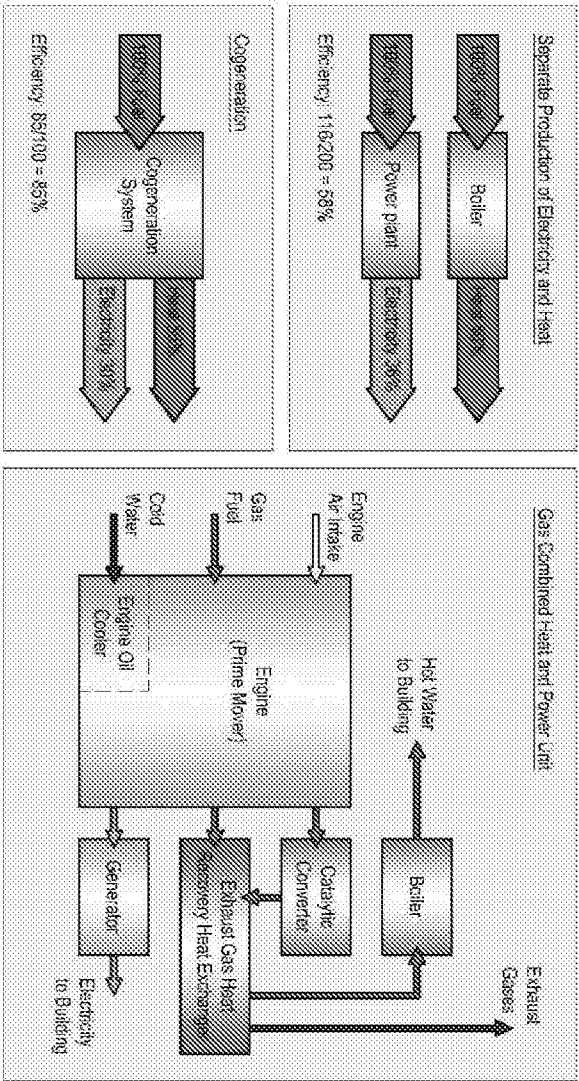


Figure 6.2 – Illustrative CHP Schematic

Design and sizing of CHP installations is usually driven by the presence of a heating base load; selection based on an electrical base load is likely to result in large quantities of heat being dumped due to there being no use for it.

The adoption of combined heat and power requires a significant investment, so it is essential that CHP plant is not sat idle – providing no benefits. CHP units are often selected so that they are operating for 17 hours per day, 11 months a year and therefore it is critical that the plant is operating at maximum efficiency, utilising all the heat available.

In a typical installation, one of the heating boilers will be replaced by a packaged CHP unit. As most small scale units produce low temperature hot water, i.e. 80°C, they are ideal for integration into 'standard' building heating systems.

In such a configuration, it is important that the CHP unit is run as the lead boiler to maximise its running hours. Balancing of water flows through the boilers and CHP unit must be carefully addressed, as the latter has a considerably higher hydraulic resistance compared to standard plant.

The CHP plant, fuelled by natural gas, is defined as a low carbon technology, with a direct benefit in the better utilisation of fossil fuels for the production of electrical energy.

Given the residential nature of the proposed student halls development, there is likely to be a significant domestic hot water base load. Figure 6.3 shows an indicative breakdown of the building energy demands broken down into end use. These predictions have been extracted from the SBEM output document and it should be noted that SBEM is an energy compliance tool and not a design tool, however, at this stage this graphic can be used as an indicative guide.



Figure 6.3 – Annual Energy Consumption Breakdown

6.4 Summary

A CHP installation has been identified as a potentially appropriate form of clean technology for application to the Vahnea Student Residences development.

The feasibility of this technology for application to the site will be considered further in Section 7 alongside the identified LZC technologies against the energy performance targets for the scheme.

7. PROPOSED LZC AND CLEAN TECHNOLOGIES

7.1 Overview

Further to the assessment of LZC and clean technologies undertaken in Section 5 and Section 6 of this report, this Section of the report will assess the potential technology options that have been identified against the following requirements:

- Part L2A energy performance requirements. The Target Emission Rate (TER) will need to be greater than the Building Emission Rate (BER) for the extension (new build) element of the scheme to pass Building Regulations.
- 10% of the regulated energy demand of the building is to be met by a low or zero carbon technology.
- For the targeted BREEAM 'Excellent' level on this scheme, it is a mandatory requirement for a minimum of 5no. Ene01 credits to be achieved.

7.2 Analysis

In order to analyse the relative energy performance and carbon reduction impact of the servicing options an energy model has been created using IES VE Compliance v 7.0.6.0. This software is an approved Simplified Building Energy Model (SBEM) interface- approved by Communities and Local Government to produce Energy Performance Certificates for non-domestic buildings and check compliance with Building Regulations.

A number of potential servicing strategies have been considered as options. The potential strategies are listed below in conjunction with the key performance/ efficiency properties assumed:

Option 1 – Direct Electric Heating and ASHP Domestic Hot Water System and PV

Electric Heating: 100% efficiency

ASHP: COP of 3.19

PV: 21.33kWp roof mounted array

Option 2 – ASHP Heating & Domestic Hot Water System and PV

ASHP: COP of 3.19

PV: 21.33kWp roof mounted array

Option 3 – Gas Fired Boilers Heating & Domestic Hot Water and PV

Boilers: 95% seasonal efficiency

PV: 21.33kWp roof mounted array

Option 4 – Direct Electric Heating and CHP Domestic Hot Water

Electric Heating: 100% efficiency

CHP Thermal Efficiency: 63%

CHPGA: 110

CHP Heat to Power Ratio: 1.9

Boilers: 95% seasonal efficiency

DHW Load Share: 80% CHP, 20% Boilers

Option 5 – CHP Heating & Domestic Hot Water

CHP Thermal Efficiency: 63%

CHPGA: 110

CHP Heat to Power Ratio: 1.9

Boilers: 95% seasonal efficiency

Thermal Load Share: 70% CHP, 30% Boilers

Table 7.1 – Energy Strategy Options Comparison Table

STRATEGY	PART L2A COMPLIANCE TER>BER %	BREEAM ENE01 CREDITS	10% LOW OR RENEWABLE ENERGY TARGET MET?	ALL ENERGY TARGETS MET?
Target	>0%	5	Yes	Yes
Option 1 Electric Htg and ASHP DHW and PV	-1.85		Not Considered Further	
Option 2 ASHP Htg & DHW and PV	-1.52	2		Not Considered Further
Option 3 Boiler Htg & DHW and PV	-4.57		Not Considered Further	
Option 4 Electric Htg and CHP DHW	-12.64	5	Yes	Yes
Option 5 CHP Htg & DHW	-16.28	4	Yes	Yes
TABLE KEY				
	Column Target Not Met			
	Column Target Met			
	Option Not Considered Further as a Scheme Energy Target has Been Shown to Not be Achievable			

From the assessment of various strategies summarised in Table 7.1, above, it can be seen that two strategies meet the energy performance targets for the development. It is proposed that these respective strategies will be explored further in the detailed design process to determine which of the two would be preferable for adoption.

8. CONCLUSIONS

When reviewing the energy and sustainability strategy for this development, careful consideration has been given to the context of the site, local planning policy and the 2013 Building Regulations.

The approach taken for the proposed energy strategy for the development has followed the guidance of the *Arun Local Plan 2011 – 2031*. A sequential approach has been adopted in line with the Energy Hierarchy- assessing in turn the feasibility of reducing the energy demand of the building, using energy more efficiently, applying LZC technologies and using the remaining fossil fuels cleanly.

A number of passive design measures have been implemented including optimising the thermal performance of the building envelope beyond the minimum U value and air infiltration standards set out in Part L of the Building Regulations, providing a sensible glazing façade ratio and utilising solar control glazing to reduce the risk of overheating.

Energy efficient building servicing systems are proposed for the development to reduce the energy loads of the development on occupation. Key measures that are proposed for the scheme to reduce regulated energy usage are high efficiency condensing boiler technology, factory applied insulation on domestic hot water stores, heat recovery ventilation systems, high efficiency lighting installations with occupancy and photocell controls where appropriate and an intelligent automatic controls system to optimise system performance. Additionally, in line with BREEAM guidance on the control of unregulated loads it is proposed for key energy efficiency measures to be incorporated into the design of the lift systems and for plug in and white goods to be sourced in accordance with the energy performance requirements set out in BREEAM issue ENE08.

A feasibility assessment has been undertaken evaluating the applicability of a number renewable and clean technologies to the Vahnea Student Residences development. The technologies identified as being potentially appropriate for the site were ASHPs, PV and CHP.

An analysis process was then undertaken assessing the energy performance of a number of servicing options incorporating these technologies using an approved SBEM interface. Two potential building servicing strategies for the scheme were found to meet the energy targets for the scheme. These strategies are summarised below:

Servicing Strategy Option A- **Direct Electric Heating System and CHP Domestic Hot Water System** (Gas Fired Boilers will be required in conjunction with the CHP engine, with the CHP meeting the base load)

Servicing Strategy Option B- **CHP Domestic Heating and Domestic Hot Water System** (Gas Fired Boilers will be required in conjunction with the CHP engine, with the CHP meeting the base load).

It is proposed that one of these design solutions will be implemented to:

- Meet the energy performance requirements of Part L2A of the Building Regulations;
- Achieve the 5 no. mandatory Ene01 credits for BREEAM 'Excellent'; and
- Meet the 10% renewable target set out in the *Arun Local Plan 2011-2031*.



APPENDIX 1 – BRUKL OUTPUT DOCUMENT (SERVICING STRATEGY OPTION A)

Project name

Vahnea Student Residences

As designed

Date: Thu Sep 20 14:38:02 2018

Administrative information

Building Details

Address: Bognor Regis, PO21 1PY

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.6

BRUKL compliance check version: v5.2.g.3

Owner Details

Name: TBC

Telephone number:

Address: , ,

Certifier details

Name: Ridge & Partners LLP

Telephone number: 01962 834400

Address: Partnership House, Moorside Road, Winchester,
SO23 7RX

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	36.4
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	36.4
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	31.8
Are emissions from the building less than or equal to the target?	BER ≤ TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	FF00002C_W-1
Floor	0.25	0.16	0.16	FF000045_F
Roof	0.25	0.16	0.16	TF000028_C
Windows***, roof windows, and rooflights	2.2	1.4	1.4	FF00002C_W-1_O0
Personnel doors	2.2	2.2	2.2	FF00002C_W-1_O1
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * There might be more than one surface where the maximum U-value occurs. ** 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. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

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

1- 1. Electric Heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	-	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- 5. Boiler and CHP Heating DHW

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- SYST0004-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0.01
Standard value	N/A	N/A

1- CCHP Generator

	CHPQA quality index	CHP electrical efficiency
This building	110	0.33
Standard value	105	0.2

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
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 supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
FF - Flat 8 Bedroom		-	-	-	1	-	-	-	-	-	0.8	0.5
FF - Flat 8 Ensuite		-	-	-	1	-	-	-	-	-	0.8	0.5
FF - Flat 8 Kitchen		-	-	-	1	-	-	-	-	-	0.8	0.5
FF - Flat 8 Corridor		-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 8 Ensuite		-	-	-	1	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
FF - Flat 8 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 8 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 8 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 8 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 8 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 6 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 7 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 6 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 5 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 5 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 5 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 5 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 5 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 5 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Comms Room	-	-	-	-	-	-	-	-	-	-	N/A
FF - Communal Circulation	-	-	-	-	-	-	-	-	-	-	N/A
FF - Cleaners Store	-	-	0.3	-	-	-	-	-	-	-	N/A
SF - Flat 13 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
SF - Flat 13 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 13 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 11 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 12 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 11 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 10 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 10 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 10 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 10 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 10 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 10 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1		
SF - Comms Room	-	-	-	-	-	-	-	-	-	-	N/A
SF - Communal Circulation	-	-	-	-	-	-	-	-	-	-	N/A
SF - Cleaners Store	-	-	0.3	-	-	-	-	-	-	-	N/A
TF - Flat 18 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
TF - Flat 18 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
TF - Flat 16 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
TF - Flat 17 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Corridor	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
TF - Flat 15 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 15 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
TF - Flat 15 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 15 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
TF - Flat 15 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 15 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Comms Room	-	-	-	-	-	-	-	-	-	-	N/A
TF - Communal Circulation	-	-	-	-	-	-	-	-	-	-	N/A
TF - Cleaners Store	-	-	0.3	-	-	-	-	-	-	-	N/A
FOF - Flat 23 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 23 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 21 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 22 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 21 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
FOF - Flat 21 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
FOF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 20 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
FOF - Flat 20 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
FOF - Flat 20 Kitchen	-	-	-	unk	-	-	-	-	-	0.8	0.5
FOF - Flat 20 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 20 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
FOF - Flat 20 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
FOF - Comms Room	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Communal Circulation	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Cleaners Store	-	-	0.3	-	-	-	-	-	-	-	N/A
FIF - Flat 25 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
FIF - Flat 25 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Comms Room	-	-	-	-	-	-	-	-	-	-	N/A
FIF - Cleaners Store	-	-	0.3	-	-	-	-	-	-	-	N/A
FIF - Flat 25 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Communal Circulation	-	-	-	-	-	-	-	-	-	-	N/A
FIF - Flat 25 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FIF - Flat 25 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Kitchen	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 3 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 3 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 3 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 3 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 3 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 3 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 3 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 3 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 3 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 3 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 4 Bedroom	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 4 Kitchen	-	-	-	unk	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	unk	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF - Flat 4 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat 4 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Plant Room	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat 1 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 1 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 1 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 1 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 1 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 2 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 2 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 2 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 2 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 2 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 2 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 2 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 2 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 2 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
GF - Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Circulation	-	-	-	-	-	-	-	-	-	-	N/A
GF - Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Comms Room	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat 1 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 1 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat 2 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat N Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat N Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat N Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat N Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat N Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat N Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat N Corridor	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat N Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF - Kitchen	-	-	-	1	-	-	-	-	-	0.8	0.5
GF - Bedroom	-	-	-	1	-	-	-	-	-	0.8	0.5
GF - Laundry	-	-	0.3	-	-	-	-	-	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
Standard value		60	60	22	
FF - Flat 8 Bedroom		-	73	-	69
FF - Flat 8 Ensuite		-	60	-	17
FF - Flat 8 Kitchen		-	67	-	414
FF - Flat 8 Corridor		-	40	-	155
FF - Flat 8 Ensuite		-	60	-	17
FF - Flat 8 Ensuite		-	60	-	16
FF - Flat 8 Bedroom		-	73	-	69
FF - Flat 8 Bedroom		-	73	-	68
FF - Flat 8 Bedroom		-	73	-	69
FF - Flat 8 Ensuite		-	60	-	15
FF - Flat 9 Kitchen		-	67	-	375
FF - Flat 9 Bedroom		-	73	-	69
FF - Flat 9 Bedroom		-	73	-	68
FF - Flat 9 Bedroom		-	73	-	69
FF - Flat 9 Shared Bathroom		-	60	-	16
FF - Flat 9 Shared Bathroom		-	60	-	21
FF - Flat 9 Corridor		-	40	-	61
FF - Flat 6 Kitchen		-	67	-	424
FF - Flat 7 Kitchen		-	67	-	440
FF - Flat 7 Corridor		-	40	-	177
FF - Flat 7 Ensuite		-	60	-	16
FF - Flat 7 Bedroom		-	73	-	78
FF - Flat 7 Ensuite		-	60	-	16
FF - Flat 7 Bedroom		-	73	-	79
FF - Flat 7 Ensuite		-	60	-	16
FF - Flat 7 Bedroom		-	73	-	80
FF - Flat 7 Bedroom		-	73	-	80
FF - Flat 7 Ensuite		-	60	-	16
FF - Flat 6 Corridor		-	40	-	93
FF - Flat 6 Ensuite		-	60	-	16
FF - Flat 6 Bedroom		-	73	-	77
FF - Flat 6 Ensuite		-	60	-	16
FF - Flat 6 Bedroom		-	73	-	78
FF - Flat 6 Bedroom		-	73	-	78
FF - Flat 6 Ensuite		-	60	-	16
FF - Flat 6 Bedroom		-	73	-	78

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
FF - Flat 6 Ensuite	-	60	-	16
FF - Stairwell	-	40	-	99
FF - Flat 5 Bedroom	-	73	-	66
FF - Flat 5 Ensuite	-	60	-	32
FF - Flat 5 Kitchen	-	67	-	407
FF - Flat 5 Corridor	-	40	-	22
FF - Flat 5 Ensuite	-	60	-	17
FF - Flat 5 Bedroom	-	73	-	69
FF - Comms Room	30	-	-	35
FF - Communal Circulation	-	40	-	244
FF - Cleaners Store	30	-	-	16
SF - Flat 13 Bedroom	-	73	-	69
SF - Flat 13 Ensuite	-	60	-	17
SF - Flat 13 Kitchen	-	67	-	414
SF - Flat 13 Corridor	-	40	-	155
SF - Flat 13 Ensuite	-	60	-	17
SF - Flat 13 Ensuite	-	60	-	16
SF - Flat 13 Bedroom	-	73	-	69
SF - Flat 13 Bedroom	-	73	-	68
SF - Flat 13 Bedroom	-	73	-	69
SF - Flat 13 Ensuite	-	60	-	15
SF - Flat 14 Kitchen	-	67	-	375
SF - Flat 14 Bedroom	-	73	-	69
SF - Flat 14 Bedroom	-	73	-	68
SF - Flat 14 Bedroom	-	73	-	69
SF - Flat 14 Shared Bathroom	-	60	-	16
SF - Flat 14 Shared Bathroom	-	60	-	21
SF - Flat 14 Corridor	-	40	-	61
SF - Flat 11 Kitchen	-	67	-	424
SF - Flat 12 Kitchen	-	67	-	440
SF - Flat 12 Corridor	-	40	-	177
SF - Flat 12 Ensuite	-	60	-	16
SF - Flat 12 Bedroom	-	73	-	78
SF - Flat 12 Ensuite	-	60	-	16
SF - Flat 12 Bedroom	-	73	-	79
SF - Flat 12 Ensuite	-	60	-	16
SF - Flat 12 Bedroom	-	73	-	80
SF - Flat 12 Bedroom	-	73	-	80
SF - Flat 12 Ensuite	-	60	-	16
SF - Flat 11 Corridor	-	40	-	93
SF - Flat 11 Ensuite	-	60	-	16
SF - Flat 11 Bedroom	-	73	-	77
SF - Flat 11 Ensuite	-	60	-	16

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
SF - Flat 11 Bedroom	-	73	-	78
SF - Flat 11 Bedroom	-	73	-	78
SF - Flat 11 Ensuite	-	60	-	16
SF - Flat 11 Bedroom	-	73	-	78
SF - Flat 11 Ensuite	-	60	-	16
SF - Stairwell	-	40	-	99
SF - Flat 10 Bedroom	-	73	-	66
SF - Flat 10 Ensuite	-	60	-	32
SF - Flat 10 Kitchen	-	60	-	136
SF - Flat 10 Corridor	-	40	-	22
SF - Flat 10 Ensuite	-	60	-	17
SF - Flat 10 Bedroom	-	73	-	69
SF - Comms Room	30	-	-	35
SF - Communal Circulation	-	40	-	244
SF - Cleaners Store	30	-	-	16
TF - Flat 18 Bedroom	-	73	-	69
TF - Flat 18 Ensuite	-	60	-	17
TF - Flat 18 Kitchen	-	67	-	414
TF - Flat 18 Corridor	-	40	-	155
TF - Flat 18 Ensuite	-	60	-	17
TF - Flat 18 Ensuite	-	60	-	16
TF - Flat 18 Bedroom	-	73	-	69
TF - Flat 18 Bedroom	-	73	-	68
TF - Flat 18 Bedroom	-	73	-	69
TF - Flat 18 Ensuite	-	60	-	15
TF - Flat 19 Kitchen	-	67	-	375
TF - Flat 19 Bedroom	-	73	-	69
TF - Flat 19 Bedroom	-	73	-	68
TF - Flat 19 Bedroom	-	73	-	69
TF - Flat 19 Shared Bathroom	-	60	-	16
TF - Flat 19 Shared Bathroom	-	60	-	21
TF - Flat 19 Corridor	-	40	-	61
TF - Flat 16 Kitchen	-	67	-	424
TF - Flat 17 Kitchen	-	67	-	440
TF - Flat 17 Corridor	-	40	-	177
TF - Flat 17 Ensuite	-	60	-	16
TF - Flat 17 Bedroom	-	73	-	78
TF - Flat 17 Ensuite	-	60	-	16
TF - Flat 17 Bedroom	-	60	-	72
TF - Flat 17 Ensuite	-	60	-	16
TF - Flat 17 Bedroom	-	73	-	80
TF - Flat 17 Bedroom	-	73	-	80
TF - Flat 17 Ensuite	-	60	-	16

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
TF - Flat 16 Corridor	-	60	-	93
TF - Flat 16 Ensuite	-	60	-	16
TF - Flat 16 Bedroom	-	73	-	77
TF - Flat 16 Ensuite	-	60	-	16
TF - Flat 16 Bedroom	-	73	-	78
TF - Flat 16 Bedroom	-	73	-	78
TF - Flat 16 Ensuite	-	60	-	16
TF - Flat 16 Bedroom	-	73	-	78
TF - Flat 16 Ensuite	-	60	-	16
TF - Stairwell	-	40	-	99
TF - Flat 15 Bedroom	-	73	-	66
TF - Flat 15 Ensuite	-	60	-	32
TF - Flat 15 Kitchen	-	67	-	407
TF - Flat 15 Corridor	-	40	-	22
TF - Flat 15 Ensuite	-	60	-	17
TF - Flat 15 Bedroom	-	73	-	69
TF - Comms Room	30	-	-	35
TF - Communal Circulation	-	40	-	244
TF - Cleaners Store	30	-	-	16
FOF - Flat 23 Bedroom	-	73	-	69
FOF - Flat 23 Ensuite	-	60	-	17
FOF - Flat 23 Kitchen	-	67	-	414
FOF - Flat 23 Corridor	-	40	-	155
FOF - Flat 23 Ensuite	-	60	-	17
FOF - Flat 23 Ensuite	-	60	-	16
FOF - Flat 23 Bedroom	-	73	-	69
FOF - Flat 23 Bedroom	-	73	-	68
FOF - Flat 23 Bedroom	-	73	-	69
FOF - Flat 23 Ensuite	-	60	-	15
FOF - Flat 24 Kitchen	-	67	-	375
FOF - Flat 24 Bedroom	-	73	-	69
FOF - Flat 24 Bedroom	-	73	-	68
FOF - Flat 24 Bedroom	-	73	-	69
FOF - Flat 24 Shared Bathroom	-	60	-	16
FOF - Flat 24 Shared Bathroom	-	60	-	21
FOF - Flat 24 Corridor	-	40	-	61
FOF - Flat 21 Kitchen	-	67	-	424
FOF - Flat 22 Kitchen	-	67	-	440
FOF - Flat 22 Corridor	-	40	-	177
FOF - Flat 22 Ensuite	-	60	-	16
FOF - Flat 22 Bedroom	-	73	-	78
FOF - Flat 22 Ensuite	-	60	-	16
FOF - Flat 22 Bedroom	-	73	-	79

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
FOF - Flat 22 Ensuite	-	60	-	16
FOF - Flat 22 Bedroom	-	73	-	80
FOF - Flat 22 Bedroom	-	73	-	80
FOF - Flat 22 Ensuite	-	60	-	16
FOF - Flat 21 Corridor	-	40	-	93
FOF - Flat 21 Ensuite	-	60	-	16
FOF - Flat 21 Bedroom	-	73	-	77
FOF - Flat 21 Ensuite	-	60	-	16
FOF - Flat 21 Bedroom	-	73	-	78
FOF - Flat 21 Bedroom	-	73	-	78
FOF - Flat 21 Ensuite	-	60	-	16
FOF - Flat 21 Bedroom	-	73	-	78
FOF - Flat 21 Ensuite	-	60	-	16
FOF - Stairwell	-	40	-	99
FOF - Flat 20 Bedroom	-	73	-	66
FOF - Flat 20 Ensuite	-	60	-	32
FOF - Flat 20 Kitchen	-	67	-	407
FOF - Flat 20 Corridor	-	40	-	22
FOF - Flat 20 Ensuite	-	60	-	17
FOF - Flat 20 Bedroom	-	73	-	69
FOF - Comms Room	30	-	-	35
FOF - Communal Circulation	-	40	-	244
FOF - Cleaners Store	30	-	-	16
FIF - Flat 25 Ensuite	-	60	-	16
FIF - Flat 25 Bedroom	-	73	-	77
FIF - Flat 25 Ensuite	-	60	-	16
FIF - Flat 25 Bedroom	-	73	-	78
FIF - Flat 25 Ensuite	-	60	-	16
FIF - Flat 25 Bedroom	-	73	-	78
FIF - Flat 25 Ensuite	-	60	-	16
FIF - Stairwell	-	40	-	99
FIF - Flat 25 Bedroom	-	73	-	66
FIF - Flat 25 Ensuite	-	60	-	17
FIF - Flat 25 Bedroom	-	73	-	69
FIF - Comms Room	30	-	-	33
FIF - Cleaners Store	30	-	-	15
FIF - Flat 25 Bedroom	-	73	-	74
FIF - Communal Circulation	-	40	-	168
FIF - Flat 25 Corridor	-	40	-	113
FIF - Flat 25 Ensuite	-	60	-	17
FIF - Flat 25 Kitchen	-	67	-	415
GF - Flat 3 Bedroom	-	73	-	68
GF - Flat 3 Ensuite	-	60	-	14

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF - Flat 3 Bedroom	-	73	-	72
GF - Flat 3 Ensuite	-	60	-	14
GF - Flat 3 Bedroom	-	73	-	72
GF - Flat 3 Ensuite	-	60	-	14
GF - Flat 3 Bedroom	-	73	-	71
GF - Flat 3 Ensuite	-	60	-	14
GF - Flat 3 Bedroom	-	73	-	80
GF - Flat 3 Ensuite	-	60	-	13
GF - Flat 4 Bedroom	-	73	-	79
GF - Flat 4 Ensuite	-	60	-	13
GF - Flat 4 Kitchen	-	67	-	419
GF - Flat 4 Ensuite	-	60	-	15
GF - Flat 4 Corridor	-	40	-	92
GF - Flat 4 Bedroom	-	73	-	73
GF - Flat 4 Ensuite	-	60	-	15
GF - Flat 4 Bedroom	-	73	-	70
GF - Flat 4 Ensuite	-	60	-	14
GF - Flat 4 Bedroom	-	73	-	71
GF - Flat 4 Ensuite	-	60	-	14
GF - Flat 4 Bedroom	-	73	-	70
GF - Flat 4 Ensuite	-	60	-	14
GF - Flat 4 Bedroom	-	73	-	69
GF - Plant Room	30	-	-	694
GF - Flat 1 Kitchen	-	67	-	357
GF - Flat 1 Ensuite	-	60	-	16
GF - Flat 1 Bedroom	-	73	-	74
GF - Flat 1 Ensuite	-	60	-	17
GF - Flat 1 Bedroom	-	73	-	76
GF - Flat 2 Kitchen	-	67	-	434
GF - Flat 2 Ensuite	-	60	-	16
GF - Flat 2 Bedroom	-	73	-	68
GF - Flat 2 Ensuite	-	60	-	16
GF - Flat 2 Bedroom	-	73	-	80
GF - Flat 2 Bedroom	-	73	-	79
GF - Flat 2 Ensuite	-	60	-	16
GF - Flat 2 Ensuite	-	60	-	16
GF - Flat 2 Bedroom	-	73	-	82
GF - Stairwell	-	40	-	96
GF - Bedroom	-	73	-	82
GF - Circulation	-	40	-	38
GF - Ensuite	-	60	-	22
GF - Comms Room	30	-	-	36
GF - Flat 1 Ensuite	-	60	-	17

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
GF - Flat 1 Bedroom		-	73	-	75
GF - Flat 3 Kitchen		-	67	-	423
GF - Flat 3 Corridor		-	40	-	78
GF - Flat 2 Corridor		-	40	-	722
GF - Flat N Ensuite		-	60	-	16
GF - Flat N Bedroom		-	80	-	62
GF - Flat N Bedroom		-	80	-	62
GF - Flat N Ensuite		-	60	-	16
GF - Flat N Bedroom		-	80	-	62
GF - Flat N Ensuite		-	60	-	16
GF - Flat N Corridor		-	40	-	57
GF - Flat N Kitchen		-	67	-	350
GF - Kitchen		-	67	-	263
GF - Bedroom		-	73	-	84
GF - Laundry		-	67	-	120

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
FF - Flat 8 Bedroom	NO (-62.6%)	NO
FF - Flat 8 Bedroom	NO (-62.6%)	NO
FF - Flat 8 Bedroom	NO (-61.9%)	NO
FF - Flat 8 Bedroom	NO (-61.9%)	NO
FF - Flat 9 Bedroom	NO (-63.2%)	NO
FF - Flat 9 Bedroom	NO (-61.9%)	NO
FF - Flat 9 Bedroom	NO (-62.6%)	NO
FF - Flat 7 Bedroom	NO (-72.1%)	NO
FF - Flat 7 Bedroom	NO (-72.2%)	NO
FF - Flat 7 Bedroom	NO (-72.7%)	NO
FF - Flat 7 Bedroom	NO (-72.6%)	NO
FF - Flat 6 Bedroom	NO (-72.1%)	NO
FF - Flat 6 Bedroom	NO (-72.2%)	NO
FF - Flat 6 Bedroom	NO (-72.3%)	NO
FF - Flat 6 Bedroom	NO (-72.5%)	NO
FF - Flat 5 Bedroom	NO (-76.8%)	NO
FF - Flat 5 Bedroom	NO (-73.3%)	NO
SF - Flat 13 Bedroom	NO (-62.6%)	NO
SF - Flat 13 Bedroom	NO (-62.6%)	NO
SF - Flat 13 Bedroom	NO (-61.9%)	NO
SF - Flat 13 Bedroom	NO (-61.9%)	NO
SF - Flat 14 Bedroom	NO (-63.2%)	NO
SF - Flat 14 Bedroom	NO (-61.9%)	NO
SF - Flat 14 Bedroom	NO (-62.6%)	NO
SF - Flat 12 Bedroom	NO (-72.1%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
SF - Flat 12 Bedroom	NO (-72.2%)	NO
SF - Flat 12 Bedroom	NO (-72.7%)	NO
SF - Flat 12 Bedroom	NO (-72.6%)	NO
SF - Flat 11 Bedroom	NO (-72.1%)	NO
SF - Flat 11 Bedroom	NO (-72.2%)	NO
SF - Flat 11 Bedroom	NO (-72.3%)	NO
SF - Flat 11 Bedroom	NO (-72.5%)	NO
SF - Flat 10 Bedroom	NO (-76.8%)	NO
SF - Flat 10 Bedroom	NO (-73.3%)	NO
TF - Flat 18 Bedroom	NO (-62.6%)	NO
TF - Flat 18 Bedroom	NO (-62.6%)	NO
TF - Flat 18 Bedroom	NO (-61.9%)	NO
TF - Flat 18 Bedroom	NO (-61.9%)	NO
TF - Flat 19 Bedroom	NO (-63.2%)	NO
TF - Flat 19 Bedroom	NO (-61.9%)	NO
TF - Flat 19 Bedroom	NO (-62.6%)	NO
TF - Flat 17 Bedroom	NO (-72.1%)	NO
TF - Flat 17 Bedroom	NO (-72.7%)	NO
TF - Flat 17 Bedroom	NO (-72.6%)	NO
TF - Flat 16 Bedroom	NO (-72.1%)	NO
TF - Flat 16 Bedroom	NO (-72.2%)	NO
TF - Flat 16 Bedroom	NO (-72.3%)	NO
TF - Flat 16 Bedroom	NO (-72.5%)	NO
TF - Flat 15 Bedroom	NO (-76.8%)	NO
TF - Flat 15 Bedroom	NO (-73.3%)	NO
FOF - Flat 23 Bedroom	NO (-62.6%)	NO
FOF - Flat 23 Bedroom	NO (-62.6%)	NO
FOF - Flat 23 Bedroom	NO (-61.9%)	NO
FOF - Flat 23 Bedroom	NO (-61.9%)	NO
FOF - Flat 24 Bedroom	NO (-63.2%)	NO
FOF - Flat 24 Bedroom	NO (-61.9%)	NO
FOF - Flat 24 Bedroom	NO (-62.6%)	NO
FOF - Flat 22 Bedroom	NO (-72.1%)	NO
FOF - Flat 22 Bedroom	NO (-72.2%)	NO
FOF - Flat 22 Bedroom	NO (-72.7%)	NO
FOF - Flat 22 Bedroom	NO (-72.6%)	NO
FOF - Flat 21 Bedroom	NO (-72.1%)	NO
FOF - Flat 21 Bedroom	NO (-72.2%)	NO
FOF - Flat 21 Bedroom	NO (-72.3%)	NO
FOF - Flat 21 Bedroom	NO (-72.5%)	NO
FOF - Flat 20 Bedroom	NO (-76.8%)	NO
FOF - Flat 20 Bedroom	NO (-73.3%)	NO
FIF - Flat 25 Bedroom	NO (-72.1%)	NO
FIF - Flat 25 Bedroom	NO (-72.2%)	NO
FIF - Flat 25 Bedroom	NO (-72.5%)	NO
FIF - Flat 25 Bedroom	NO (-76.8%)	NO
FIF - Flat 25 Bedroom	NO (-73.3%)	NO
FIF - Flat 25 Bedroom	NO (-91%)	NO
GF - Flat 3 Bedroom	NO (-90.2%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF - Flat 3 Bedroom	NO (-71.7%)	NO
GF - Flat 3 Bedroom	NO (-72%)	NO
GF - Flat 3 Bedroom	NO (-71.7%)	NO
GF - Flat 3 Bedroom	NO (-75.1%)	NO
GF - Flat 4 Bedroom	NO (-74.6%)	NO
GF - Flat 4 Bedroom	NO (-65.2%)	NO
GF - Flat 4 Bedroom	NO (-63.6%)	NO
GF - Flat 4 Bedroom	NO (-64%)	NO
GF - Flat 4 Bedroom	NO (-63.2%)	NO
GF - Flat 4 Bedroom	NO (-63.1%)	NO
GF - Flat 1 Bedroom	NO (-61.9%)	NO
GF - Flat 1 Bedroom	NO (-61.9%)	NO
GF - Flat 2 Bedroom	NO (-61.9%)	NO
GF - Flat 2 Bedroom	NO (-73.1%)	NO
GF - Flat 2 Bedroom	NO (-72.5%)	NO
GF - Flat 2 Bedroom	NO (-74%)	NO
GF - Bedroom	NO (-72.2%)	NO
GF - Flat 1 Bedroom	NO (-62.6%)	NO
GF - Flat N Bedroom	NO (-71.5%)	NO
GF - Flat N Bedroom	NO (-71.1%)	NO
GF - Flat N Bedroom	NO (-71.2%)	NO
GF - Bedroom	NO (-67.8%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of 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?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	3463.6	3463.6
External area [m ²]	3911.1	3911.1
Weather	SOU	SOU
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	1317.19	1971.29
Average U-value [W/m ² K]	0.34	0.5
Alpha value* [%]	27.79	17.79

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
100	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 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	14.35	21.34
Cooling	0	0
Auxiliary	7.98	5.92
Lighting	22.2	15.8
Hot water	118.41	86.08
Equipment*	44.56	44.56
TOTAL**	131.6	129.14

* Energy used by equipment does not count towards the total for 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	31.33	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	182.7	194.11
Primary energy* [kWh/m ²]	181.56	193.51
Total emissions [kg/m ²]	31.8	36.4

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

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 SSEF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	41.3	141.4	14.4	0	6.7	0.8	0	1	0
	Notional	62.9	131.2	21.3	0	5.9	0.82	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

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.18	FF00002C_W-1
Floor	0.2	0.16	FF000045_F
Roof	0.15	0.16	TF000028_C
Windows, roof windows, and rooflights	1.5	1.4	FF00002C_W-1_O0
Personnel doors	1.5	2.2	FF00002C_W-1_O1
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)] * There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5

APPENDIX 2 – BRUKL OUTPUT DOCUMENT (SERVICING STRATEGY OPTION B)

Project name

Vahnea Student Residences

As designed

Date: Thu Sep 20 15:46:13 2018

Administrative information

Building Details

Address: Bognor Regis, PO21 1PY

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.6

BRUKL compliance check version: v5.2.g.3

Owner Details

Name: TBC

Telephone number:

Address: , ,

Certifier details

Name: Ridge & Partners LLP

Telephone number: 01962 834400

Address: Partnership House, Moorside Road, Winchester, SO23 7RX

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	35
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	35
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	28.6
Are emissions from the building less than or equal to the target?	BER ≤ TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	FF00002C_W-1
Floor	0.25	0.16	0.16	FF000045_F
Roof	0.25	0.16	0.16	TF000028_C
Windows***, roof windows, and rooflights	2.2	1.4	1.4	FF00002C_W-1_O0
Personnel doors	2.2	2.2	2.2	FF00002C_W-1_O1
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * There might be more than one surface where the maximum U-value occurs. ** 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. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

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

1- 5. Boiler and CHP Heating DHW

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- SYST0004-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0.01
Standard value	N/A	N/A

1- CCHP Generator

	CHPQA quality index	CHP electrical efficiency
This building	110	0.33
Standard value	105	0.2

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
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 supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
FF - Flat 8 Bedroom	-	-	-	1.9	-	-	-	-	-	0.8	0.5
FF - Flat 8 Ensuite	-	-	-	1.9	-	-	-	-	-	0.8	0.5
FF - Flat 8 Kitchen	-	-	-	1.9	-	-	-	-	-	0.8	0.5
FF - Flat 8 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 8 Ensuite	-	-	-	1.9	-	-	-	-	-	0.8	0.5
FF - Flat 8 Ensuite	-	-	-	1.9	-	-	-	-	-	0.8	0.5
FF - Flat 8 Bedroom	-	-	-	1.9	-	-	-	-	-	0.8	0.5
FF - Flat 8 Bedroom	-	-	-	1.9	-	-	-	-	-	0.8	0.5
FF - Flat 8 Bedroom	-	-	-	1.9	-	-	-	-	-	0.8	0.5
FF - Flat 8 Ensuite	-	-	-	1.9	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
FF - Flat 9 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 9 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 6 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 7 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 7 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 6 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 6 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 5 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 5 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 5 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 5 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FF - Flat 5 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Flat 5 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FF - Comms Room	-	-	-	-	-	-	-	-	-	-	N/A
FF - Communal Circulation	-	-	-	-	-	-	-	-	-	-	N/A
FF - Cleaners Store	-	-	0.3	-	-	-	-	-	-	-	N/A
SF - Flat 13 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 13 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1		
SF - Flat 13 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 13 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 14 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 11 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 12 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 12 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 11 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 11 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 10 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 10 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 10 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 10 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
SF - Flat 10 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Flat 10 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
SF - Comms Room	-	-	-	-	-	-	-	-	-	-	N/A
SF - Communal Circulation	-	-	-	-	-	-	-	-	-	-	N/A
SF - Cleaners Store	-	-	0.3	-	-	-	-	-	-	-	N/A
TF - Flat 18 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1		
TF - Flat 18 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
TF - Flat 18 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 18 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 19 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
TF - Flat 16 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
TF - Flat 17 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 17 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Corridor	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 16 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
TF - Flat 15 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 15 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 15 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 15 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
TF - Flat 15 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Flat 15 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
TF - Comms Room	-	-	-	-	-	-	-	-	-	-	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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
TF - Communal Circulation	-	-	-	-	-	-	-	-	-	-	N/A
TF - Cleaners Store	-	-	0.3	-	-	-	-	-	-	-	N/A
FOF - Flat 23 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 23 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 23 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Shared Bathroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 24 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 21 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 22 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 22 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 21 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 21 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 20 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 20 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 20 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1		
FOF - Flat 20 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Flat 20 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Flat 20 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FOF - Comms Room	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Communal Circulation	-	-	-	-	-	-	-	-	-	-	N/A
FOF - Cleaners Store	-	-	0.3	-	-	-	-	-	-	-	N/A
FIF - Flat 25 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
FIF - Flat 25 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Comms Room	-	-	-	-	-	-	-	-	-	-	N/A
FIF - Cleaners Store	-	-	0.3	-	-	-	-	-	-	-	N/A
FIF - Flat 25 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Communal Circulation	-	-	-	-	-	-	-	-	-	-	N/A
FIF - Flat 25 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
FIF - Flat 25 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
FIF - Flat 25 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 3 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Kitchen	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat 4 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Bedroom	-	-	-	with	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	with	-	-	-	-	-	0.8	0.5

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	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
GF - Flat 4 Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 4 Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 4 Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 4 Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Plant Room	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat 1 Kitchen	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 1 Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 1 Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 1 Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 1 Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 2 Kitchen	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 2 Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 2 Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 2 Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 2 Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 2 Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 2 Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 2 Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 2 Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Stairwell	-	-	-	-	-	-	-	-	-	-	N/A
GF - Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Circulation	-	-	-	-	-	-	-	-	-	-	N/A
GF - Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Comms Room	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat 1 Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 1 Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 3 Kitchen	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat 3 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat 2 Corridor	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat N Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat N Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat N Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat N Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat N Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat N Ensuite	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Flat N Corridor	-	-	-	-	-	-	-	-	-	-	N/A
GF - Flat N Kitchen	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Kitchen	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Bedroom	-	-	-	0.3	-	-	-	-	-	0.8	0.5
GF - Laundry	-	-	0.3	-	-	-	-	-	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
FF - Flat 8 Bedroom		-	73	-	69
FF - Flat 8 Ensuite		-	60	-	17
FF - Flat 8 Kitchen		-	67	-	414
FF - Flat 8 Corridor		-	40	-	155
FF - Flat 8 Ensuite		-	60	-	17
FF - Flat 8 Ensuite		-	60	-	16
FF - Flat 8 Bedroom		-	73	-	69
FF - Flat 8 Bedroom		-	73	-	68
FF - Flat 8 Bedroom		-	73	-	69
FF - Flat 8 Ensuite		-	60	-	15
FF - Flat 9 Kitchen		-	67	-	375
FF - Flat 9 Bedroom		-	73	-	69
FF - Flat 9 Bedroom		-	73	-	68
FF - Flat 9 Bedroom		-	73	-	69
FF - Flat 9 Shared Bathroom		-	60	-	16
FF - Flat 9 Shared Bathroom		-	60	-	21
FF - Flat 9 Corridor		-	40	-	61
FF - Flat 6 Kitchen		-	67	-	424
FF - Flat 7 Kitchen		-	67	-	440
FF - Flat 7 Corridor		-	40	-	177
FF - Flat 7 Ensuite		-	60	-	16
FF - Flat 7 Bedroom		-	73	-	78
FF - Flat 7 Ensuite		-	60	-	16
FF - Flat 7 Bedroom		-	73	-	79
FF - Flat 7 Ensuite		-	60	-	16
FF - Flat 7 Bedroom		-	73	-	80
FF - Flat 7 Bedroom		-	73	-	80
FF - Flat 7 Ensuite		-	60	-	16
FF - Flat 6 Corridor		-	40	-	93
FF - Flat 6 Ensuite		-	60	-	16
FF - Flat 6 Bedroom		-	73	-	77
FF - Flat 6 Ensuite		-	60	-	16
FF - Flat 6 Bedroom		-	73	-	78
FF - Flat 6 Bedroom		-	73	-	78
FF - Flat 6 Ensuite		-	60	-	16
FF - Flat 6 Bedroom		-	73	-	78
FF - Flat 6 Ensuite		-	60	-	16
FF - Stairwell		-	40	-	99
FF - Flat 5 Bedroom		-	73	-	66
FF - Flat 5 Ensuite		-	60	-	32
FF - Flat 5 Kitchen		-	67	-	407
FF - Flat 5 Corridor		-	40	-	22

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
FF - Flat 5 Ensuite		-	60	-	17
FF - Flat 5 Bedroom		-	73	-	69
FF - Comms Room		30	-	-	35
FF - Communal Circulation		-	40	-	244
FF - Cleaners Store		30	-	-	16
SF - Flat 13 Bedroom		-	73	-	69
SF - Flat 13 Ensuite		-	60	-	17
SF - Flat 13 Kitchen		-	67	-	414
SF - Flat 13 Corridor		-	40	-	155
SF - Flat 13 Ensuite		-	60	-	17
SF - Flat 13 Ensuite		-	60	-	16
SF - Flat 13 Bedroom		-	73	-	69
SF - Flat 13 Bedroom		-	73	-	68
SF - Flat 13 Bedroom		-	73	-	69
SF - Flat 13 Ensuite		-	60	-	15
SF - Flat 14 Kitchen		-	67	-	375
SF - Flat 14 Bedroom		-	73	-	69
SF - Flat 14 Bedroom		-	73	-	68
SF - Flat 14 Bedroom		-	73	-	69
SF - Flat 14 Shared Bathroom		-	60	-	16
SF - Flat 14 Shared Bathroom		-	60	-	21
SF - Flat 14 Corridor		-	40	-	61
SF - Flat 11 Kitchen		-	67	-	424
SF - Flat 12 Kitchen		-	67	-	440
SF - Flat 12 Corridor		-	40	-	177
SF - Flat 12 Ensuite		-	60	-	16
SF - Flat 12 Bedroom		-	73	-	78
SF - Flat 12 Ensuite		-	60	-	16
SF - Flat 12 Bedroom		-	73	-	79
SF - Flat 12 Ensuite		-	60	-	16
SF - Flat 12 Bedroom		-	73	-	80
SF - Flat 12 Bedroom		-	73	-	80
SF - Flat 12 Ensuite		-	60	-	16
SF - Flat 11 Corridor		-	40	-	93
SF - Flat 11 Ensuite		-	60	-	16
SF - Flat 11 Bedroom		-	73	-	77
SF - Flat 11 Ensuite		-	60	-	16
SF - Flat 11 Bedroom		-	73	-	78
SF - Flat 11 Bedroom		-	73	-	78
SF - Flat 11 Ensuite		-	60	-	16
SF - Flat 11 Bedroom		-	73	-	78
SF - Flat 11 Ensuite		-	60	-	16
SF - Stairwell		-	40	-	99

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
SF - Flat 10 Bedroom	-	73	-	66
SF - Flat 10 Ensuite	-	60	-	32
SF - Flat 10 Kitchen	-	60	-	136
SF - Flat 10 Corridor	-	40	-	22
SF - Flat 10 Ensuite	-	60	-	17
SF - Flat 10 Bedroom	-	73	-	69
SF - Comms Room	30	-	-	35
SF - Communal Circulation	-	40	-	244
SF - Cleaners Store	30	-	-	16
TF - Flat 18 Bedroom	-	73	-	69
TF - Flat 18 Ensuite	-	60	-	17
TF - Flat 18 Kitchen	-	67	-	414
TF - Flat 18 Corridor	-	40	-	155
TF - Flat 18 Ensuite	-	60	-	17
TF - Flat 18 Ensuite	-	60	-	16
TF - Flat 18 Bedroom	-	73	-	69
TF - Flat 18 Bedroom	-	73	-	68
TF - Flat 18 Bedroom	-	73	-	69
TF - Flat 18 Ensuite	-	60	-	15
TF - Flat 19 Kitchen	-	67	-	375
TF - Flat 19 Bedroom	-	73	-	69
TF - Flat 19 Bedroom	-	73	-	68
TF - Flat 19 Bedroom	-	73	-	69
TF - Flat 19 Shared Bathroom	-	60	-	16
TF - Flat 19 Shared Bathroom	-	60	-	21
TF - Flat 19 Corridor	-	40	-	61
TF - Flat 16 Kitchen	-	67	-	424
TF - Flat 17 Kitchen	-	67	-	440
TF - Flat 17 Corridor	-	40	-	177
TF - Flat 17 Ensuite	-	60	-	16
TF - Flat 17 Bedroom	-	73	-	78
TF - Flat 17 Ensuite	-	60	-	16
TF - Flat 17 Bedroom	-	60	-	72
TF - Flat 17 Ensuite	-	60	-	16
TF - Flat 17 Bedroom	-	73	-	80
TF - Flat 17 Bedroom	-	73	-	80
TF - Flat 17 Ensuite	-	60	-	16
TF - Flat 16 Corridor	-	60	-	93
TF - Flat 16 Ensuite	-	60	-	16
TF - Flat 16 Bedroom	-	73	-	77
TF - Flat 16 Ensuite	-	60	-	16
TF - Flat 16 Bedroom	-	73	-	78
TF - Flat 16 Bedroom	-	73	-	78

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
TF - Flat 16 Ensuite	-	60	-	16
TF - Flat 16 Bedroom	-	73	-	78
TF - Flat 16 Ensuite	-	60	-	16
TF - Stairwell	-	40	-	99
TF - Flat 15 Bedroom	-	73	-	66
TF - Flat 15 Ensuite	-	60	-	32
TF - Flat 15 Kitchen	-	67	-	407
TF - Flat 15 Corridor	-	40	-	22
TF - Flat 15 Ensuite	-	60	-	17
TF - Flat 15 Bedroom	-	73	-	69
TF - Comms Room	30	-	-	35
TF - Communal Circulation	-	40	-	244
TF - Cleaners Store	30	-	-	16
FOF - Flat 23 Bedroom	-	73	-	69
FOF - Flat 23 Ensuite	-	60	-	17
FOF - Flat 23 Kitchen	-	67	-	414
FOF - Flat 23 Corridor	-	40	-	155
FOF - Flat 23 Ensuite	-	60	-	17
FOF - Flat 23 Ensuite	-	60	-	16
FOF - Flat 23 Bedroom	-	73	-	69
FOF - Flat 23 Bedroom	-	73	-	68
FOF - Flat 23 Bedroom	-	73	-	69
FOF - Flat 23 Ensuite	-	60	-	15
FOF - Flat 24 Kitchen	-	67	-	375
FOF - Flat 24 Bedroom	-	73	-	69
FOF - Flat 24 Bedroom	-	73	-	68
FOF - Flat 24 Bedroom	-	73	-	69
FOF - Flat 24 Shared Bathroom	-	60	-	16
FOF - Flat 24 Shared Bathroom	-	60	-	21
FOF - Flat 24 Corridor	-	40	-	61
FOF - Flat 21 Kitchen	-	67	-	424
FOF - Flat 22 Kitchen	-	67	-	440
FOF - Flat 22 Corridor	-	40	-	177
FOF - Flat 22 Ensuite	-	60	-	16
FOF - Flat 22 Bedroom	-	73	-	78
FOF - Flat 22 Ensuite	-	60	-	16
FOF - Flat 22 Bedroom	-	73	-	79
FOF - Flat 22 Ensuite	-	60	-	16
FOF - Flat 22 Bedroom	-	73	-	80
FOF - Flat 22 Bedroom	-	73	-	80
FOF - Flat 22 Ensuite	-	60	-	16
FOF - Flat 21 Corridor	-	40	-	93
FOF - Flat 21 Ensuite	-	60	-	16

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
FOF - Flat 21 Bedroom		-	73	-	77
FOF - Flat 21 Ensuite		-	60	-	16
FOF - Flat 21 Bedroom		-	73	-	78
FOF - Flat 21 Bedroom		-	73	-	78
FOF - Flat 21 Ensuite		-	60	-	16
FOF - Flat 21 Bedroom		-	73	-	78
FOF - Flat 21 Ensuite		-	60	-	16
FOF - Stairwell		-	40	-	99
FOF - Flat 20 Bedroom		-	73	-	66
FOF - Flat 20 Ensuite		-	60	-	32
FOF - Flat 20 Kitchen		-	67	-	407
FOF - Flat 20 Corridor		-	40	-	22
FOF - Flat 20 Ensuite		-	60	-	17
FOF - Flat 20 Bedroom		-	73	-	69
FOF - Comms Room		30	-	-	35
FOF - Communal Circulation		-	40	-	244
FOF - Cleaners Store		30	-	-	16
FIF - Flat 25 Ensuite		-	60	-	16
FIF - Flat 25 Bedroom		-	73	-	77
FIF - Flat 25 Ensuite		-	60	-	16
FIF - Flat 25 Bedroom		-	73	-	78
FIF - Flat 25 Ensuite		-	60	-	16
FIF - Flat 25 Bedroom		-	73	-	78
FIF - Flat 25 Ensuite		-	60	-	16
FIF - Stairwell		-	40	-	99
FIF - Flat 25 Bedroom		-	73	-	66
FIF - Flat 25 Ensuite		-	60	-	17
FIF - Flat 25 Bedroom		-	73	-	69
FIF - Comms Room		30	-	-	33
FIF - Cleaners Store		30	-	-	15
FIF - Flat 25 Bedroom		-	73	-	74
FIF - Communal Circulation		-	40	-	168
FIF - Flat 25 Corridor		-	40	-	113
FIF - Flat 25 Ensuite		-	60	-	17
FIF - Flat 25 Kitchen		-	67	-	415
GF - Flat 3 Bedroom		-	73	-	68
GF - Flat 3 Ensuite		-	60	-	14
GF - Flat 3 Bedroom		-	73	-	72
GF - Flat 3 Ensuite		-	60	-	14
GF - Flat 3 Bedroom		-	73	-	72
GF - Flat 3 Ensuite		-	60	-	14
GF - Flat 3 Bedroom		-	73	-	71
GF - Flat 3 Ensuite		-	60	-	14

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF - Flat 3 Bedroom	-	73	-	80
GF - Flat 3 Ensuite	-	60	-	13
GF - Flat 4 Bedroom	-	73	-	79
GF - Flat 4 Ensuite	-	60	-	13
GF - Flat 4 Kitchen	-	67	-	419
GF - Flat 4 Ensuite	-	60	-	15
GF - Flat 4 Corridor	-	40	-	92
GF - Flat 4 Bedroom	-	73	-	73
GF - Flat 4 Ensuite	-	60	-	15
GF - Flat 4 Bedroom	-	73	-	70
GF - Flat 4 Ensuite	-	60	-	14
GF - Flat 4 Bedroom	-	73	-	71
GF - Flat 4 Ensuite	-	60	-	14
GF - Flat 4 Bedroom	-	73	-	70
GF - Flat 4 Ensuite	-	60	-	14
GF - Flat 4 Bedroom	-	73	-	69
GF - Plant Room	30	-	-	694
GF - Flat 1 Kitchen	-	67	-	357
GF - Flat 1 Ensuite	-	60	-	16
GF - Flat 1 Bedroom	-	73	-	74
GF - Flat 1 Ensuite	-	60	-	17
GF - Flat 1 Bedroom	-	73	-	76
GF - Flat 2 Kitchen	-	67	-	434
GF - Flat 2 Ensuite	-	60	-	16
GF - Flat 2 Bedroom	-	73	-	68
GF - Flat 2 Ensuite	-	60	-	16
GF - Flat 2 Bedroom	-	73	-	80
GF - Flat 2 Bedroom	-	73	-	79
GF - Flat 2 Ensuite	-	60	-	16
GF - Flat 2 Ensuite	-	60	-	16
GF - Flat 2 Bedroom	-	73	-	82
GF - Stairwell	-	40	-	96
GF - Bedroom	-	73	-	82
GF - Circulation	-	40	-	38
GF - Ensuite	-	60	-	22
GF - Comms Room	30	-	-	36
GF - Flat 1 Ensuite	-	60	-	17
GF - Flat 1 Bedroom	-	73	-	75
GF - Flat 3 Kitchen	-	67	-	423
GF - Flat 3 Corridor	-	40	-	78
GF - Flat 2 Corridor	-	40	-	722
GF - Flat N Ensuite	-	60	-	16
GF - Flat N Bedroom	-	80	-	62

General lighting and display lighting		Luminous efficacy [lm/W]			
Zone name		Luminaire	Lamp	Display lamp	General lighting [W]
	Standard value	60	60	22	
GF - Flat N Bedroom		-	80	-	62
GF - Flat N Ensuite		-	60	-	16
GF - Flat N Bedroom		-	80	-	62
GF - Flat N Ensuite		-	60	-	16
GF - Flat N Corridor		-	40	-	57
GF - Flat N Kitchen		-	67	-	350
GF - Kitchen		-	67	-	263
GF - Bedroom		-	73	-	84
GF - Laundry		-	67	-	120

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
FF - Flat 8 Bedroom	NO (-62.6%)	NO
FF - Flat 8 Bedroom	NO (-62.6%)	NO
FF - Flat 8 Bedroom	NO (-61.9%)	NO
FF - Flat 8 Bedroom	NO (-61.9%)	NO
FF - Flat 9 Bedroom	NO (-63.2%)	NO
FF - Flat 9 Bedroom	NO (-61.9%)	NO
FF - Flat 9 Bedroom	NO (-62.6%)	NO
FF - Flat 7 Bedroom	NO (-72.1%)	NO
FF - Flat 7 Bedroom	NO (-72.2%)	NO
FF - Flat 7 Bedroom	NO (-72.7%)	NO
FF - Flat 7 Bedroom	NO (-72.6%)	NO
FF - Flat 6 Bedroom	NO (-72.1%)	NO
FF - Flat 6 Bedroom	NO (-72.2%)	NO
FF - Flat 6 Bedroom	NO (-72.3%)	NO
FF - Flat 6 Bedroom	NO (-72.5%)	NO
FF - Flat 5 Bedroom	NO (-76.8%)	NO
FF - Flat 5 Bedroom	NO (-73.3%)	NO
SF - Flat 13 Bedroom	NO (-62.6%)	NO
SF - Flat 13 Bedroom	NO (-62.6%)	NO
SF - Flat 13 Bedroom	NO (-61.9%)	NO
SF - Flat 13 Bedroom	NO (-61.9%)	NO
SF - Flat 14 Bedroom	NO (-63.2%)	NO
SF - Flat 14 Bedroom	NO (-61.9%)	NO
SF - Flat 14 Bedroom	NO (-62.6%)	NO
SF - Flat 12 Bedroom	NO (-72.1%)	NO
SF - Flat 12 Bedroom	NO (-72.2%)	NO
SF - Flat 12 Bedroom	NO (-72.7%)	NO
SF - Flat 12 Bedroom	NO (-72.6%)	NO
SF - Flat 11 Bedroom	NO (-72.1%)	NO
SF - Flat 11 Bedroom	NO (-72.2%)	NO
SF - Flat 11 Bedroom	NO (-72.3%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
SF - Flat 11 Bedroom	NO (-72.5%)	NO
SF - Flat 10 Bedroom	NO (-76.8%)	NO
SF - Flat 10 Bedroom	NO (-73.3%)	NO
TF - Flat 18 Bedroom	NO (-62.6%)	NO
TF - Flat 18 Bedroom	NO (-62.6%)	NO
TF - Flat 18 Bedroom	NO (-61.9%)	NO
TF - Flat 18 Bedroom	NO (-61.9%)	NO
TF - Flat 19 Bedroom	NO (-63.2%)	NO
TF - Flat 19 Bedroom	NO (-61.9%)	NO
TF - Flat 19 Bedroom	NO (-62.6%)	NO
TF - Flat 17 Bedroom	NO (-72.1%)	NO
TF - Flat 17 Bedroom	NO (-72.7%)	NO
TF - Flat 17 Bedroom	NO (-72.6%)	NO
TF - Flat 16 Bedroom	NO (-72.1%)	NO
TF - Flat 16 Bedroom	NO (-72.2%)	NO
TF - Flat 16 Bedroom	NO (-72.3%)	NO
TF - Flat 16 Bedroom	NO (-72.5%)	NO
TF - Flat 15 Bedroom	NO (-76.8%)	NO
TF - Flat 15 Bedroom	NO (-73.3%)	NO
FOF - Flat 23 Bedroom	NO (-62.6%)	NO
FOF - Flat 23 Bedroom	NO (-62.6%)	NO
FOF - Flat 23 Bedroom	NO (-61.9%)	NO
FOF - Flat 23 Bedroom	NO (-61.9%)	NO
FOF - Flat 24 Bedroom	NO (-63.2%)	NO
FOF - Flat 24 Bedroom	NO (-61.9%)	NO
FOF - Flat 24 Bedroom	NO (-62.6%)	NO
FOF - Flat 22 Bedroom	NO (-72.1%)	NO
FOF - Flat 22 Bedroom	NO (-72.2%)	NO
FOF - Flat 22 Bedroom	NO (-72.7%)	NO
FOF - Flat 22 Bedroom	NO (-72.6%)	NO
FOF - Flat 21 Bedroom	NO (-72.1%)	NO
FOF - Flat 21 Bedroom	NO (-72.2%)	NO
FOF - Flat 21 Bedroom	NO (-72.3%)	NO
FOF - Flat 21 Bedroom	NO (-72.5%)	NO
FOF - Flat 20 Bedroom	NO (-76.8%)	NO
FOF - Flat 20 Bedroom	NO (-73.3%)	NO
FIF - Flat 25 Bedroom	NO (-72.1%)	NO
FIF - Flat 25 Bedroom	NO (-72.2%)	NO
FIF - Flat 25 Bedroom	NO (-72.5%)	NO
FIF - Flat 25 Bedroom	NO (-76.8%)	NO
FIF - Flat 25 Bedroom	NO (-73.3%)	NO
FIF - Flat 25 Bedroom	NO (-91%)	NO
GF - Flat 3 Bedroom	NO (-90.2%)	NO
GF - Flat 3 Bedroom	NO (-71.7%)	NO
GF - Flat 3 Bedroom	NO (-72%)	NO
GF - Flat 3 Bedroom	NO (-71.7%)	NO
GF - Flat 3 Bedroom	NO (-75.1%)	NO
GF - Flat 4 Bedroom	NO (-74.6%)	NO
GF - Flat 4 Bedroom	NO (-65.2%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF - Flat 4 Bedroom	NO (-63.6%)	NO
GF - Flat 4 Bedroom	NO (-64%)	NO
GF - Flat 4 Bedroom	NO (-63.2%)	NO
GF - Flat 4 Bedroom	NO (-63.1%)	NO
GF - Flat 1 Bedroom	NO (-61.9%)	NO
GF - Flat 1 Bedroom	NO (-61.9%)	NO
GF - Flat 2 Bedroom	NO (-61.9%)	NO
GF - Flat 2 Bedroom	NO (-73.1%)	NO
GF - Flat 2 Bedroom	NO (-72.5%)	NO
GF - Flat 2 Bedroom	NO (-74%)	NO
GF - Bedroom	NO (-72.2%)	NO
GF - Flat 1 Bedroom	NO (-62.6%)	NO
GF - Flat N Bedroom	NO (-71.5%)	NO
GF - Flat N Bedroom	NO (-71.1%)	NO
GF - Flat N Bedroom	NO (-71.2%)	NO
GF - Bedroom	NO (-67.8%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of 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?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	3463.6	3463.6
External area [m ²]	3911.1	3911.1
Weather	SOU	SOU
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	1317.19	1971.29
Average U-value [W/m ² K]	0.34	0.5
Alpha value* [%]	27.79	17.79

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
100	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 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	16.62	21.34
Cooling	0	0
Auxiliary	10.6	7.41
Lighting	22.2	15.8
Hot water	114.84	86.08
Equipment*	44.56	44.56
TOTAL**	132.66	130.63

* Energy used by equipment does not count towards the total for 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	31.6	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	178.84	194.11
Primary energy* [kWh/m ²]	161.55	200.54
Total emissions [kg/m ²]	28.6	35

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

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 SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	12.3	138	4	0	9.3	0.85	0	0.95	0
Notional	62.9	131.2	21.3	0	7.4	0.82	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

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.18	FF00002C_W-1
Floor	0.2	0.16	FF000045_F
Roof	0.15	0.16	TF000028_C
Windows, roof windows, and rooflights	1.5	1.4	FF00002C_W-1_O0
Personnel doors	1.5	2.2	FF00002C_W-1_O1
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)] U _{i-Min} = Minimum individual element U-values [W/(m²K)] * There might be more than one surface where the minimum U-value occurs.			

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5

