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TYBALDS ESTATE REGENERATION

GREAT ORMOND STREET HOSPITAL PARENTS ACCOMMODATION AT THE TYBALDS ESTATE

ENERGY AND SUSTAINABILITY STATEMENT

Revision 01

Prepared by Alex Maguire, issued 29th January 2016

CONTENTS

1.0 INTRODUCTION

This document has been prepared to summarise the approach to reducing carbon emissions arising from the use of fixed building services installations within the proposed building.

2.0 BACKGROUND

An energy strategy was prepared for the Tybalds Estate Regeneration project which balanced the performance requirements of the new homes, improved performance of systems serving existing dwellings and compliance with associated legislation.

The system was designed to demonstrate compliance against the 2011 version of the London Plan and associated second and third tier documentation which required a carbon improvement of 25% beyond Part L 2010 requirements. This was equivalent to the required standard for compliance with Code for Sustainable Homes (CfSH) level 4.

As the building is now being used as parent accommodation it cannot be assessed under the residential framework as the building is defined under Building regulations in the category of 'Room for residential purposes' which requires assessment using Part L2[1] as a non-domestic building.

Current London Borough of Camden Policy DP22 requires that non domestic developments over 500sq.m are to achieve BREEAM 'Excellent' from 2016 onwards.

A BREEAM assessment has not been undertaken as both the proposed blocks are under the 500 sq.m threshold for this policy but the performance initiatives that are set out within BREEAM UK New Construction 20142 have been considered. That assessment methodology requires a minimum Energy Performance Ratio for New Constructions (EPR NC).of 0.375 for an 'Excellent' rating. Unfortunately the EPRNC cannot be easily determined without a BREEAM pre-assessment and whilst not a requirement for these buildings individually the team has sought to achieve the most technically viable level of performance and that is demonstrated herein with the associated Part L2 BRUKL calculations.

[1] Building Regulations Part L2:2013
[2] BREEAM UK New Construction 2014, Building Research Establishment, 2014

3.0 MEWS BOOKEND

3.1 Envelope performance

Thermal envelope performance will be increased beyond the requirements of Part L to first reduce the requirement of energy for space conditioning. Heat interface units which incorporate separate plate heat exchangers for the generation of heating and hot water will be used for the delivery of energy to zones of the building. Zones have been selected on the basis of hot water provision to optimise the provision of plant items.

Table 3.2 – Fabric performance standards

Element	Approved document L1A 2013 target U value (W/m^2K)	LBC target U value (W/m^2K)	Proposed target U value (W/m^2K)
External wall	0.30	0.20	0.16
Floor	0.25	0.13	0.11
Roof	0.20	0.13	0.15
Glazing (double)	2.00	1.40	1.50
Air tightness (m^3/hm^2)	10	3	5

3.2 Ventilation

As the rooms within the building will not be permanently occupied it is important to provide background ventilation to both maintain air quality and mitigate the potential for overheating. Domestic heat recovery ventilation systems will be provided to parts of the building for this purpose.

3.3 Thermal energy

For the Tybalds Estate development analysis of feasible options determined that the most appropriate technology for carbon reduction would be small scale combined heat and power plant incorporated within a centralised communal system.

Numerous options were considered for the Mew Houses which were originally planned to be fed from the central plant installations. Their remote location from the main distribution spines and the nature of the connection to the Mews Houses and the Mews Bookend block was reconsidered and following an appraisal of the capital cost and efficiency of such a configuration it was decided that a locally serviced option was most appropriate.

A strategy has thus been developed for the use of high efficiency gas fired condensing boilers serving parts of the building. These boilers will allow the efficient generation of hot water for domestic purposes with limited distribution losses which often penalises many centrally services schemes.

3.4 Carbon performance

Modelling of the building has been undertaken to determine the potential performance against the Building Regulations Part L2 framework. A copy of a BRUKL document is included within Appendix A for both a central hot water storage option and a combination boiler based option. These indicate improvements of 5% and 24% beyond the notional building level respectively.

3.5 Summary

The preferred strategy uses the following key design elements:

- Improved fabric performance, beyond the already enhanced fabric proposed for the development
- High efficiency heat recovery installations
- High efficiency gas fired condensing boiler

Performance levels proposed under the original estate strategy have been maintained and further modelling using Part L2A has been undertaken. This demonstrates a range of improvement in carbon emissions of between 5 and 24% depending upon the strategy for hot water generation that is adopted. Designs will be developed to ensure that performance levels target the latter.

4.0 BLEMUNDSBURY BOOKEND

4.1 Envelope performance

Thermal envelope performance will be increased beyond the requirements of Part L to first reduce the requirement of energy for space conditioning. Heat interface units which incorporate separate plate heat exchangers for the generation of heating and hot water will be used for the delivery of energy to zones of the building. Zones have been selected on the basis of hot water provision to optimise the provision of plant items.

Table 3.2 – Fabric performance standards

Element	Approved document L1A 2013 target U value (W/m^2K)	LBC target U value (W/m^2K)	Proposed target U value (W/m^2K)
External wall	0.30	0.20	0.19
Floor	0.25	0.13	0.15
Roof	0.20	0.13	0.13
Glazing (double)	2.00	1.40	1.40
Air tightness (m^3/hm^2)	10	3	5

4.2 Ventilation

As the rooms within the building will not be permanently occupied it is important to provide background ventilation to both maintain air quality and mitigate the potential for overheating. Domestic heat recovery ventilation systems will be provided to parts of the building for this purpose.

4.3 Thermal energy

For the Tybalds Estate development analysis of feasible options determined that the most appropriate technology for carbon reduction would be small scale combined heat and power plant incorporated within a centralised communal system.

Replacement of existing communal plant installations and the incorporation of those systems into the new communal system provides numerous benefits across estate. Resilience is provided through new plant which serves both new and existing dwellings. Existing dwellings receive energy from more efficient central plant, distribution and delivery installations. The increased demand on the new system made up of services to new dwellings and those existing dwellings which are transferred from other aged systems, this provides an increased baseload against which combined heat and power can operate thereby increasing its viability.

Under the original strategy, it was intended that the central plant installation would serve the Blemundsbury bookend and that energy would be delivered to individual residences via heat interface units. This strategy has been tested and the subsequent design developed to meet the required performance criteria for the development, including the load associated with the Blemundsbury bookend.

Continuation of this strategy remains the most logical solution for the building in its new use and this actually suits the anticipated load profile of the new accommodation for Great Ormond Street Hospital. This load profile is expected to include low levels of thermal energy for heating purposes due to the fabric performance standards which exceed those required by Building Regulations Part L. Higher levels of thermal energy will be required for domestic hot water production given the anticipated occupation of the residential rooms within the building. The proposed strategy is able to deliver this efficiently through the plate heat exchangers within individual HIU's which generate hot water on demand.

4.4 Carbon performance

Modelling of the building has been undertaken to determine the potential performance against the Building Regulations Part L2 framework. A copy of the BRUKL document is included within Appendix B which indicates an improvement of approximately 11% over the notional building level. The results do not include the benefit of the small scale CHP which forms part of the central plant installation, modelling assumes 'district heating' only. A further improvement will be realised when this is incorporated but the proportion of energy delivered via this means will be dependent upon a wider analysis of the overall network, which can be undertaken at the detail design stage.

Modelling of the building to show the benefit of the combined heat and power instalaltion that will form part of the central plant installation has been undertaken. A unit capacity of 20kW has been used in the sample analysis. Whilst the overall capacity of the unit will not directly relate to the building, the large scale of the communal network means that the run time of the CHP will be extended and it will thus achieve a better performance index. Its benefit is therefore much greater than its capacity would suggest. The sample analysis for the Blemundsbury bookend indicates an improvement of 48% beyond Part L with a run time at peak load of around 380 hours. The anticipated run time of the unit in overall terms will be around 5000 hours.

Whilst by no means final or detailed, this analysis demonstrates the potential range of carbon reduction that could be calculated at detailed design stage.

4.5 Summary

The original envelope and central plant design was developed under the previous energy related framework which required a carbon reduction of 25% beyond Part L 2010 levels. This requirement was referenced with London Borough of Camden's sustainability policy and was also a minimum requirement for CfSH Level 4 compliance.

Performance levels proposed under the original estate strategy have been maintained and further modelling using Part L2A has indicated an improvement of 11% beyond Part L2: 2013 requirements. When the benefit of CHP is incorporated the potential improvement over Part L could by up to 48%.

Additional modelling will be required during the detailed design stage to confirm final performance levels.

5.0 PRINCIPLES OF SUSTAINABILITY

5.1 Introduction

Sustainability issues are being addressed by the project team as the project develops. In this section the guiding principles are set out and these will be further developed as the project progresses. Attention has been given to:

- Water efficiency
- Materials
- Green / brown roofs
- Flooding
- Biodiversity
- Adaptation to climate change

5.2 Water Efficiency

Water saving features will be incorporated for both consumption and discharge of wastewater. A maximum internal water use figure of 105 litres/person/day will be achieved through the specification of low-flow fittings and efficient water use appliances.

To compliment low water use fittings, additional electronic controls will be considered to both avoid unnecessary consumption and prevent excessive consumption.

Other water saving devices which will also be considered during the design process are to include low flush WCs, spray taps, spray showers and shallow baths all as recommended within CfSH and BDR. Surface water run off generated as a result of the proposed development will be managed in a number of ways as part of a surface water management strategy using Sustainable Drainage Systems (SUDS).

This provides the benefit of attenuation and pollution control prior to the infiltration of water to the ground or discharge to a sewer.

5.3 Materials

Embodied energy is the energy that has gone into the manufacture, processing and transportation of materials to site. Where possible materials with a low embodied energy will be specified and, where high embodied energy materials are selected, their volume is to be minimised.

Construction elements are to be assessed using the 2008 Green Guide for specification. It is expected that at least 3 of the 5 following building elements will achieve a Green Guide rating of D to A+:

- Roof
- External walls
- Internal walls
- Upper and ground floors
- Windows

In addition to this the design team have made a commitment that a significant proportion of the materials used in finishing the basic building elements will be responsibly sourced.

All timber or timber products will be FSC/PEFC/CSA certified (internal doors, skirting, panelling, kitchen units, fitted furniture, bath panels, fascias, frames, boarding, or other significant use). All UPVC products will be ISO14001/EMAS/ BES6001 certified for the key & supply chain processes.

5.4 Green / brown roofs

Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover/landscaping over a drainage layer. They are designed to intercept and retain precipitation, reducing the volume of run off and attenuating peak flows.

Green roofs provide a reduction in the volume of run off generated and to peak flows from the development and provide a useful contribution to meeting surface water attenuation requirements.

Proposals for green roofs will be developed as the design progresses but this is being balanced against the provision of external amenity space

5.5 Flooding

The team will seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

5.6 Adapting to climate change

Design development has considered the most appropriate use of materials and their performance to reduce the energy requirement of the development. Overheating analysis demonstrated that overheating is a potential risk with the proposed fabric standards and air tightness.

Natural ventilation will be maximised for the maintenance of indoor air quality and also to provide a degree of summertime control but it will not be possible to open windows in all cases without potential security or noise issues. Mechanical ventilation systems with heat recovery are proposed to ensure a continuous mechanical ventilation rate within each occupied space.

The surface water drainage management strategy will need to take into account future allowances for climate change for a predicted increase of 30% in rainfall intensities in accordance with the NPPF.

APPENDIX A - MEWS BOOKEND BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

7585TM_MBE001 - Local boiler - DHWS instantanious

As built

Date: Thu Feb 04 10:35:45 2016

Administrative information

Building Details

Address: Mews Houses - Book End, London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.4

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.4

BRUKL compliance check version: v5.2.d.2

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Alex E T Maguire

Telephone number: 01438 314422

Address: Building 3, Gateway 1000, Arlington Business Park, Stevenage, SG1 2FP

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	28
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	28
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	21.1
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.13	0.35	0_000009:Surf[4]
Floor	0.25	0.17	0.18	0_000008:Surf[3]
Roof	0.25	0.15	0.15	1_000000:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.51	1.51	0_000008:Surf[1]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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	<0.9

1- LPHW heating & MVHR

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0.2	0	0.65
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

2- LPHW heating & NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0.2	0	-
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					YES

* 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.

"No HWS in project, or hot water is provided by HVAC system"

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
0_BEDROOM	-	82	-	51
0_BEDROOM	-	77	-	62
0_COMMUNAL KITCHEN DINING LIVING	-	70	-	246
0_ENSUITE	-	122	-	33
0_ENSUITE	-	125	-	30
0_ENTRANCE LOBBY	-	174	-	23
0_LOBBY	-	135	-	18
0_LOBBY	-	135	-	18
0_REFUGE	-	174	-	8
0_REFUSE	-	174	-	11
0_STAIR	-	76	-	65
0_STORE	-	174	-	8
1_BEDROOM	-	72	-	87
1_BEDROOM	-	83	-	51
1_BEDROOM	-	75	-	74
1_BEDROOM	-	78	-	62
1_ENSUITE	-	125	-	32
1_ENSUITE	-	110	-	38
1_ENSUITE	-	130	-	30
1_ENSUITE	-	127	-	33

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
1_LOBBY	-	141	-	18
1_LOBBY	-	141	-	18
1_REFUGE	-	174	-	8
1_STAIR	-	76	-	93
1_STORE	-	174	-	8
2_BEDROOM	-	77	-	79
2_BEDROOM	-	77	-	74
2_BEDROOM	-	86	-	51
2_ENSUITE	-	108	-	45
2_ENSUITE	-	129	-	33
2_ENSUITE	-	134	-	33
2_LOBBY	-	149	-	18
2_LOBBY	-	132	-	23
2_REFUGE	-	174	-	8
2_STAIR	-	75	-	87
2_STORE	-	174	-	9

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?
0_BEDROOM	NO (-69%)	NO
0_BEDROOM	NO (-61.1%)	NO
0_COMMUNAL KITCHEN DINING LIVING	NO (-61.6%)	NO
1_BEDROOM	NO (-67.4%)	NO
1_BEDROOM	NO (-48.3%)	NO
1_BEDROOM	NO (-48.1%)	NO
1_BEDROOM	NO (-61.1%)	NO
2_BEDROOM	NO (-51.8%)	NO
2_BEDROOM	NO (-52.3%)	NO
2_BEDROOM	NO (-56.8%)	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?	NO
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]	267.8	267.8
External area [m^2]	707.5	707.5
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	200.84	364.67
Average U-value [W/m^2K]	0.28	0.52
Alpha value* [%]	11.01	10

* 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
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
100	**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/m^2]

	Actual	Notional
Heating	24.02	52.48
Cooling	0	0
Auxiliary	1.25	1.25
Lighting	9.06	10.76
Hot water	49.01	49.01
Equipment*	8.24	8.24
TOTAL**	**83.34**	**113.5**

* 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/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	73.9	162.88
Primary energy* [kWh/m^2]	120.75	159.77
Total emissions [kg/m^2]	21.1	28

* 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	91.3	0	29.7	0	1.2	0.85	0	0.91	0
	Notional	196.7	0	63.4	0	1.2	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	38.7	0	12.6	0	1.4	0.85	0	0.91	0
	Notional	96.1	0	31	0	1.4	0.86	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	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.04	2_000000:Surf[12]
Floor	0.2	0.04	1_000002:Surf[5]
Roof	0.15	0.15	1_000000:Surf[0]
Windows, roof windows, and rooflights	1.5	1.51	0_000008:Surf[1]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = 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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

7585TM_MBE002 - Local boiler - DHWS storage cylinder

As built

Date: Thu Feb 04 10:38:47 2016

Administrative information

Building Details

Address: Mews Houses - Book End, London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.4

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.4

BRUKL compliance check version: v5.2.d.2

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Alex E T Maguire

Telephone number: 01438 314422

Address: Building 3, Gateway 1000, Arlington Business Park, Stevenage, SG1 2FP

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	28
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	28
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	26.4
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.13	0.35	0_000009:Surf[4]
Floor	0.25	0.17	0.18	0_000008:Surf[3]
Roof	0.25	0.15	0.15	1_000000:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.51	1.51	0_000008:Surf[1]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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	<0.9

1- LPHW heating & MVHR

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0.2	0	0.65
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

2- LPHW heating & NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0.2	0	-
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					YES

* 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.

"No HWS in project, or hot water is provided by HVAC system"

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
0_BEDROOM	-	82	-	51
0_BEDROOM	-	77	-	62
0_COMMUNAL KITCHEN DINING LIVING	-	70	-	246
0_ENSUITE	-	122	-	33
0_ENSUITE	-	125	-	30
0_ENTRANCE LOBBY	-	174	-	23
0_LOBBY	-	135	-	18
0_LOBBY	-	135	-	18
0_REFUGE	-	174	-	8
0_REFUSE	-	174	-	11
0_STAIR	-	76	-	65
0_STORE	-	174	-	8
1_BEDROOM	-	72	-	87
1_BEDROOM	-	83	-	51
1_BEDROOM	-	75	-	74
1_BEDROOM	-	78	-	62
1_ENSUITE	-	125	-	32
1_ENSUITE	-	110	-	38
1_ENSUITE	-	130	-	30
1_ENSUITE	-	127	-	33

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
1_LOBBY	-	141	-	18
1_LOBBY	-	141	-	18
1_REFUGE	-	174	-	8
1_STAIR	-	76	-	93
1_STORE	-	174	-	8
2_BEDROOM	-	77	-	79
2_BEDROOM	-	77	-	74
2_BEDROOM	-	86	-	51
2_ENSUITE	-	108	-	45
2_ENSUITE	-	129	-	33
2_ENSUITE	-	134	-	33
2_LOBBY	-	149	-	18
2_LOBBY	-	132	-	23
2_REFUGE	-	174	-	8
2_STAIR	-	75	-	87
2_STORE	-	174	-	9

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?
0_BEDROOM	NO (-69%)	NO
0_BEDROOM	NO (-61.1%)	NO
0_COMMUNAL KITCHEN DINING LIVING	NO (-61.6%)	NO
1_BEDROOM	NO (-67.4%)	NO
1_BEDROOM	NO (-48.3%)	NO
1_BEDROOM	NO (-48.1%)	NO
1_BEDROOM	NO (-61.1%)	NO
2_BEDROOM	NO (-51.8%)	NO
2_BEDROOM	NO (-52.3%)	NO
2_BEDROOM	NO (-56.8%)	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?	NO
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]	267.8	267.8
External area [m^2]	707.5	707.5
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	200.84	364.67
Average U-value [W/m^2K]	0.28	0.52
Alpha value* [%]	11.01	10

* 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
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
100	**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/m^2]

	Actual	Notional
Heating	24.02	52.48
Cooling	0	0
Auxiliary	5.11	1.25
Lighting	9.06	10.76
Hot water	64.23	49.01
Equipment*	8.24	8.24
TOTAL**	**102.41**	**113.5**

* 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/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	73.9	162.88
Primary energy* [kWh/m^2]	151.15	159.77
Total emissions [kg/m^2]	26.4	28

* 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	91.3	0	29.7	0	1.2	0.85	0	0.91	0
	Notional	196.7	0	63.4	0	1.2	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	38.7	0	12.6	0	1.4	0.85	0	0.91	0
	Notional	96.1	0	31	0	1.4	0.86	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	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.04	2_000000:Surf[12]
Floor	0.2	0.04	1_000002:Surf[5]
Roof	0.15	0.15	1_000000:Surf[0]
Windows, roof windows, and rooflights	1.5	1.51	0_000008:Surf[1]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = 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 B - BLEMDUNSBURY BOOKEND BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

7585TM_BBE001

As built

Date: Thu Feb 04 10:28:16 2016

Administrative information

Building Details

Address: Blemundsbury - Book End, London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.4

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.4

BRUKL compliance check version: v5.2.d.2

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Alex E T Maguire

Telephone number: 01438 314422

Address: Building 3, Gateway 1000, Arlington Business Park, Stevenage, SG1 2FP

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	32.3
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	32.3
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	28.7
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.17	0.31	0_000005:Surf[12]
Floor	0.25	0.15	0.17	1_000006:Surf[6]
Roof	0.25	0.13	0.13	1_000016:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	0_00000E:Surf[0]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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	<0.9

1- LPHW heating & MVHR

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	1.5	0.65
Standard value	N/A	N/A	N/A	1.5^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

2- LPHW heating & NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	0	-
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					YES

"No HWS in project, or hot water is provided by HVAC system"

1- CHECK2-CHP

	CHPQA quality index	CHP electrical efficiency
This building	0	0.3
Standard value	Not provided	N/A

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
1_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
1_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
1_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
1_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
1_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
1_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
1_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
1_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	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
1_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
2_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
2_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
2_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
2_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
2_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
2_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
2_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
2_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
1_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	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	
0_BEDROOM	-	82	-	116
0_COMMUNAL AREA	-	68	-	202
0_DUMMY SPACE	-	59	-	410
0_ENSUITE	-	104	-	43
0_LIVING DINING KITCHEN	-	66	-	298
0_LOBBY	-	120	-	26
0_STAIR	-	73	-	94
0_STORE	-	174	-	6
1_BEDROOM	-	87	-	59
1_BEDROOM	-	80	-	109
1_BEDROOM	-	83	-	82
1_BEDROOM	-	71	-	89
1_BEDROOM	-	68	-	108
1_CORRIDOR	-	108	-	64
1_DUMMY SPACE	-	64	-	186
1_ENSUITE	-	107	-	39
1_ENSUITE	-	115	-	34
1_ENSUITE	-	109	-	37
1_ENSUITE	-	113	-	35
1_ENSUITE	-	111	-	35
1_ENSUITE	-	101	-	43
1_LOBBY	-	116	-	26
1_STAIR	-	70	-	128
1_STORE	-	174	-	6
1_STORE	-	174	-	8
2_BEDROOM	-	92	-	109
2_BEDROOM	-	79	-	89
2_BEDROOM	-	94	-	108
2_BEDROOM	-	74	-	108

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
2_ENSUITE	-	133	-	39
2_ENSUITE	-	144	-	34
2_ENSUITE	-	141	-	35
2_ENSUITE	-	138	-	36
2_LOBBY	-	146	-	26
2_LOBBY	-	146	-	26
2_STAIR	-	77	-	123
2_STORE	-	174	-	6
1_BEDROOM	-	80	-	77

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?
0_BEDROOM	NO (-55.7%)	NO
0_COMMUNAL AREA	NO (-55%)	NO
0_LIVING DINING KITCHEN	NO (-87.7%)	NO
1_BEDROOM	NO (-62.7%)	NO
1_BEDROOM	NO (-13.7%)	NO
1_BEDROOM	NO (-27.4%)	NO
1_BEDROOM	NO (-32.1%)	NO
1_BEDROOM	NO (-50.1%)	NO
2_BEDROOM	NO (-8.8%)	NO
2_BEDROOM	NO (-46.7%)	NO
2_BEDROOM	NO (-27.1%)	NO
2_BEDROOM	NO (-49.8%)	NO
1_BEDROOM	NO (-14.6%)	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?	NO
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]	538	538
External area [m^2]	1224.6	1224.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	3
Average conductance [W/K]	358.39	627.25
Average U-value [W/m^2K]	0.29	0.51
Alpha value* [%]	9.65	10

* 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
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
100	**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/m^2]

	Actual	Notional
Heating	22	35.72
Cooling	0	0
Auxiliary	1.85	1.5
Lighting	10.49	8.77
Hot water	54.03	56.87
Equipment*	8.21	8.21
TOTAL**	**88.37**	**102.86**

* 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/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	74.39	128.6
Primary energy* [kWh/m^2]	37.89	30.73
Total emissions [kg/m^2]	28.7	32.3

* 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] District heating, [HFT] District Heating, [CFT] Electricity										
	Actual	97.7	0	28.9	0	2.2	0.94	0	1	0
	Notional	149	0	41.4	0	1.6	1	0	----	----
[ST] Central heating using water: radiators, [HS] District heating, [HFT] District Heating, [CFT] Electricity										
	Actual	41.2	0	12.2	0	1.4	0.94	0	1	0
	Notional	100.9	0	28	0	1.4	1	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	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.04	1_00000E:Surf[11]
Floor	0.2	0.15	0_00000E:Surf[4]
Roof	0.15	0.13	1_000016:Surf[1]
Windows, roof windows, and rooflights	1.5	1.4	0_00000E:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = 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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

7585TM_BBE002 - Central boiler and CHP - DHWS instantanious

As built

Date: Thu Feb 04 16:57:21 2016

Administrative information

Building Details

Address: Blemunsbury - Book End, London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.5

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.5

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

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Alex E T Maguire

Telephone number: 01438 314422

Address: Building 3, Gateway 1000, Arlington Business Park, Stevenage, SG1 2FP

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	27.5
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	27.5
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	14.2
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.17	0.31	0_000005:Surf[12]
Floor	0.25	0.15	0.17	1_000006:Surf[5]
Roof	0.25	0.13	0.13	0D000000:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	0B000000:Surf[0]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

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

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

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

* 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	<0.9

1- LPHW heating & MVHR

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0.2	0	0.65
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* 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.

2- LPHW heating & NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0.2	0	-
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					YES

* 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.

"No HWS in project, or hot water is provided by HVAC system"

1- CHECK2-CHP

	CHPQA quality index	CHP electrical efficiency
This building	0	0.32
Standard value	Not provided	N/A

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
0_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
0_COMMUNAL AREA	-	-	-	1.5	-	-	-	-	-	-	N/A
0_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
0_LIVING DINING KITCHEN	-	-	-	1.5	-	-	-	-	-	-	N/A
1_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
1_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	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
1_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
1_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
1_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
1_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
1_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
1_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
1_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
1_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
1_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
1_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
2_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
2_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
2_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
2_BEDROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
2_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
2_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
2_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	N/A
2_ENSUITE	-	-	-	1.5	-	-	-	-	-	-	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	
0_BEDROOM	-	82	-	116
0_COMMUNAL AREA	-	68	-	202
0_DUMMY SPACE	-	59	-	410
0_ENSUITE	-	104	-	43
0_LIVING DINING KITCHEN	-	66	-	298
0_LOBBY	-	120	-	26
0_STAIR	-	73	-	94
0_STORE	-	174	-	6
1_BEDROOM	-	80	-	77
1_BEDROOM	-	81	-	108
1_BEDROOM	-	87	-	59
1_BEDROOM	-	83	-	82
1_BEDROOM	-	71	-	89
1_BEDROOM	-	68	-	108
1_DUMMY SPACE	-	64	-	186
1_ENSUITE	-	111	-	36
1_ENSUITE	-	107	-	39
1_ENSUITE	-	109	-	37
1_ENSUITE	-	101	-	43
1_ENSUITE	-	111	-	35
1_ENSUITE	-	113	-	35

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
1_LOBBY	-	116	-	26
1_LOBBY	-	99	-	62
1_STAIR	-	70	-	128
1_STORE	-	174	-	8
1_STORE	-	174	-	6
2_BEDROOM	-	79	-	89
2_BEDROOM	-	74	-	108
2_BEDROOM	-	94	-	108
2_BEDROOM	-	93	-	108
2_ENSUITE	-	139	-	35
2_ENSUITE	-	138	-	36
2_ENSUITE	-	133	-	39
2_ENSUITE	-	141	-	35
2_LOBBY	-	146	-	26
2_LOBBY	-	146	-	26
2_STAIR	-	77	-	123
2_STORE	-	174	-	6

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?
0_BEDROOM	NO (-55.7%)	NO
0_COMMUNAL AREA	NO (-55%)	NO
0_LIVING DINING KITCHEN	NO (-85.3%)	NO
1_BEDROOM	NO (-14.6%)	NO
1_BEDROOM	YES (+2.8%)	NO
1_BEDROOM	NO (-60.7%)	NO
1_BEDROOM	NO (-27.4%)	NO
1_BEDROOM	NO (-55.5%)	NO
1_BEDROOM	NO (-42.7%)	NO
2_BEDROOM	NO (-46.7%)	NO
2_BEDROOM	NO (-49.8%)	NO
2_BEDROOM	NO (-8.8%)	NO
2_BEDROOM	NO (-27.4%)	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?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	537.5	537.5
External area [m²]	1224.6	1224.6
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	369.61	627.37
Average U-value [W/m²K]	0.3	0.51
Alpha value* [%]	9.63	10

* 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
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
100	**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	29.72	38.16
Cooling	0	0
Auxiliary	2.11	1.6
Lighting	9.98	8.75
Hot water	77.18	59.29
Equipment*	8.2	8.2
TOTAL**	**89.2**	**107.8**

* 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	29.8	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	75.79	125.01
Primary energy* [kWh/m²]	72.01	128.46
Total emissions [kg/m²]	14.2	27.5

* 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	98.3	0	14.7	0	2.6	0.85	0	0.91	0
	Notional	143	0	43.6	0	1.7	0.91	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	43.7	0	3.5	0	1.4	0.85	0	0.91	0
	Notional	100.9	0	30.8	0	1.4	0.91	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	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	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.04	1_00000E:Surf[11]
Floor	0.2	0.15	0B000000:Surf[4]
Roof	0.15	0.13	0D000000:Surf[1]
Windows, roof windows, and rooflights	1.5	1.4	0B000000:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = 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
$m^3/(h.m^2)$ at 50 Pa	5	5

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