General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
LG storage	100	-	-
01_Office int1	116	-	-
05_Office int1	118	-	-
05_Office int1	116	-	-
04_Office int1	117	-	-
04_Office int1	116	-	-
LG_Changing room2	100	-	-
LG_Changing room2 circ	100	-	-
LG_Changing room1 circ	100	-	-
LG_Changing room1	100	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
LG_Atrium-Lounge	NO (-99.9%)	NO
LG_Cafe	N/A	N/A
00_Office peri S	NO (-61.4%)	NO
00_Office peri SE	NO (-76.7%)	NO
06_Office peri SE	NO (-44.2%)	NO
07_Amenity	NO (-57.2%)	NO
LG_Office peri NE	NO (-84.9%)	NO
LG_Office corner N	NO (-89.5%)	NO
00_Reception peri NE	NO (-76.1%)	NO
00_Reception int	NO (-96.8%)	NO
00_Office int	NO (-96.1%)	NO
00_Office peri NE	NO (-84%)	NO
00_Office peri NW1	NO (-81.4%)	NO
00_Office corner N	NO (-86.7%)	NO
01_Office peri S	NO (-85.2%)	NO
01_Office peri SE	NO (-88.2%)	NO
01_Office peri SW	NO (-89.5%)	NO
01_Office int2	NO (-84.3%)	NO
01_Office peri NE	NO (-78.7%)	NO
01_Office corner N	NO (-80.3%)	NO
02_Office int1	NO (-16.3%)	NO
02_Office peri NW1	NO (-75.6%)	NO
02_Office peri NE	NO (-74%)	NO
02_Office corner N	NO (-76.7%)	NO
02_Office peri SE2	NO (-80.5%)	NO
02_Office peri SW	NO (-88.1%)	NO
02_Office int2	NO (-75.5%)	NO
02_Office peri SE1	NO (-83.3%)	NO
02_Office peri S	NO (-85%)	NO
03_Office int1	YES (+20.4%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
03_Office peri NW1	NO (-72.3%)	NO
03_Office peri NE	NO (-68.8%)	NO
03_Office corner N	NO (-73%)	NO
03_Office peri SE2	NO (-70.9%)	NO
03_Office peri SW	NO (-85.7%)	NO
03_Office int2	NO (-66%)	NO
03_Office peri SE1	NO (-73%)	NO
03_Office peri S	NO (-82.1%)	NO
04_Office peri SE2	NO (-63.1%)	NO
04_Office peri SW	NO (-82.7%)	NO
04_Office int2	NO (-53.4%)	NO
04_Office peri SE1	NO (-64.9%)	NO
04_Office peri S	NO (-78.9%)	NO
05_Office peri SE2	NO (-48.7%)	NO
05_Office peri SW	NO (-78.5%)	NO
05_Office int2	NO (-30.4%)	NO
05_Office peri SE1	NO (-52.8%)	NO
05_Office peri S	NO (-74.6%)	NO
05_Office peri NW1	NO (-82.4%)	NO
05_Office peri NE	NO (-77.6%)	NO
05_Office peri NW1	NO (-84%)	NO
05_Office peri NW1	NO (-88.1%)	NO
04_Office peri NW1	NO (-73.7%)	NO
04_Office peri NE	NO (-70.5%)	NO
06_Office peri NW1	NO (-79.5%)	NO
LG_Gym	N/A	N/A
LG_Office int	NO (-97.4%)	NO
LG_Office peri NW2	NO (-83.9%)	NO
01_Office peri NW1	NO (-80.5%)	NO
06_Office peri NW2	NO (-80%)	NO
06_Office peri SW	NO (-62.7%)	NO
06_Office int	NO (-75.6%)	NO
LG_Office peri NW1	NO (-81.3%)	NO
01_Office int1	NO (-37.6%)	NO
05_Office int1	NO (-92.2%)	NO
05_Office int1	YES (+273.9%)	NO
04_Office int1	NO (-94%)	NO
04_Office int1	NO (-89.3%)	NO

Regulation 25A: Consideration of high efficiency 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
Floor area [m^2]	10978.8	10978.8
External area [m^2]	8180.4	8180.4
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	3121.57	2940.31
Average U-value [W/m^2K]	0.38	0.36
Alpha value* [%]	4.78	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
99	**Offices and Workshop Businesses**
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
1	**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	1.57	2.03
Cooling	3.18	4.13
Auxiliary	6.26	7.03
Lighting	6.81	8.08
Hot water	11.51	8.69
Equipment*	43.74	43.74
TOTAL**	**29.32**	**29.96**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	1.4
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*1.4*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	77.22	80.64
Primary energy [kWh/m^2]	43.24	42.08
Total emissions [kg/m^2]	3.96	3.86

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	4.6	94.1	0.5	4.3	7.7	2.44	6.08	2.64	7.63
	Notional	3.4	92.3	0.3	5.5	9	2.78	4.63	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	7.5	35.5	0.9	1.6	39	2.44	6.1	2.64	7.63
	Notional	0	57.2	0	3.4	32.2	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	13.3	0	3.9	0	2.4	0.94	0	1	0
	Notional	102.7	0	20.2	0	2.1	1.41	0	----	----
[ST] Central heating using water: radiators, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	40.4	0	12	0	1.1	0.94	0	1	0
	Notional	54.9	0	10.8	0	1	1.41	0	----	----
[ST] Central heating using water: radiators, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	30.7	0	9.1	0	1	0.94	0	1	0
	Notional	44.8	0	8.8	0	1	1.41	0	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	13.1	90.3	1.5	4.3	8.4	2.51	5.89	2.64	7.63
	Notional	8.5	96.5	0.8	5.8	9.2	2.78	4.63	----	----
[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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

21 Bloomsbury Street GREEN

As designed

Date: Tue Jul 12 09:51:43 2022

Administrative information

Building Details

Address: 21 Bloomsbury Street, London, WC1B 3HF

Certifier details

Name: Kartik Amrania

Telephone number: 44(0)1628623423

Address: Sweco UK, 1 Bath Road, Maidenhead, SL6 4AQ

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

BRUKL compliance check version: v6.1.b.0

Foundation area [m²]: 1006.64

The CO_2 emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), kgCO_2/m².annum	3.86	
Building CO_2 emission rate (BER), kgCO_2/m².annum	3.93	
Target primary energy rate (TPER), kWh/m².annum	42.08	
Building primary energy rate (BPER), kWh/m².annum	42.96	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.25	0.26	LG000005:Surf[3]
Floors	0.18	0.2	0.2	LG000005:Surf[0]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	0.22	0.35	LG000007:Surf[1]
Windows** and roof windows	1.6	1.4	1.4	00000004:Surf[0]
Rooflights***	2.2	1.81	1.81	0600000B:Surf[0]
Personnel doors^	1.6	1.3	1.3	LG000005:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

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

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

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

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

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	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

Building services

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

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

1- WC HRU_electric heater

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

2- Circ heating only

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

3- Office L00-L05 FCU_VRF_AHU

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.2	7.63	0	1.65	0.83
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

4- Gym/Cafe FCU_VRF_HRU

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.2	7.63	0	1.6	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

5- Office LG & L06 FCU_VRF_AHU

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.2	7.63	0	2.08	0.82
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

6- Shower HRU_electric heater

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

Zone-level mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
LG_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
LG_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
LG_wc3	-	-	0.5	-	-	-	-	-	-	-	N/A
LG_Atrium-Lounge	-	-	-	-	-	-	-	0.2	-	-	N/A
LG_Cafe	-	-	-	-	-	-	-	0.2	-	-	N/A
00_wc3	-	-	0.5	-	-	-	-	-	-	-	N/A
00_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Office peri SE	-	-	-	-	-	-	-	0.2	-	-	N/A
01_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
01_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
04_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
04_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
05_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
05_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
06_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
06_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
06_Office peri SE	-	-	-	-	-	-	-	0.2	-	-	N/A
07_Amenity	-	-	-	-	-	-	-	0.2	-	-	N/A
00_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
LG_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
LG_Office corner N	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Reception peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Reception int	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Office int	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Office corner N	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office peri SE	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
01_Office int2	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office corner N	-	-	-	-	-	-	-	0.2	-	-	N/A
02_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
02_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
02_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office corner N	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri SE2	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office int2	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri SE1	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
03_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
03_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
03_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office corner N	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri SE2	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office int2	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri SE1	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri SE2	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office int2	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri SE1	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri SE2	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office int2	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri SE1	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
LG_Gym	-	-	-	-	-	-	-	0.2	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
LG_Office int	-	-	-	-	-	-	-	0.2	-	-	N/A
LG_Office peri NW2	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Office peri NW2	-	-	-	-	-	-	-	0.2	-	-	N/A
07_wc	-	-	0.5	-	-	-	-	-	-	-	N/A
06_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Office int	-	-	-	-	-	-	-	0.2	-	-	N/A
LG_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
LG_UKPN	100	-	-
LG_Switch room	100	-	-
LG_wc2	100	-	-
LG_wc1	100	-	-
LG_Water storage	100	-	-
LG_Stairs1	100	-	-
LG_Circ2	100	-	-
LG_wc3	100	-	-
LG_Circ3	100	-	-
LG_Atrium-Lounge	91	35	3.857
LG_Bin store	100	-	-
LG_Cafe	100	-	-
LG_AHU room	100	-	-
LG_Circ4	100	-	-
LG_Cycle store	100	-	-
00_Store	100	-	-
00_Stairs1	100	-	-
00_Circ2	100	-	-
00_wc3	100	-	-
00_Lift lobby	100	-	-
00_Generator	100	-	-
00_Stairs2	100	-	-
00_Office peri S	121	-	-
00_Office peri SE	122	-	-
00_Circ3	100	-	-
00_Cupboard	100	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
01_AHU room	100	-	-
01_Circ1	100	-	-
01_wc1	100	-	-
01_Stairs1	100	-	-
01_Circ2	100	-	-
01_wc2	100	-	-
01_Circ3	100	-	-
04_Circ1	100	-	-
04_wc1	100	-	-
04_Stairs1	100	-	-
04_Circ2	100	-	-
04_wc2	100	-	-
04_Stairs2	100	-	-
04_Circ3	100	-	-
04_Cupboard	100	-	-
05_Circ1	100	-	-
05_wc1	100	-	-
05_Stairs1	100	-	-
05_Circ2	100	-	-
05_wc2	100	-	-
05_Stairs2	100	-	-
05_Circ3	100	-	-
05_Cupboard	100	-	-
06_Switch room	100	-	-
06_Circ1	100	-	-
06_wc1	100	-	-
06_Stairs1	100	-	-
06_Circ2	100	-	-
06_wc2	100	-	-
06_Stairs2	100	-	-
06_Office peri SE	119	-	-
06_Circ3	100	-	-
07_Stairs1	100	-	-
07_Amenity	76	-	-
00_wc1	100	-	-
00_AHU room	100	-	-
00_platform lift	100	-	-
00_Circ1	100	-	-
LG_Office peri NE	118	-	-
LG_Office corner N	119	-	-
00_Reception peri NE	98	35	3.857
00_Reception int	93	35	3.857
00_Office int	117	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
00_Office peri NE	121	-	-
00_Office peri NW1	118	-	-
00_Office corner N	122	-	-
01_Office peri S	117	-	-
01_Office peri SE	119	-	-
01_Office peri SW	117	-	-
01_Office int2	116	-	-
01_Office peri NE	117	-	-
01_Office corner N	119	-	-
02_Circ1	100	-	-
02_wc1	100	-	-
02_Stairs1	100	-	-
02_Circ2	100	-	-
02_wc2	100	-	-
02_Stairs2	100	-	-
02_Circ3	100	-	-
02_Cupboard	100	-	-
02_AHU room	100	-	-
02_Office int1	116	-	-
02_Office peri NW1	117	-	-
02_Office peri NE	118	-	-
02_Office corner N	119	-	-
02_Office peri SE2	122	-	-
02_Office peri SW	117	-	-
02_Office int2	117	-	-
02_Office peri SE1	117	-	-
02_Office peri S	118	-	-
03_Circ1	100	-	-
03_wc1	100	-	-
03_Stairs1	100	-	-
03_Circ2	100	-	-
03_wc2	100	-	-
03_Stairs2	100	-	-
03_Circ3	100	-	-
03_Cupboard	100	-	-
03_AHU room	100	-	-
03_Office int1	116	-	-
03_Office peri NW1	117	-	-
03_Office peri NE	118	-	-
03_Office corner N	119	-	-
03_Office peri SE2	122	-	-
03_Office peri SW	117	-	-
03_Office int2	117	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
03_Office peri SE1	117	-	-
03_Office peri S	118	-	-
04_Office peri SE2	122	-	-
04_Office peri SW	117	-	-
04_Office int2	117	-	-
04_Office peri SE1	117	-	-
04_Office peri S	118	-	-
05_Office peri SE2	122	-	-
05_Office peri SW	117	-	-
05_Office int2	117	-	-
05_Office peri SE1	117	-	-
05_Office peri S	118	-	-
05_Office peri NW1	117	-	-
05_Office peri NE	118	-	-
05_Office peri NW1	118	-	-
05_Office peri NW1	119	-	-
05_store	100	-	-
04_Office peri NW1	117	-	-
04_Office peri NE	118	-	-
06_Office peri NW1	122	-	-
LG_Circ5	100	-	-
LG_Gym lobby	100	-	-
LG_Gym	78	-	-
LG_Office int	116	-	-
LG_Office peri NW2	117	-	-
LG_Building management	100	-	-
LG_Hot water storage	100	-	-
LG_store	100	-	-
LG_Circ1	100	-	-
01_Stairs2	100	-	-
01_Office peri NW1	118	-	-
04_AHU room	100	-	-
04_storage	100	-	-
05_storage	100	-	-
05_AHU room	100	-	-
06_Office peri NW2	119	-	-
06_Plant	100	-	-
07_Circ1	100	-	-
07_wc	100	-	-
06_Office peri SW	121	-	-
06_Smoke fans	100	-	-
06_Office int	117	-	-
LG_Office peri NW1	119	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
LG storage	100	-	-
01_Office int1	116	-	-
05_Office int1	118	-	-
05_Office int1	116	-	-
04_Office int1	117	-	-
04_Office int1	116	-	-
LG_Changing room2	100	-	-
LG_Changing room2 circ	100	-	-
LG_Changing room1 circ	100	-	-
LG_Changing room1	100	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
LG_Atrium-Lounge	NO (-99.9%)	NO
LG_Cafe	N/A	N/A
00_Office peri S	NO (-61.4%)	NO
00_Office peri SE	NO (-76.7%)	NO
06_Office peri SE	NO (-44.2%)	NO
07_Amenity	NO (-57.2%)	NO
LG_Office peri NE	NO (-84.9%)	NO
LG_Office corner N	NO (-89.5%)	NO
00_Reception peri NE	NO (-76.1%)	NO
00_Reception int	NO (-96.8%)	NO
00_Office int	NO (-96.1%)	NO
00_Office peri NE	NO (-84%)	NO
00_Office peri NW1	NO (-81.4%)	NO
00_Office corner N	NO (-86.7%)	NO
01_Office peri S	NO (-85.2%)	NO
01_Office peri SE	NO (-88.2%)	NO
01_Office peri SW	NO (-89.5%)	NO
01_Office int2	NO (-84.3%)	NO
01_Office peri NE	NO (-78.7%)	NO
01_Office corner N	NO (-80.3%)	NO
02_Office int1	NO (-16.3%)	NO
02_Office peri NW1	NO (-75.6%)	NO
02_Office peri NE	NO (-74%)	NO
02_Office corner N	NO (-76.7%)	NO
02_Office peri SE2	NO (-80.5%)	NO
02_Office peri SW	NO (-88.1%)	NO
02_Office int2	NO (-75.5%)	NO
02_Office peri SE1	NO (-83.3%)	NO
02_Office peri S	NO (-85%)	NO
03_Office int1	YES (+20.4%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
03_Office peri NW1	NO (-72.3%)	NO
03_Office peri NE	NO (-68.8%)	NO
03_Office corner N	NO (-73%)	NO
03_Office peri SE2	NO (-70.9%)	NO
03_Office peri SW	NO (-85.7%)	NO
03_Office int2	NO (-66%)	NO
03_Office peri SE1	NO (-73%)	NO
03_Office peri S	NO (-82.1%)	NO
04_Office peri SE2	NO (-63.1%)	NO
04_Office peri SW	NO (-82.7%)	NO
04_Office int2	NO (-53.4%)	NO
04_Office peri SE1	NO (-64.9%)	NO
04_Office peri S	NO (-78.9%)	NO
05_Office peri SE2	NO (-48.7%)	NO
05_Office peri SW	NO (-78.5%)	NO
05_Office int2	NO (-30.4%)	NO
05_Office peri SE1	NO (-52.8%)	NO
05_Office peri S	NO (-74.6%)	NO
05_Office peri NW1	NO (-82.4%)	NO
05_Office peri NE	NO (-77.6%)	NO
05_Office peri NW1	NO (-84%)	NO
05_Office peri NW1	NO (-88.1%)	NO
04_Office peri NW1	NO (-73.7%)	NO
04_Office peri NE	NO (-70.5%)	NO
06_Office peri NW1	NO (-79.5%)	NO
LG_Gym	N/A	N/A
LG_Office int	NO (-97.4%)	NO
LG_Office peri NW2	NO (-83.9%)	NO
01_Office peri NW1	NO (-80.5%)	NO
06_Office peri NW2	NO (-80%)	NO
06_Office peri SW	NO (-62.7%)	NO
06_Office int	NO (-75.6%)	NO
LG_Office peri NW1	NO (-81.3%)	NO
01_Office int1	NO (-37.6%)	NO
05_Office int1	NO (-92.2%)	NO
05_Office int1	YES (+273.9%)	NO
04_Office int1	NO (-94%)	NO
04_Office int1	NO (-89.3%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	10978.8	10978.8
External area [m^2]	8180.4	8180.4
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	3121.57	2940.31
Average U-value [W/m^2K]	0.38	0.36
Alpha value* [%]	4.78	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
99	**Offices and Workshop Businesses**
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
1	**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	1.39	2.03
Cooling	3.18	4.13
Auxiliary	6.26	7.03
Lighting	6.81	8.08
Hot water	11.51	8.69
Equipment*	43.74	43.74
TOTAL**	**29.15**	**29.96**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	1.4
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*1.4*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	77.22	80.64
Primary energy [kWh/m^2]	42.96	42.08
Total emissions [kg/m^2]	3.93	3.86

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	4.6	94.1	0.4	4.3	7.7	3.2	6.08	3.2	7.63
	Notional	3.4	92.3	0.3	5.5	9	2.78	4.63	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	7.5	35.5	0.7	1.6	39	3.2	6.1	3.2	7.63
	Notional	0	57.2	0	3.4	32.2	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	13.3	0	3.7	0	2.4	1	0	1	0
	Notional	102.7	0	20.2	0	2.1	1.41	0	----	----
[ST] Central heating using water: radiators, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	40.4	0	11.2	0	1.1	1	0	1	0
	Notional	54.9	0	10.8	0	1	1.41	0	----	----
[ST] Central heating using water: radiators, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	30.7	0	8.5	0	1	1	0	1	0
	Notional	44.8	0	8.8	0	1	1.41	0	----	----
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	13.1	90.3	1.1	4.3	8.4	3.2	5.89	3.2	7.63
	Notional	8.5	96.5	0.8	5.8	9.2	2.78	4.63	----	----
[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

Appendix B – Thermal Comfort Assessment

Thermal Comfort Report

21 Bloomsbury Street

65204879/CG/200511
Revision 01

SWECO

Issue	Date	Reason for Issue	Prepared		Checked		Approved	
01	11/05/22	Revision for issue	CG	11/05/22	KA	17/05/22	KA	17/05/22

Thermal Comfort Assessment
Revision 01

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Contents

Appendices

1. Executive Summary

The aim of this report is to provide an overview of thermal comfort within the offices and reception areas at 21 Bloomsbury Street development, for the current weather prediction and for a projected climate change scenario.

This study summarises the latest façade optimisation strategies proposed as regards glazing to solid ratio, solar coatings and shading. These optimisation measures have contributed substantially to increase the fabric energy efficiency, reduce solar gains, cooling loads and its associated carbon emissions.

A detailed thermal comfort analysis using dynamic simulation modelling was carried out in terms of summer and winter operative temperatures; and HVAC systems response to peak demand.

This report shows compliance with the GLA's Cooling Hierarchy and CIBSE thermal comfort criteria. It refers to BREEAM UK 2014 Refurbishment specific requirements on achieving Hea 04 Thermal Modelling credit.

The results show that all offices and reception area comply with GLA and BREEAM overheating criteria under the moderate summer scenario (DSY1).

The occupants will feel the internal environment to be normal, i.e. not cold or warm, for all the climate predictions assessed (DSY1, DSY2 and DSY3) with less than 10% of people feeling uncomfortable in most of the operating hours.

2. Introduction

The aim of this study is to assess the indoor thermal comfort within the office and reception areas at 21 Bloomsbury Street development, located in Central London, for current and future weather predictions.

This document summarises the latest design recommendations regarding façade optimisation and calculations heating and cooling loads using dynamic simulation software.

It also highlights the potential credits that could be awarded on Health and Wellbeing (Hea 04) credit under BREEAM UK Refurbishment 2014 for Non-domestic buildings scheme.

2.1 Development Description

21 Bloomsbury Street is a 7-storey commercial development comprised of 6 levels of offices. The project is located in the London Borough of Camden bounded by main tube stations, Tottenham Court Road, Goodge Street and Holborn.

Figure 2.1 21 Bloomsbury Street development: London location plan. Source: Stiff + Trevillion

2.2 Building Regulations Part L 2021 Compliance

Section 4 of the Building Regulations 2021 concerns the amount of solar gain entering the building through glazing. It is understood that the objective of this Criterion is to ensure that spaces are not excessively serviced to maintain thermal comfort, and thus to ensure that the energy consumption and carbon dioxide emissions related to those services are minimised.

This Criterion is purely related to solar gains compared against a benchmark notional building. There is no other indication of overheating compliance from Part L 2021 Building Regulations. However, the GLA encourages developments to assess the risk of overheating in non-residential buildings through dynamic simulation as stated in their SPG, section 3.2.3: *"Overheating is not fully assessed by carbon dioxide emission models; therefore, developers are encouraged to **undertake dynamic thermal modelling** to ensure that their development does not overheat."*

4.18 For each space in the building that is occupied or mechanically cooled, the solar gains through the glazing – aggregated from April to September inclusive – should be no greater than would occur through the relevant reference glazing systems in Table 4.3 with a defined total solar energy transmittance (g-value) calculated according to **BS EN 410**. In this context, an occupied space means a space that is intended to be occupied by the same person for a substantial part of the day. This excludes circulation spaces and other areas of transient occupancy, such as toilets.

Table 4.3 Reference glazing systems for solar gain calculation

Type of space (as defined in the National Calculation Methodology)	Average zone height	Glazing location for reference space	Glazing area for reference space	Framing factor for reference space	Glazing g-value for reference space
Side-lit	Any	East-facing façade	Full-width to a height of 1000mm	10%	0.48
Top-lit	≤6m	Roof	10% of roof area[1]	25%	0.48
	>6m	Roof	10% of roof area[1]	15%	0.42

NOTE:
1. 'Roof area' determined from the inside of the space looking out.

Part L 2021, Section 4, paragraph 4.18

2.3 Thermal Comfort Assessment Criteria

Operative temperature as defined by CIBSE Guide A refers to the combination of the air temperature and the mean radiant temperature into a single value to express their joint effect. It is usually the most important variable affecting thermal comfort.

2.3.1 Naturally Ventilated Spaces

CIBSE TM 52: 2013 is used to check overheating in non-residential naturally ventilated buildings.

The assessment consists of three criteria which are detailed below. Of which passing two of the three criteria results into compliance essentially indicate low or no risk of overheating.

ΔT is the difference between actual operative room temperature (T_{OP}) and the maximum acceptable room temperature (T_{max}). The T_{max} is calculated by:

$$T_{max} = 0.33 \times T_{rm} + 21.8$$

Where T_{rm} is the outdoor running mean temperature (°C).

Criterion 1: Hours of Exceedance (H_e)

The number of hours (He) during which DT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours.

Criterion 2: Daily weighted exceedance (We)

To allow for the severity of overheating the weighted exceedance (W_e) shall be less than or equal to 6 in any one day where:

$$W_e = (\sum h_e)\ x\ WF$$

$$= (h_{e0}\ x\ 0) + (h_{e1}\ x\ 1) + (h_{e2}\ x\ 2) + (h_{e3}\ x\ 3)$$

Where WF = 0 if ΔT≤0; Otherwise WF = ΔT and h_{ey} is the time (hrs) when WF = y

Criterion 3: Upper limit temperature (Tupp)

To set an absolute maximum value for the indoor operative temperature the value of DT shall not exceed 4 K.

It is recommended that, any occupied spaces **pass 2 of the 3** above presented criteria to indicate the absence of overheating within the occupancy space.

2.3.2 Mechanically Cooled Spaces

CIBSE Guide A Environmental Design 2015 recommends winter and summer operative temperatures for a range of air-conditioned building types in Table 1.5. For open plan offices, they range between 21-23°C in winter and 22-25°C in summer; and for reception between 19-21°C in winter and 21-25°C in summer.

These temperature ranges corresponded to a predicted mean vote (PMV) of ±0.5 and predicted percentage dissatisfied of 10%.

Table 1.5 Recommended comfort criteria for specific applications — *continued*

Building/room type	Customary winter operative temperatures for stated activity and clothing levels*			Customary summer operative temperatures (air conditioned buildings†) for stated activity and clothing levels*		
	Temp. / °C	Activity / met	Clothing / clo	Temp. / °C	Activity / met	Clothing / clo
Offices:						
— board room, large conference room	21–23	1.2	0.9	22–25	1.2	0.7
— general, small conference room, executive office	21–23	1.2	0.9	22–25	1.2	0.7
— open–plan	21–23	1.2	0.9	22–25	1.2	0.7
General building areas:						
— corridors	19–21	1.4	1.0	21–25	1.3	0.6
— entrance halls/lobbies	19–21	1.4	1.0	21–25	1.3	0.6
— kitchens (commercial)	15–18	1.8	1.0	18–25	1.6	0.6
— toilets	19–21	—	—	21–25	—	—
— waiting areas/rooms	19–21	1.4	1.0	21–25	1.3	0.6

A mechanically cooled building or space should not exceed the predicted indoor temperature values tabulated in table 1.8 for more than 3% of occupied hours for thermal comfort (CIBSE Guide A, 2015), assuming clothing insulation of 1.0 for winter and 0.6 for summer.

Table 1.8 Maximum temperatures (category II expectation) for indoor environment in indoor spaces; clothing is assumed to be 1.0 clo in winter and 0.5 clo in summer (see Table 1.7 for category definitions) (data source: BS EN 15251 (BSI, 2007)

Type and use of space	Assumed activity level (/ met)	Maximum temperature for stated clothing level	
		Winter clo = 1.0	Summer clo = 0.5
Residential (sedentary)	1.2	24.0	26.0
Residential (active)	1.5	22.0	—
Offices	1.2	24.0	26.0
Public spaces (auditoria, café etc.)	~1.2	24.0	26.0
Classrooms	1.2	24.0	26.0
Kindergarten	1.4	22.5	25.5
Shops	1.6	22.0	25.0

In this study cooling will be provided for the areas assessed. The lower and upper temperature limits for those uses for winter and summer respectively is targeted at:

- Offices: Winter: 21°C / Summer: 25°C
- Reception: Winter: 19°C / Summer: 25°C

2.3.3 Predicted Mean Vote (PMV) and Predicted Percentage Dissatisfied (PPD)

PMV and PPD are defined within the EN ISO 7730:2005 as follows:

"A human being's thermal sensation is mainly related to the thermal balance of his or her body as a whole. This balance is influenced by physical activity and clothing, as well as the environmental parameters: air temperature, mean radiant temperature, air velocity and air humidity. When these factors have been estimated or measured, the thermal sensation of the body as a whole can be predicted by calculating the predicted mean vote (PMV). The PMV is an index that predicts the mean value of the votes of a large group of persons on the 7-point thermal sensation scale (see Table 1), based on the heat balance of the human body. Thermal balance is obtained when the internal heat production in the body is equal to the loss of heat to the environment. In a moderate environment, the human thermoregulatory system will automatically attempt to modify skin temperature and sweat secretion to maintain heat balance."

The predicted percentage dissatisfied (PPD) index provides information on thermal discomfort or thermal dissatisfaction by predicting the percentage of people likely to feel too warm or too cool in a given environment. The PPD can be obtained from the PMV, refer to figure 1.3 (Source: CIBSE Guide A 2015).

The assessment considers the following thermal comfort parameters:

Occupancy type	Nominal Design air speed (m/s)	Activity level	Clothing level (clo)
All spaces	0.15	Very light work	0.50 summer clothing 0.80 winter clothing

Table 1 — Seven-point thermal sensation scale

+ 3	Hot
+ 2	Warm
+ 1	Slightly warm
0	Neutral
– 1	Slightly cool
–2	Cool
– 3	Cold

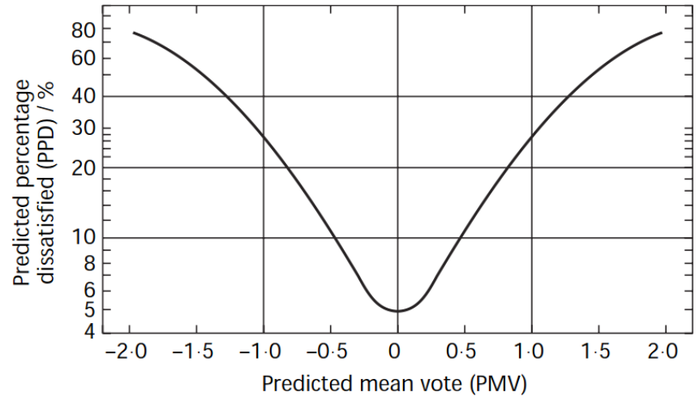


Figure 1.3 PPD as a function of PMV

2.4 Greater London Authority Guidance (GLA) 2022

2.4.1 Cooling Hierarchy

Paragraph 8.2 of the GLA Guidance on Preparing Energy Assessments (June 2022) states that major development proposals should reduce potential overheating and reliance on air-conditioning systems and demonstrate this in accordance with the cooling hierarchy outlined as follows:

London Plan: **Policy SI 4** – Cooling hierarchy
1. Reduce the amount of heat entering a building in summer through **orientation**, **passive shading measures** including balconies, louvres, internal or external blinds, shutters, high albedo materials, fenestration, insulation, trees and vegetation.
2. Minimise internal heat generation through **energy efficient design**.
3. Manage the heat within the building through exposed internal **thermal mass and high ceilings**.
4. **Passive ventilation** through the use of openable windows, shallow floorplates, dual aspect units designing in the 'stack effect'.
5. **Mechanical ventilation** can be used to make use of 'free cooling' where the outside temperature is below that in the building during summer months.
6. Provide **active cooling** systems.

2.4.2 Overheating Risk Analysis

In accordance with BREEAM UK 2014 Refurbishment the overheating risk analysis follows:

Thermal Comfort Period	Assessment Criteria Reference
Summer	CIBSE TM52:2013 - "The limits of thermal comfort: avoiding overheating in European buildings" CIBSE Guide A 2015, table 1.5
Winter	CIBSE Guide A 2015, table 1.5

This report shows overheating analysis considering 3 weather data scenarios relevant to the site location of the development (**London Weather Central – LWC**) in accordance with CIBSE TM49: Design Summer Years for London (2014).

DSY (Design Summer Year) weather files are composed of a single continuous year of data collected by The UK Meteorological Office (MO) at stations across the UK. The CIBSE weather files used for the current analysis (2020s) comprise the period from 2011 to 2040 where each of them represents summers with different types of hot events:

Design Weather File	Summer description
DSY1 2020 high emissions 50% percentile	Moderately warm
DSY2 2020 high emissions 50% percentile	Very intense single warm spell
DSY3 2020 high emissions 50% percentile	Prolonged period of persistent warmth

Full compliance with the overheating criteria is sought for DSY1 scenario and mitigation measures are proposed to meet the criteria for the other two weather projections.

2.5 BREEAM UK Refurbishment 2014 – Hea 04 Thermal Comfort

This report shows evidence to achieve three credits under Hea 04 Thermal Comfort – Thermal Modelling and Design for Future Thermal Comfort (criteria 1 to 8), the table below summarizes where the relevant information is located within this report:

Hea 04 – Thermal Modelling Criteria	Section within this report
1. Thermal modelling has been carried out using software in accordance with CIBSE AM11 Building Energy and Environmental Modelling.	Section 3 - Methodology
2. The software used to carry out the simulation at the detailed design stage provides full dynamic thermal analysis. For smaller and more basic building designs with less complex heating or cooling systems, an alternative less complex means of analysis may be appropriate (such methodologies must still be in accordance with CIBSE AM11).	Section 3 – Methodology Section 6 - Results
3. The modelling demonstrates that: a. For air-conditioned buildings, summer and winter operative temperature ranges in occupied spaces are in accordance with the criteria set out in CIBSE Guide A Environmental Design, Table 1.5; or other appropriate industry standard (where this sets a higher or more appropriate requirement/level for the building type). b. For naturally ventilated/free running buildings: i. Winter operative temperature ranges in occupied spaces are in accordance with the criteria set out in CIBSE Guide A Environmental design, Table 1.5; or other appropriate industry standard (where this sets a higher or more appropriate requirement/level for the building type). ii. The building is designed to limit the risk of overheating, in accordance with the adaptive comfort methodology outlined in CIBSE TM52: The limits of thermal comfort: avoiding overheating in European buildings.	Section 6.1.1

Hea 04 – Thermal Modelling Criteria	Section within this report
5. For air-conditioned buildings, the PMV (predicted mean vote) and PPD (predicted percentage of dissatisfied) indices based on the above modelling are reported via the BREEAM assessment scoring and reporting tool.	Section 6.2
6. Criteria 1 to 4 are achieved	Refer to above: criteria 1-4 have been demonstrably achieved
7. The thermal modelling demonstrates that the relevant requirements set out in criterion 3 of Hea04 are achieved for a projected climate change environment.	Section 6.1.1 - Future weather files were use in the modelling process and the proposal meets the requirements.
8. Not applicable – criterion 6 has been met.	n/a – see above.
9. For air-conditioned buildings, the PMV and the PPD indices based on the above modelling are reported via the BREEAM assessment scoring and reporting tool.	The PMV and PPD values in section 6.2 will be reflected in the building scoring and reporting tool.
10. Criteria 1 to 4 are achieved.	Refer to above: criteria 1-4 have been demonstrably achieved.
11. The thermal modelling analysis (above) has informed the temperature control strategy for the building and its users.	Refer to Section 6.1.2
12. The strategy for proposed heating/ cooling system(s) demonstrates that it has addressed the following: a. Zones within the building and how the building services could efficiently and appropriately heat or cool these areas e.g. consider the different requirements for the central core of a building	Refer to Section 6.1.2 and Appendix C. The thermal zoning of the building has fan coil units in the office floors to address the difference in

Hea 04 – Thermal Modelling Criteria	Section within this report
compared with the external perimeteradjacent to the windows. b. Where specified, any new local cooling or heating services (or changes to existing services) are designed to ensure they do not conflict with core services (e.g. conflicts between two separate cooling systems, conflicts between core heating and locally provided cooling systems)	the heat gains between the core and the perimeter areas adjacent to glazing.
c. The degree of occupant control required for these zones, based on discussions with the end user (or alternatively building type/use specific design guidance, case studies, feedback) and considers: i. User knowledge of building services ii. Occupancy type, patterns and room functions (and therefore appropriate level of control required) iii. How the user is likely to operate/interact with the system(s) e.g. are they likely to open windows, access TRV's on radiators, change air conditioning settings etc. iv. The user expectations (e.g. this may differ in the summer and winter; users tend to accept warmer internal conditions in the summer) and degree of individual control (i.e. obtaining the balance between occupant preferences, for example, some occupants like fresh air and others dislike drafts).	Criterion 12 (c,d,e) compliance to be demonstrated as part of the CAT A & B Fit out specifications and drawings
d. How the proposed systems will interact with each other (where there is more than one system) and how this mayaffect the building occupants thermal comfort. e. The need or otherwise for an accessible building user actuated manual override for any automatic systems	

3. Methodology

3.1 Thermal Modelling

Sweco have used Integrated Environmental Systems (IES VE) dynamic simulation software to produce the simulation results for this report. The IES software has been approved by the Department for Communities and Local Government (DCLG) for use as a Dynamic Simulation Model (DSM) software package. As part of its approval process, the IES software had to demonstrate that it satisfies all the tests and other requirements defined within sections 2 and 3 of "CIBSE TM33:2006, CIBSE standard tests for the assessment of building services design software".

IES VE software is also listed within CIBSE AM 11: 2015 Building Energy and Environmental Modelling Appendix D as an accredited tool for dynamic simulation modelling.

The following image have been extracted from the IES 3D model:

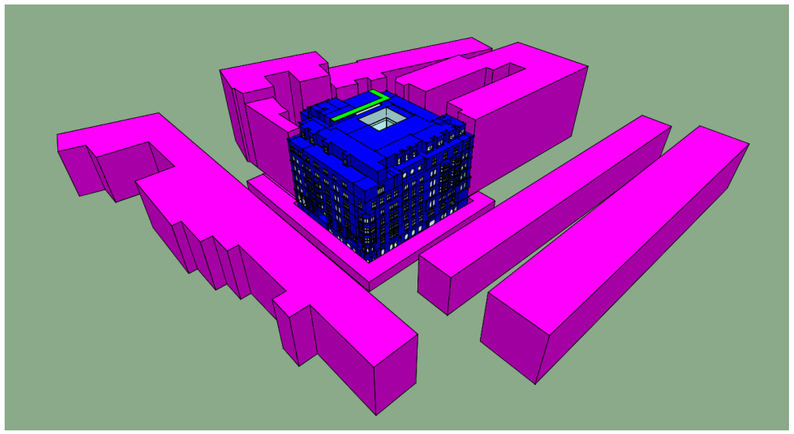


Figure 3.1 IES thermal model view

3.2 Weather Data

The overheating analysis was undertaken using the CIBSE TM49: 'London Design Summer Years' (DSY) mentioned in section 2.4.2.

The table below indicates the average percentage of hours during the summer season (April to September) that the external dry-bulb temperature is above a certain value for each analysed weather scenario:

Dry-bulb temperature (°C) - % hours in range							
	> 26.00	> 27.00	> 28.00	> 29.00	> 30.00	> 31.00	> 32.00
LWC DSY1	5.5	3.2	1.8	1.0	0.6	0.3	0.2
LWC DSY2	6.2	4.5	3.1	2.2	1.7	1.0	0.8
LWC DSY3	7.4	5.8	4.4	3.2	2.1	1.2	0.8

It can be noted that DSY2 and DSY3 have prolonged hours of high temperatures over the summer season. The design intention is to comply with DSY 1 weather data and provide recommendations of adaptation measures to achieve thermal comfort for DSY 2 and 3 in the summer.

3.3 Façade Optimization

Detailed thermal modelling analysis (using industry recognised & DCLG Certified dynamic simulation software) has been used during the design process to optimise the glazing modifications. This was a useful tool for balancing cooling loads against daylighting, which ensure reasonable levels of natural daylight penetration while limiting unwanted solar gain and heat loss.

Through simulations, it was possible to determine that the design the building façades responds to its orientation and subsequent relationship to direct sun angles. The optimisation of the façade was achieved through balancing the performance specification of the solar-controlled glass, depth of window reveals and actual proportions of glazing and opaque façade elements.

The building façade improvement including glazing modifications will be designed such that the building form and massing will provide passive control of solar gains. This will ensure that solar gains are maximised in winter months (when they are beneficial in reducing heating loads), while in summer months they are minimised (to reduce the effective cooling loads).

4. Building Envelope

The building element properties applied to the thermal model are outlined in the following tables.

Table 4-1 Thermal Performance of Opaque Building Elements

Building Element Parameters	Values
Building Air tightness	3 $m^3/h/m^2$ @ 50pa
Retained Wall	0.26 W/m^2K
New wall	0.22 W/m^2K
Exposed Roof	0.15 W/m^2K
Internal Wall (Non-Insulated)	1.80 W/m^2K
Internal Ceiling / Floor	1.0 W/m^2K
Exposed Floor	0.20 W/m^2K

Table 4-2 Thermal Performance of Glazing

Location	Glazing G-value (BS EN 410)	Visible Light Transmission	Overall Glazing U-value
Rooflight	0.30	≥60%	1.8 W/m^2K
North/East facade	0.40	≥60%	1.4 W/m^2K
South/West facade	0.28	≥60%	1.4 W/m^2K

4.1 Auxiliary Ventilation and Infiltration

Fresh air supply is assigned to the areas as shown below.

Table 4.3 Auxiliary Ventilation Rates

Location	Description	
Offices	Infiltration rate	0.25 ach (summer); 0.50 ach (winter)
	Auxiliary Ventilation	16.5 L/s per person
Reception	Infiltration rate	1.0 ach
	Auxiliary Ventilation	12 L/s per person

4.2 Internal Loads and Operational Profiles

A variety of uses is proposed across the four buildings analysed. The tables below break down the internal gains and related operational profiles.

Table 4.4 Internal Gains per Building Use

Location	Lighting (W/m^2)	Small power (W/m^2)	People (m2/per)	Cooling Set-point (°C)	Heating Set-point (°C)	Operational Profile
Offices	5	16	8	22	22	8am to 6pm
Reception	10	10	6	24	20	8am to 6pm

5. HVAC Strategy

5.1 Central Plant Heating & Cooling

A sustainable heating and cooling strategy will be developed to embrace the principals of the circular economy and maximise on site resources. The development will be served by an HVRF system consisting of external VRF condenser units in the level 06 plant area. There will be one unit provided per office tenancy, plus an additional 2 landlord units to serve lower ground / ground, and the level 07 amenity area.

The VRF units at roof level will each feed a 2-pipe refrigerant loop to HBC controller units located at high level within the space being served. The controller unit provides a hydraulic break between the incoming refrigerant pipework and the hot or cold water which it then supplies to the terminal units to realise either heating or cooling. The arrangement of the HVRF system as opposed to a regular VRF system allows a reduced refrigerant load to be used for the same amount of thermal capacity.

The individual VRF units will be sized and used to meet the annual simultaneous peak heating and cooling load for each of the demises within the building. The configuration of the VRF units will be modelled and evaluated during the next design stage alongside the building Energy & Sustainability Strategy.

The proposal described above is exhibited in the diagram below.

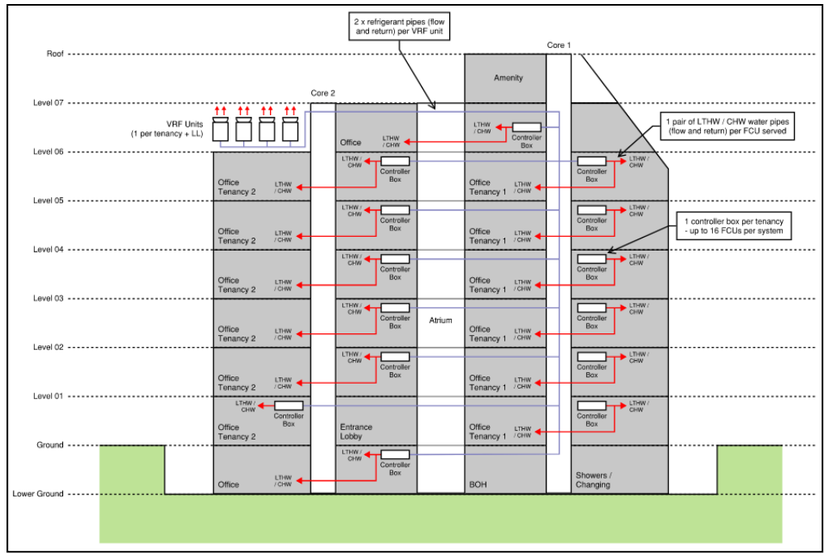


Figure 5.1 - Thermal Strategy - HVRF

5.2 Office Areas Comfort Heating and Cooling

Fan cool units provided at high level within the office floor plate are proposed for all floor levels and these will provide heating and cooling to meet the office comfort requirements. Concealed, partial exposed and fully exposed services options will be considered at the next design stage.

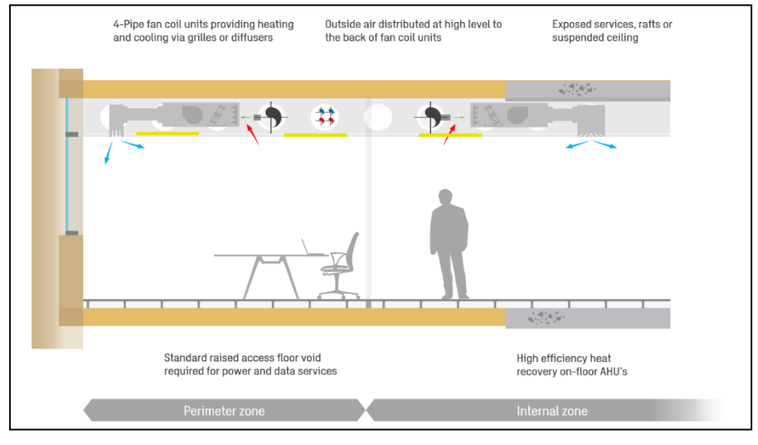


Figure 5.2 - Office Heating / Cooling Arrangement

6. Thermal Comfort Results

6.1 Cooling and Adaptability to Climate Change

6.1.1 Summer Thermal Comfort

The analysis considers all the offices and reception areas to be mechanically cooled with limited cooling capacity to assess the overheating risk. The compliant scenario under DSY 1 (scenario 1) is then analysed against the other two weather files: DSY2 and DSY3, scenarios 2 and 3 respectively.

The analysis concluded that no spaces are at risk of overheating under DSY1, 2 or 3. The cooling capacity for offices areas was limited to 75 W/m2, this can be further optimised and allowances for climate change and extreme weather projections can be made. For more detailed results, refer to Appendix A.

Although there is no requirement to pass the thermal comfort criteria under DSY2 and DSY3, as part of building's strategy for adaptability in case of extreme weather scenarios, the Proposed Development was analysed.

Table 6.2 summarizes the scenarios assessed to determine the risk of overheating and thermal comfort conditions during the summer with cooling. CIBSE Guide A outlines 3% as the maximum allowance of annual occupied hours that the operative temperature can exceed 25°C in office areas during occupied hours and considered anything above as overheating risk.

All the areas comply with the criteria for weather scenario DSY1. Cooling set point 22°C for offices and 24°C for the reception area is required to meet overheating criteria. These set points sit within the band 24°C ±2 specified by the M&E design. North, East and West facades meet overheating criteria with limited cooling 45W/m²; South facing areas require 75W/m². Decreasing solar gains in the South façade could be achieved by further reducing the glazing ratio.

The last three rows illustrate the scenarios passing the criteria for each of the weather files including DSY2 and DSY3 as they are considered intense summer periods for assessing projected climate change scenarios in line with BREEAM Hea 04 methodology. 21 Bloomsbury Street development can ensure thermal comfort conditions for future climate change in all the areas assessed.

Table 6.1 Overheating criteria results

Scenarios	Weather File	Setpoint	Cooling Capacity	Rooms failing	CIBSE A Status
		°C	W/m2		
1	DSY1	24	45	14	Fail
2		22	45	8	Fail
3		24	55	9	Fail
4		22	55	3	Fail
5		22	65	2	Fail
6		22	75	0	Pass
6a	DSY2	22	75	0	Pass
6b	DSY3	22	75	0	Pass

6.1.2 Thermal zoning

The thermal modelling also has informed the temperature control strategy for the building and its users. The current assessment has been carried out based on the thermal zoning below to ensure providing the adequate amount of heating and cooling that consider the different requirements for the central core of a building compared with the external perimeter adjacent to the glazing.

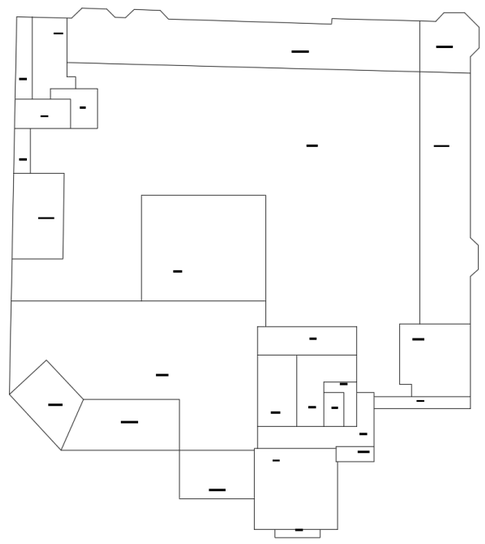


Figure 6.1 zoning Level 2-3

Please refer to ST-PR-02-102 drawing dated February 2022 for the typical floor fan coil units zoning. **Appendix C** shows 2nd floor plan layout.

6.1.3 Winter Thermal Comfort

Operative temperature for winter comfort range as per CIBSE Guide A table 1.5 is presented in the table below. Results show that all the areas assessed are within the comfortable range during the occupied hours.

A comfortable indoor temperature is maintained in offices when set point is 22°C; and in reception when setpoint is 20°C.

Table 6.2 Percentage of hours of winter operative temperature ranges – DSY 1

Use	Winter comfort range (CIBSE Table 1.5)	Operative temperature (°C) - % hours in range		
		Winter		
		< 19	< 21	< 22
Offices	21-23°C		0.0	
Reception	19-21°C	0.0		

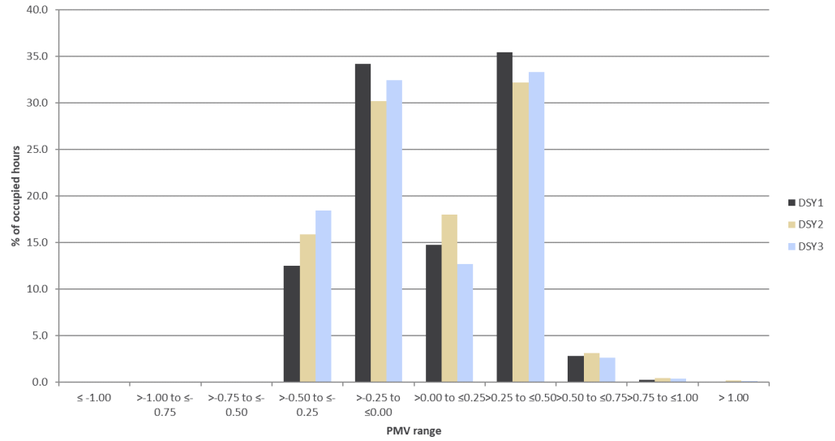


Figure 6.2 PMV range compliant for all the areas assessed

6.2 PMV and PPD

Regarding summer thermal comfort indication of predicted mean vote (PMV) and predicted percentage dissatisfied (PPD), as defined in EN ISO 7730:2005, the results are indicated as a range in the table below in which offices and reception were assessed under current and future weather predictions (DSY2 and DSY3)

Table 6.3 PMV and PPD results

Weather File	Use	PMV	PPD
DSY1	All areas	-0.25 to 0.50	5-10%
DSY2			
DSY3			

Results indicate that all the areas assessed are within PMV band value -0.25 to 0.50, PPD corresponds to values between 5 to 10%. Based on the results, the occupants of the areas assessed will feel the environment to be normal, i.e. not cold or warm under current and future weather conditions. The designed HVAC cooling system can meet the set point rapidly due to high plant response.

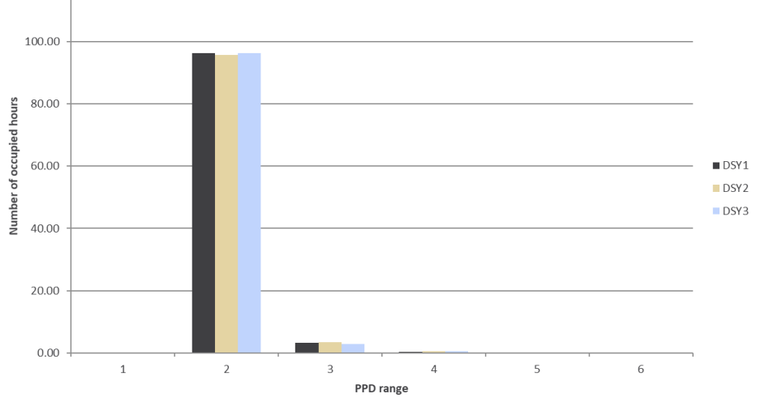


Figure 6.3 PPD range compliant for all the areas assessed

7. Conclusions

This report has given an overview of the passive design measures to provide thermal comfort conditions within the offices and reception areas in 21 Bloomsbury Street development:

Façade Optimisation:

- Glazing g value 0.40 on North and East facades; and 0.28 on South and West for further solar radiation reduction.
- Glazing ratio optimized to minimize solar gains and maximize daylighting provision.
- Building fabric U-values optimized for new and existing facade.
- Limiting internal heat gains through energy efficient design (LED lighting, high efficiency equipment)

Active measures include:

- HVAC system as follows:
  - Offices: summer set point of 22°C; winter set point 22°C
  - Reception: summer set point of 24°C; winter set point 20°C
- North, East and West facades meet overheating criteria with limited cooling 45W/m²; South facing areas require 75W/m². Decreasing solar gains in the South façade could be achieved by further reducing the glazing ratio.
- The development will be served by an HVRF system consisting of external VRF condenser units. Fan cool units provided at high level within the office floor plate are proposed for all floor levels.

Thermal modelling has confirmed that the above measures would provide a thermally comfortable indoor environment with acceptable ranges of people dissatisfied. It can be concluded that the development achieves a comfortable environment under a mechanically ventilated scenario under weather scenarios DSY1, DSY2 and DSY3.

It must be stressed that any change to specified equivalent opening free areas can drastically impact the results. Therefore, the design team should flag any issues regarding the reliance on opening windows for thermal comfort as the design develops.

7.1 BREEAM Compliance 2014 Refurbishment_Hea04 credit

Regarding Health and Wellbeing (Hea) credit 04 – Thermal Comfort requirements of the BREEAM UK 2014 Refurbishment for Non-domestic buildings, the design team has conducted a thermal comfort study and applied appropriate measures to improve resilience and adaptability to a future weather scenario.

This study supports and complies with the requirements to achieve the three associated Hea04 credits as described in section 2.5.

Appendices

Appendix A – PMV and PPD Tables

PREDICTED MEAN VOTE - DSY1

Sim06

DSY1										
Predicted mean vote (PMV) - % of hours in range										
Room Name	<= -1.00	>-1.00 to <=-0.75	>-0.75 to <=-0.50	>-0.50 to <=-0.25	>-0.25 to <=0.00	>0.00 to <=0.25	>0.25 to <=0.50	>0.50 to <=0.75	>0.75 to <=1.00	> 1.00
LG_Office peri NW1	0	0	0	12.4	37.7	14.1	34.2	1.6	0	0
LG_Office peri NW2	0	0	0	18	33.3	15.1	32.5	1.2	0	0
LG_Office peri NE	0	0	0	20	31.2	14.8	32.6	1.4	0	0
LG_Office corner N	0	0	0	23.5	30	15.2	30.3	1	0	0
00_Office peri NW1	0	0	0	13	36.3	14.8	34.5	1.4	0	0
00_Office peri NE	0	0	0	15	34.4	15.2	34	1.3	0	0
00_Office corner N	0	0	0	20.4	31.5	16	31.2	0.9	0	0
00_Reception	0	0	0.1	42.7	9	8.6	9.4	21.5	8.6	0.2
00_Office peri S	0	0	0	20.7	28.7	13.3	31.6	4.2	1.1	0.4
00_Office peri SE	0	0	0	23	27.3	14.2	33.2	2.2	0.1	0
01_Office int1	0	0	0	3.3	42.6	15.9	37.1	1.1	0	0
01_Office peri NW1	0	0	0	11.8	36	15.3	35.4	1.5	0	0
01_Office peri S	0	0	0	11.3	36.4	14	36.8	1.5	0	0
01_Office peri SE	0	0	0	17.8	32.1	15.1	33.7	1.4	0	0
01_Office int2	0	0	0	3.3	42.7	16.3	36.7	1	0	0
04_Office int1	0	0	0	1.9	41.8	15.9	39.1	1.3	0	0
04_Office peri NE	0	0	0	9.7	35.8	14.4	38.2	1.9	0	0
04_Office corner N	0	0	0	17	30.4	15.3	35.5	1.8	0	0
04_Office int2	0	0	0	2.7	41.4	16.2	38.6	1.2	0	0
05_Office int1	0	0	0	3.7	41.2	14.7	38.8	1.7	0	0
05_Office peri NW1	0	0	0	11.5	35.8	15.6	35.7	1.3	0	0
05_Office int2	0	0	0	3.8	41.3	15.2	38.1	1.5	0	0
05_Office peri NW1	0	0	0	12.5	35.6	15.8	34.8	1.3	0	0
05_Office peri NW1	0	0	0	16.1	33.3	15.6	33.8	1.3	0	0
06_Office peri NW1	0	0	0	19.3	30.5	15.2	33.3	1.6	0	0
03_Office int1	0	0	0	1.7	41.8	16.2	39.1	1.2	0	0
01_Office peri NE	0	0	0	11.6	35.5	15.5	35.9	1.6	0	0
01_Office corner N	0	0	0	18.4	30.3	14.2	35.1	2	0	0
04_Office peri NW1	0	0	0	10.4	35.9	14.8	37.1	1.8	0	0
02_Office int1	0	0	0	1.9	42.1	16.4	38.4	1.1	0	0
01_Office peri SW	0	0	0	12.5	35.6	15.3	35.4	1.1	0	0
05_Office peri SE2	0	0	0	19.8	24.3	11.5	30.2	10.7	2.2	1.3
05_Office peri S	0	0	0	9.9	34.9	15.6	38.1	1.5	0	0
05_Office peri SE1	0	0	0	12	28.1	14.6	36.5	8.3	0.4	0.1
05_Office peri NE	0	0	0	13.1	34.5	15.3	35.6	1.6	0	0
00_Office int	0	0	0	7.8	41.4	15.9	34	0.9	0	0
02_Office peri NE	0	0	0	10.4	35.6	15.3	37.1	1.7	0	0
03_Office peri NE	0	0	0	9.8	35.7	14.6	38.1	1.9	0	0
02_Office corner N	0	0	0	17.8	29.9	14.4	35.8	2.2	0	0
03_Office corner N	0	0	0	17.2	30.2	14.7	36	2	0	0
03_Office peri NW1	0	0	0	10.4	35.9	15.1	37.1	1.6	0	0
03_Office int2	0	0	0	2	41.9	16.5	38.6	1	0	0
02_Office int2	0	0	0	2.2	42.2	16.5	38.2	1	0	0
02_Office peri NW1	0	0	0	11	35.9	15	36.5	1.6	0	0
02_Office peri SE2	0	0	0	20.5	26.8	12.1	33.2	6.2	0.9	0.2
02_Office peri S	0	0	0	9.3	36.2	15.2	38	1.2	0	0
02_Office peri SE1	0	0	0	10.8	33.7	14.8	37.5	3.2	0	0
03_Office peri SE2	0	0	0	19.2	26.5	12.1	33.3	7.5	1.2	0.4
04_Office peri SE2	0	0	0	18.3	25.3	12.4	31.3	9.8	1.9	1.1
03_Office peri S	0	0	0	8.2	36	15.8	38.7	1.3	0	0
04_Office peri S	0	0	0	7.6	35.6	16.3	39.2	1.3	0	0
03_Office peri SE1	0	0	0	10.2	32.3	14.9	38.4	4.1	0.1	0
04_Office peri SE1	0	0	0	9.4	30.7	14.6	38.7	6.3	0.2	0
02_Office peri SW	0	0	0	10.2	36.4	15.6	36.7	1.1	0	0
03_Office peri SW	0	0	0	9.6	36.5	15.2	37.5	1.2	0	0
04_Office peri SW	0	0	0	9.7	36.2	15	37.7	1.4	0	0
05_Office peri SW	0	0	0	12.3	34.5	14.6	36.8	1.8	0	0
LG_Office peri NW3	0	0	0	22.2	29.6	14.7	32.1	1.5	0	0
LG_Office int	0	0	0	11.9	38.6	16	32.5	1	0	0
06_Office peri SW	0	0	0	12.5	34.4	12.8	37.3	2.8	0.1	0
06_Office corner S	0	0	0	14.7	27.2	14.4	35.4	7.4	0.7	0.2
06_Office peri SE	0	0	0	5.2	31.4	12.1	37.6	13.4	0.3	0.1
06_Office peri NW2	0	0	0	15.5	33.6	15.6	34	1.3	0	0
06_Office int1	0	0	0	8.7	36.6	12.9	38.8	3	0	0
06_Office int2	0	0	0	14.2	33.7	13.4	36.7	2.1	0	0
Average	0.00	0.00	0.00	12.53	34.15	14.76	35.44	2.80	0.27	0.06

PREDICTED MEAN VOTE – DSY2

Sim06a

DSY2											
	Predicted mean vote (PMV) - % of hours in range										
Room Name	<= -1.00	>-1.00 to <=-0.75	>-0.75 to <=-0.50	>-0.50 to <=-0.25	>-0.25 to <=0.00	>0.00 to <=0.25	>0.25 to <=0.50	>0.50 to <=0.75	>0.75 to <=1.00	> 1.00
LG_Office peri NW1	0	0	0	17.5	32.4	16.8	30.9	2.4	0	0
LG_Office peri NW2	0	0	0	21.7	29.8	17.4	29.2	1.9	0	0
LG_Office peri NE	0	0	0	23	29.4	16.6	28.9	2.2	0	0
LG_Office corner N	0	0	0	25.7	28.8	16	27.8	1.7	0.1	0
00_Office peri NW1	0	0	0	17.5	31.8	17.5	31	2.1	0.1	0
00_Office peri NE	0	0	0	19.6	30.3	17.7	30.1	2.2	0.1	0
00_Office corner N	0	0	0	23.5	28.9	17.7	28.3	1.5	0.1	0
00_Reception	0	0	0.3	41.9	10.3	9.7	7.8	19.5	9.8	0.6
00_Office peri S	0	0	0	21.5	27.2	15.4	29.9	3.9	1	1.1
00_Office peri SE	0	0	0	24.3	25.1	16.8	30.1	2.9	0.3	0.4
01_Office int1	0	0	0	7.6	37.4	20.6	32.9	1.4	0	0
01_Office peri NW1	0	0	0	16.3	31.5	18.3	31.7	2.2	0	0
01_Office peri S	0	0	0	14.9	31.7	18.1	32.7	2.3	0.4	0
01_Office peri SE	0	0	0	20.1	29.9	17.6	30.1	2.3	0.1	0
01_Office int2	0	0	0	7.8	37.4	21.1	32.5	1.3	0	0
04_Office int1	0	0	0	5.8	37.3	20.7	34.7	1.5	0	0
04_Office peri NE	0	0	0	14.2	30.7	18.3	34	2.9	0	0
04_Office corner N	0	0	0	19.9	27.6	17.6	32.2	2.4	0.2	0
04_Office int2	0	0	0	6.7	36.5	21.3	34.1	1.5	0	0
05_Office int1	0	0	0	8.5	36	19.1	34.3	2.2	0	0
05_Office peri NW1	0	0	0	16	31.3	18.7	32.1	1.9	0	0
05_Office int2	0	0	0	9	35.4	19.9	33.7	2.1	0	0
05_Office peri NW1	0	0	0	17.4	30.9	18.4	31.4	1.9	0	0
05_Office peri NW1	0	0	0	20.2	29.3	17.9	30.5	2.1	0	0
06_Office peri NW1	0	0	0	22.1	28.3	17.1	30	2.3	0.1	0
03_Office int1	0	0	0	5.3	37.5	21	34.7	1.5	0	0
01_Office peri NE	0	0	0	16.2	30.9	18.5	31.9	2.5	0	0
01_Office corner N	0	0	0	21.3	27.3	16.9	31.5	2.6	0.3	0
04_Office peri NW1	0	0	0	15	31.1	18.3	33	2.6	0	0
02_Office int1	0	0	0	5.5	37.8	21.3	34	1.4	0	0
01_Office peri SW	0	0	0	16.9	31.3	18.9	31.1	1.8	0.1	0
05_Office peri SE2	0	0	0.1	20.2	21.7	12.9	31.4	9	2.2	2.5
05_Office peri S	0	0	0	13.2	29.4	20.7	34.2	2.2	0.4	0
05_Office peri SE1	0	0	0	12.4	26	16.8	36.4	6.9	0.8	0.7
05_Office peri NE	0	0	0	18.1	29.6	18.6	31.4	2.3	0	0
00_Office int	0	0	0	13.7	35.8	18.6	30.7	1.3	0	0
02_Office peri NE	0	0	0	14.7	30.7	18.8	33.1	2.7	0	0
03_Office peri NE	0	0	0	14.1	30.8	18.4	33.8	2.9	0	0
02_Office corner N	0	0	0	20.2	27.4	17.2	32.2	2.7	0.3	0
03_Office corner N	0	0	0	20	27.4	17.2	32.5	2.6	0.3	0
03_Office peri NW1	0	0	0	15	31	18.6	32.9	2.4	0	0
03_Office int2	0	0	0	5.6	37.4	21.6	33.9	1.4	0	0
02_Office int2	0	0	0	6.1	37.4	21.7	33.5	1.3	0	0
02_Office peri NW1	0	0	0	15.6	31	18.6	32.5	2.3	0	0
02_Office peri SE2	0	0	0	20.4	24.7	14.7	32.5	5.4	1.3	1
02_Office peri S	0	0	0	13.1	30.3	20.5	33.8	2.1	0.2	0
02_Office peri SE1	0	0	0	13.7	28.2	18.7	35.5	3.3	0.5	0.1
03_Office peri SE2	0	0	0	19.8	23.7	14.5	33	6.3	1.4	1.3
04_Office peri SE2	0	0	0	18.3	23.9	13.5	32.7	7.5	1.8	2.3
03_Office peri S	0	0	0	12.1	29.7	21.1	34.7	2.1	0.2	0
04_Office peri S	0	0	0	11	30.2	21.2	35.1	2.1	0.4	0
03_Office peri SE1	0	0	0	12.5	27.4	18.4	36.8	4.3	0.6	0.1
04_Office peri SE1	0	0	0	10.8	27.4	17.2	38	5.3	0.7	0.5
02_Office peri SW	0	0	0	14.9	31.2	19.8	32.1	1.8	0.1	0
03_Office peri SW	0	0	0	14.3	31.1	19.6	33	1.8	0.2	0
04_Office peri SW	0	0	0	14.3	30.8	19.7	33	1.9	0.2	0
05_Office peri SW	0	0	0	16.1	30.2	18.5	32.6	2.2	0.4	0
LG_Office peri NW3	0	0	0	24.5	28.1	16.4	28.7	2.2	0.1	0
LG_Office int	0	0	0	18	33.4	18.1	29.2	1.3	0	0
06_Office peri SW	0	0	0	16	29.7	16.8	33.8	3.3	0.2	0.3
06_Office corner S	0	0	0	14.8	25.2	15.8	35.7	6.4	1.1	1
06_Office peri SE	0	0	0	6.6	27.9	14	38	12.2	0.7	0.5
06_Office peri NW2	0	0	0	19.5	29.8	18.1	30.5	2.1	0	0
06_Office int1	0	0	0	12.8	31.8	16.6	34.7	3.9	0.2	0
06_Office int2	0	0	0	17.5	29.9	17.2	32.4	2.6	0.4	0
Average	0.00	0.00	0.01	15.89	30.17	18.02	32.18	3.12	0.42	0.19

PREDICTED MEAN VOTE – DSY3

Sim06b

DSY3										
Predicted mean vote (PMV) - % of hours in range										
Room Name	<= -1.00	>-1.00 to <=-0.75	>-0.75 to <=-0.50	>-0.50 to <=-0.25	>-0.25 to <=0.00	>0.00 to <=0.25	>0.25 to <=0.50	>0.50 to <=0.75	>0.75 to <=1.00	> 1.00
LG_Office peri NW1	0	0	0	18.8	35.1	11.7	33.2	1.1	0	0
LG_Office peri NW2	0	0	0	23.4	31.9	12	31.6	1	0	0
LG_Office peri NE	0	0	0	25.8	30.2	11.6	31.3	1.1	0	0
LG_Office corner N	0	0	0	28.3	29.9	11.7	29.2	0.8	0	0
00_Office peri NW1	0	0	0	19.5	33.4	12.2	33.8	1.1	0	0
00_Office peri NE	0	0	0	21.3	32.2	12.7	32.5	1.3	0	0
00_Office corner N	0	0	0	25.5	30.5	13.2	30.1	0.8	0	0
00_Reception	0	0	0.2	47.4	8.6	7.5	8	19.4	8.3	0.7
00_Office peri S	0	0	0	27.7	26.5	11	27.3	5	1.7	0.8
00_Office peri SE	0	0	0.2	29.7	26.2	11.2	28.6	3.4	0.7	0
01_Office int1	0	0	0	7.3	42.3	14.2	35.6	0.6	0	0
01_Office peri NW1	0	0	0	18.3	33.2	12.5	34.8	1.2	0	0
01_Office peri S	0	0	0	18.1	33.6	12.7	34.3	1.3	0	0
01_Office peri SE	0	0	0	23.9	30.7	12.2	31.8	1.3	0	0
01_Office int2	0	0	0	7.5	42.4	14.4	35.1	0.6	0	0
04_Office int1	0	0	0	5.7	42.2	13.7	37.5	0.8	0	0
04_Office peri NE	0	0	0	16	33.9	11.9	36.2	2	0	0
04_Office corner N	0	0	0	22.5	28.6	12.5	34.5	1.9	0	0
04_Office int2	0	0	0	6.8	41.4	14.2	37	0.6	0	0
05_Office int1	0	0	0	8.2	40.7	13.1	37	1	0	0
05_Office peri NW1	0	0	0	17.9	33.3	12.9	35.1	0.9	0	0
05_Office int2	0	0	0	9.6	39.8	13.3	36.4	0.9	0	0
05_Office peri NW1	0	0	0	19.3	32.6	12.7	34.5	0.9	0	0
05_Office peri NW1	0	0	0	22.1	30.7	12.9	33.3	1	0	0
06_Office peri NW1	0	0	0	24.5	29	11.9	33.4	1.2	0	0
03_Office int1	0	0	0	5	42.9	13.9	37.5	0.7	0	0
01_Office peri NE	0	0	0	18.3	33	12.5	34.5	1.6	0	0
01_Office corner N	0	0	0	24.1	28.3	11.8	33.3	2.2	0.2	0
04_Office peri NW1	0	0	0	16.8	33.5	12.3	36	1.4	0	0
02_Office int1	0	0	0	5.4	42.8	14.2	37	0.6	0	0
01_Office peri SW	0	0	0	19	33.1	12.8	34.1	1	0	0
05_Office peri SE2	0	0	0.3	25.9	22.1	10.8	26.4	9	2.7	2.8
05_Office peri S	0	0	0	16.8	32.2	14.7	34.9	1.4	0	0
05_Office peri SE1	0	0	0	17.8	27.6	12.9	32.3	8	1.1	0.3
05_Office peri NE	0	0	0	20.1	31.3	12.4	34.9	1.3	0	0
00_Office int	0	0	0	14.4	38.7	13.8	32.5	0.5	0	0
02_Office peri NE	0	0	0	16.9	33.3	12.6	35.4	1.8	0	0
03_Office peri NE	0	0	0	16.1	33.9	12	36	2	0	0
02_Office corner N	0	0	0	23.4	28.2	12	33.7	2.5	0.2	0
03_Office corner N	0	0	0	22.7	28.5	12.2	34.4	2.1	0.1	0
03_Office peri NW1	0	0	0	16.7	33.6	12.3	36	1.3	0	0
03_Office int2	0	0	0	5.8	42.4	14.5	36.7	0.6	0	0
02_Office int2	0	0	0	6.2	42.5	14.5	36.3	0.6	0	0
02_Office peri NW1	0	0	0	17.5	33.3	12.5	35.6	1.2	0	0
02_Office peri SE2	0	0	0	26.8	24.9	11.2	27.9	6.8	1.5	0.9
02_Office peri S	0	0	0	16	33.9	14.1	35.1	1	0	0
02_Office peri SE1	0	0	0	17.6	31.5	13.6	33.4	3.8	0.2	0
03_Office peri SE2	0	0	0.1	26.7	23.5	11.6	27.4	7.5	2	1.2
04_Office peri SE2	0	0	0.1	24.8	23.6	11.3	26.7	8.5	2.7	2.3
03_Office peri S	0	0	0	15.2	33.4	14.8	35.4	1.1	0	0
04_Office peri S	0	0	0	14.1	33.8	15.1	35.8	1.2	0	0
03_Office peri SE1	0	0	0	17.2	30.2	13.9	33.6	4.8	0.5	0
04_Office peri SE1	0	0	0	15.3	30.1	13.3	33.8	6.8	0.7	0
02_Office peri SW	0	0	0	16.6	34.2	13.1	35.2	1	0	0
03_Office peri SW	0	0	0	16.2	33.7	13.4	35.5	1.2	0	0
04_Office peri SW	0	0	0	16.1	33.9	13	35.8	1.3	0	0
05_Office peri SW	0	0	0	18.5	32.2	12.4	35.3	1.6	0.1	0
LG_Office peri NW3	0	0	0	27.1	29	11.5	31.2	1.3	0	0
LG_Office int	0	0	0	18.7	36.1	13	31.5	0.6	0	0
06_Office peri SW	0	0	0	19.5	31	11.7	34.7	2.8	0.4	0
06_Office corner S	0	0	0	20.6	25.8	13.1	30.6	7.4	1.8	0.7
06_Office peri SE	0	0	0	9.6	33	11.7	32.8	12.1	0.7	0.2
06_Office peri NW2	0	0	0	21.9	30.7	12.9	33.5	1.1	0	0
06_Office int1	0	0	0	15.5	33.8	11.7	35	4.1	0	0
06_Office int2	0	0	0	20.7	30.6	11.8	34.4	2.4	0.1	0
Average	0.00	0.00	0.01	18.44	32.45	12.66	33.30	2.61	0.40	0.15

PERCENTAGE OF PEOPLE DISSATISFIED – DSY1

Sim06

DSY1						
Percentage people dissatisfied- % of hours in range						
Room name	<= 5.00	>5.00 to <=10.00	>10.00 to <=15.00	>15.00 to <=20.00	>20.00 to <=25.00	> 25.00
LG_Office peri NW1	0	98.2	1.8	0	0	0
LG_Office peri NW2	0	98.4	1.6	0	0	0
LG_Office peri NE	0	98.4	1.6	0	0	0
LG_Office corner N	0	98.8	1.2	0	0	0
00_Office peri NW1	0	98.3	1.7	0	0	0
00_Office peri NE	0	98.4	1.6	0	0	0
00_Office corner N	0	98.8	1.2	0	0	0
00_Reception	0	69	14.7	14.3	1.7	0.2
00_Office peri S	0	93.6	4.6	0.9	0.5	0.4
00_Office peri SE	0	97	2.7	0.2	0	0
01_Office int1	0	98.5	1.5	0	0	0
01_Office peri NW1	0	98.2	1.8	0	0	0
01_Office peri S	0	98	2	0	0	0
01_Office peri SE	0	98.3	1.7	0	0	0
01_Office int2	0	98.6	1.4	0	0	0
04_Office int1	0	98.3	1.7	0	0	0
04_Office peri NE	0	97.6	2.4	0	0	0
04_Office corner N	0	97.7	2.3	0	0	0
04_Office int2	0	98.5	1.5	0	0	0
05_Office int1	0	97.9	2.1	0	0	0
05_Office peri NW1	0	98.3	1.7	0	0	0
05_Office int2	0	98.2	1.8	0	0	0
05_Office peri NW1	0	98.3	1.7	0	0	0
05_Office peri NW1	0	98.4	1.6	0	0	0
06_Office peri NW1	0	98.2	1.8	0	0	0
03_Office int1	0	98.4	1.6	0	0	0
01_Office peri NE	0	98	2	0	0	0
01_Office corner N	0	97.6	2.4	0	0	0
04_Office peri NW1	0	97.8	2.2	0	0	0
02_Office int1	0	98.5	1.5	0	0	0
01_Office peri SW	0	98.5	1.5	0	0	0
05_Office peri SE2	0	84.6	11.1	1.9	1	1.4
05_Office peri S	0.1	98.1	1.9	0	0	0
05_Office peri SE1	0	90	9.2	0.5	0.2	0.1
05_Office peri NE	0	98.1	1.9	0	0	0
00_Office int	0	98.8	1.2	0	0	0
02_Office peri NE	0	97.7	2.3	0	0	0
03_Office peri NE	0	97.5	2.5	0	0	0
02_Office corner N	0.1	97.2	2.7	0	0	0
03_Office corner N	0.1	97.5	2.5	0	0	0
03_Office peri NW1	0	97.9	2.1	0	0	0
03_Office int2	0	98.5	1.5	0	0	0
02_Office int2	0	98.6	1.4	0	0	0
02_Office peri NW1	0	98	2	0	0	0
02_Office peri SE2	0	91.5	6.8	0.9	0.4	0.3
02_Office peri S	0	98.5	1.5	0	0	0
02_Office peri SE1	0	96.2	3.7	0.1	0	0
03_Office peri SE2	0	89.7	8.2	1	0.6	0.4
04_Office peri SE2	0	86.1	10.1	1.7	1	1.2
03_Office peri S	0	98.3	1.7	0	0	0
04_Office peri S	0	98.3	1.7	0	0	0
03_Office peri SE1	0	95	4.9	0.2	0	0
04_Office peri SE1	0	92	7.5	0.3	0.1	0
02_Office peri SW	0	98.4	1.6	0	0	0
03_Office peri SW	0	98.2	1.8	0	0	0
04_Office peri SW	0	97.9	2.1	0	0	0
05_Office peri SW	0	97.6	2.3	0	0	0
LG_Office peri NW3	0	98.4	1.6	0	0	0
LG_Office int	0	98.6	1.4	0	0	0
06_Office peri SW	0	96.3	3.6	0.1	0	0
06_Office corner S	0	90.6	8	0.8	0.2	0.3
06_Office peri SE	0	84.8	14.4	0.5	0.2	0.1
06_Office peri NW2	0	98.4	1.6	0	0	0
06_Office int1	0	96.1	3.9	0	0	0
06_Office int2	0	97.2	2.8	0	0	0
Average	0.00	96.33	3.14	0.36	0.09	0.07

PERCENTAGE OF PEOPLE DISSATISFIED – DSY2

Sim06a

DSY2						
Percentage people dissatisfied- % of hours in range						
Room name	<= 5.00	>5.00 to <=10.00	>10.00 to <=15.00	>15.00 to <=20.00	>20.00 to <=25.00	> 25.00
LG_Office peri NW1	0	97.2	2.7	0.1	0	0
LG_Office peri NW2	0	97.6	2.2	0.1	0	0
LG_Office peri NE	0	97.5	2.5	0	0	0
LG_Office corner N	0	97.9	2	0.1	0	0
00_Office peri NW1	0	97.3	2.5	0.1	0	0
00_Office peri NE	0	97.5	2.4	0.1	0	0
00_Office corner N	0	98	1.8	0.2	0	0
00_Reception	0	69.2	14.4	13.7	2	0.7
00_Office peri S	0	93.4	4.3	0.8	0.4	1.2
00_Office peri SE	0	96.1	3.1	0.1	0.2	0.5
01_Office int1	0	98.2	1.8	0	0	0
01_Office peri NW1	0	97.2	2.7	0.1	0	0
01_Office peri S	0.1	97	2.5	0.4	0.1	0
01_Office peri SE	0	97.3	2.5	0.1	0	0
01_Office int2	0	98.4	1.6	0	0	0
04_Office int1	0	97.9	2.1	0	0	0
04_Office peri NE	0	96.5	3.4	0.1	0	0
04_Office corner N	0	96.8	2.9	0.2	0.1	0
04_Office int2	0	98.1	1.9	0	0	0
05_Office int1	0	97.3	2.7	0	0	0
05_Office peri NW1	0	97.5	2.5	0	0	0
05_Office int2	0	97.4	2.6	0	0	0
05_Office peri NW1	0	97.6	2.4	0	0	0
05_Office peri NW1	0	97.5	2.4	0.1	0	0
06_Office peri NW1	0	97.1	2.7	0.2	0	0
03_Office int1	0	98.1	1.9	0	0	0
01_Office peri NE	0	97	2.9	0	0	0
01_Office corner N	0	96.6	3	0.1	0.2	0.1
04_Office peri NW1	0	96.9	3	0.1	0	0
02_Office int1	0	98.2	1.8	0	0	0
01_Office peri SW	0	97.8	2	0.2	0	0
05_Office peri SE2	0	85	9.6	1.6	1.2	2.6
05_Office peri S	0	97.2	2.3	0.4	0.1	0.1
05_Office peri SE1	0	90.5	7.5	0.9	0.4	0.7
05_Office peri NE	0	97.3	2.7	0	0	0
00_Office int	0	98.4	1.6	0	0	0
02_Office peri NE	0	96.7	3.3	0	0	0
03_Office peri NE	0	96.5	3.4	0.1	0	0
02_Office corner N	0	96.3	3.3	0.1	0.2	0.1
03_Office corner N	0	96.5	3.1	0.2	0.2	0
03_Office peri NW1	0	97	2.9	0.1	0	0
03_Office int2	0	98.3	1.7	0	0	0
02_Office int2	0.1	98.4	1.6	0	0	0
02_Office peri NW1	0	97.1	2.7	0.1	0	0
02_Office peri SE2	0	91.6	5.7	1	0.6	1.2
02_Office peri S	0	97.5	2.1	0.3	0.1	0
02_Office peri SE1	0	95.3	3.9	0.4	0.2	0.1
03_Office peri SE2	0	89.9	6.8	1.2	0.7	1.4
04_Office peri SE2	0	87.1	8	1.7	0.8	2.4
03_Office peri S	0	97.4	2.2	0.3	0.1	0
04_Office peri S	0	97.3	2.3	0.4	0.1	0
03_Office peri SE1	0	94.3	4.9	0.2	0.3	0.2
04_Office peri SE1	0	92.7	5.8	0.6	0.4	0.5
02_Office peri SW	0	97.8	2.1	0.2	0	0
03_Office peri SW	0	97.6	2.2	0.2	0.1	0
04_Office peri SW	0	97.5	2.2	0.3	0.1	0
05_Office peri SW	0	97.1	2.5	0.1	0.2	0
LG_Office peri NW3	0	97.4	2.3	0.2	0	0
LG_Office int	0	98.3	1.7	0	0	0
06_Office peri SW	0	95.2	4.1	0.2	0.1	0.3
06_Office corner S	0	90.3	7	1.1	0.5	1
06_Office peri SE	0	84.7	13.5	1	0.3	0.5
06_Office peri NW2	0	97.5	2.4	0.1	0	0
06_Office int1	0	95	4.6	0.3	0.1	0
06_Office int2	0	96.4	3.2	0.2	0.2	0
Average	0.00	95.71	3.45	0.47	0.15	0.21

PERCENTAGE OF PEOPLE DISSATISFIED – DSY3

Sim06b

DSY3						
Percentage people dissatisfied- % of hours in range						
Room name	<= 5.00	>5.00 to <=10.00	>10.00 to <=15.00	>15.00 to <=20.00	>20.00 to <=25.00	> 25.00
LG_Office peri NW1	0	98.4	1.6	0	0	0
LG_Office peri NW2	0	98.7	1.2	0	0	0
LG_Office peri NE	0	98.6	1.4	0	0	0
LG_Office corner N	0	98.9	1.1	0	0	0
00_Office peri NW1	0	98.6	1.4	0	0	0
00_Office peri NE	0	98.4	1.6	0	0	0
00_Office corner N	0	99	1	0	0	0
00_Reception	0	70.7	12.7	14.3	1.5	0.8
00_Office peri S	0	91.7	5.3	1.5	0.7	0.9
00_Office peri SE	0	95.2	3.9	0.5	0.4	0
01_Office int1	0	99.2	0.8	0	0	0
01_Office peri NW1	0	98.5	1.5	0	0	0
01_Office peri S	0	98.1	1.9	0	0	0
01_Office peri SE	0	98.2	1.7	0	0	0
01_Office int2	0	99.3	0.7	0	0	0
04_Office int1	0	99	1	0	0	0
04_Office peri NE	0	97.5	2.5	0	0	0
04_Office corner N	0	97.8	2.1	0.1	0	0
04_Office int2	0	99.1	0.9	0	0	0
05_Office int1	0	98.7	1.3	0	0	0
05_Office peri NW1	0	98.8	1.2	0	0	0
05_Office int2	0	98.9	1.1	0	0	0
05_Office peri NW1	0	98.8	1.2	0	0	0
05_Office peri NW1	0	98.7	1.3	0	0	0
06_Office peri NW1	0	98.4	1.5	0	0	0
03_Office int1	0	99.1	0.9	0	0	0
01_Office peri NE	0	98	2	0	0	0
01_Office corner N	0	96.9	2.7	0.3	0	0
04_Office peri NW1	0	98.2	1.8	0	0	0
02_Office int1	0	99.2	0.8	0	0	0
01_Office peri SW	0	98.7	1.3	0	0	0
05_Office peri SE2	0	84.1	9.8	1.8	1.3	3
05_Office peri S	0	98.2	1.6	0.1	0	0
05_Office peri SE1	0	89.6	8.4	1.2	0.4	0.4
05_Office peri NE	0	98.4	1.6	0	0	0
00_Office int	0	99.3	0.7	0	0	0
02_Office peri NE	0	97.7	2.3	0	0	0
03_Office peri NE	0	97.4	2.6	0	0	0
02_Office corner N	0	96.7	3	0.3	0	0
03_Office corner N	0	97	2.7	0.3	0	0
03_Office peri NW1	0	98.3	1.7	0	0	0
03_Office int2	0	99.2	0.8	0	0	0
02_Office int2	0	99.2	0.8	0	0	0
02_Office peri NW1	0	98.4	1.6	0	0	0
02_Office peri SE2	0	89.7	7.5	1.3	0.5	1
02_Office peri S	0	98.7	1.3	0	0	0
02_Office peri SE1	0	95.3	4.3	0.4	0	0
03_Office peri SE2	0	88.3	7.7	1.6	1.1	1.3
04_Office peri SE2	0	85.5	8.9	1.6	1.3	2.7
03_Office peri S	0	98.6	1.4	0	0	0
04_Office peri S	0	98.5	1.5	0	0	0
03_Office peri SE1	0	93.8	5.6	0.4	0.1	0
04_Office peri SE1	0	91.6	7.4	0.7	0.3	0
02_Office peri SW	0	98.6	1.4	0	0	0
03_Office peri SW	0	98.5	1.4	0.1	0	0
04_Office peri SW	0	98.4	1.5	0.1	0	0
05_Office peri SW	0	98.1	1.7	0.2	0	0
LG_Office peri NW3	0	98.4	1.6	0	0	0
LG_Office int	0	99.2	0.8	0	0	0
06_Office peri SW	0	96.2	3.3	0.2	0.2	0.1
06_Office corner S	0	88.8	8.1	1.6	0.6	0.9
06_Office peri SE	0	85.6	12.8	1.1	0.2	0.2
06_Office peri NW2	0	98.7	1.3	0	0	0
06_Office int1	0	95	4.9	0	0	0
06_Office int2	0	96.8	2.8	0.3	0	0
Average	0.00	96.36	2.86	0.46	0.13	0.17

Appendices

Appendix B – Operative Temperature Tables

Sim06_cooling75W-m2_setp22_DSY1.aps

Operative temperature (°C) - % hours in range	
Location	> 25.00
LG_Office peri NW1	0
LG_Office peri NW2	0
LG_Office peri NE	0
LG_Office corner N	0
00_Office peri NW1	0
00_Office peri NE	0
00_Office corner N	0
00_Reception	0.2
00_Office peri S	0.5
00_Office peri SE	0
01_Office int1	0
01_Office peri NW1	0
01_Office peri S	0
01_Office peri SE	0
01_Office int2	0
04_Office int1	0
04_Office peri NE	0
04_Office corner N	0
04_Office int2	0
05_Office int1	0
05_Office peri NW1	0
05_Office int2	0
05_Office peri NW1	0
05_Office peri NW1	0
06_Office peri NW1	0
03_Office int1	0
01_Office peri NE	0
01_Office corner N	0
04_Office peri NW1	0
02_Office int1	0
01_Office peri SW	0
05_Office peri SE2	1.6
05_Office peri S	0
05_Office peri SE1	0.1
05_Office peri NE	0
00_Office int	0
02_Office peri NE	0
03_Office peri NE	0
02_Office corner N	0
03_Office corner N	0
03_Office peri NW1	0
03_Office int2	0
02_Office int2	0
02_Office peri NW1	0
02_Office peri SE2	0.2
02_Office peri S	0
02_Office peri SE1	0
03_Office peri SE2	0.5
04_Office peri SE2	1.3
03_Office peri S	0
04_Office peri S	0
03_Office peri SE1	0
04_Office peri SE1	0
02_Office peri SW	0
03_Office peri SW	0
04_Office peri SW	0
05_Office peri SW	0
LG_Office peri NW3	0
LG_Office int	0
06_Office peri SW	0
06_Office corner S	0.3
06_Office peri SE	0
06_Office peri NW2	0
06_Office int1	0
06_Office int2	0

Sim06a_cooling75W-m2_setp22_DSY2.aps

Operative temperature (°C) - % hours in range	
Location	> 25.00
LG_Office peri NW1	0
LG_Office peri NW2	0
LG_Office peri NE	0
LG_Office corner N	0
00_Office peri NW1	0
00_Office peri NE	0
00_Office corner N	0
00_Reception	0.6
00_Office peri S	1.1
00_Office peri SE	0.4
01_Office int1	0
01_Office peri NW1	0
01_Office peri S	0.1
01_Office peri SE	0
01_Office int2	0
04_Office int1	0
04_Office peri NE	0
04_Office corner N	0
04_Office int2	0
05_Office int1	0
05_Office peri NW1	0
05_Office int2	0
05_Office peri NW1	0
05_Office peri NW1	0
06_Office peri NW1	0
03_Office int1	0
01_Office peri NE	0
01_Office corner N	0.1
04_Office peri NW1	0
02_Office int1	0
01_Office peri SW	0
05_Office peri SE2	2.7
05_Office peri S	0.1
05_Office peri SE1	0.5
05_Office peri NE	0
00_Office int	0
02_Office peri NE	0
03_Office peri NE	0
02_Office corner N	0.1
03_Office corner N	0.1
03_Office peri NW1	0
03_Office int2	0
02_Office int2	0
02_Office peri NW1	0
02_Office peri SE2	1.1
02_Office peri S	0
02_Office peri SE1	0.1
03_Office peri SE2	1.4
04_Office peri SE2	2.4
03_Office peri S	0
04_Office peri S	0.1
03_Office peri SE1	0.1
04_Office peri SE1	0.4
02_Office peri SW	0
03_Office peri SW	0
04_Office peri SW	0
05_Office peri SW	0
LG_Office peri NW3	0
LG_Office int	0
06_Office peri SW	0.3
06_Office corner S	0.9
06_Office peri SE	0.4
06_Office peri NW2	0
06_Office int1	0
06_Office int2	0.1

Sim06b_cooling75W-m2_setp22_DSY3.aps

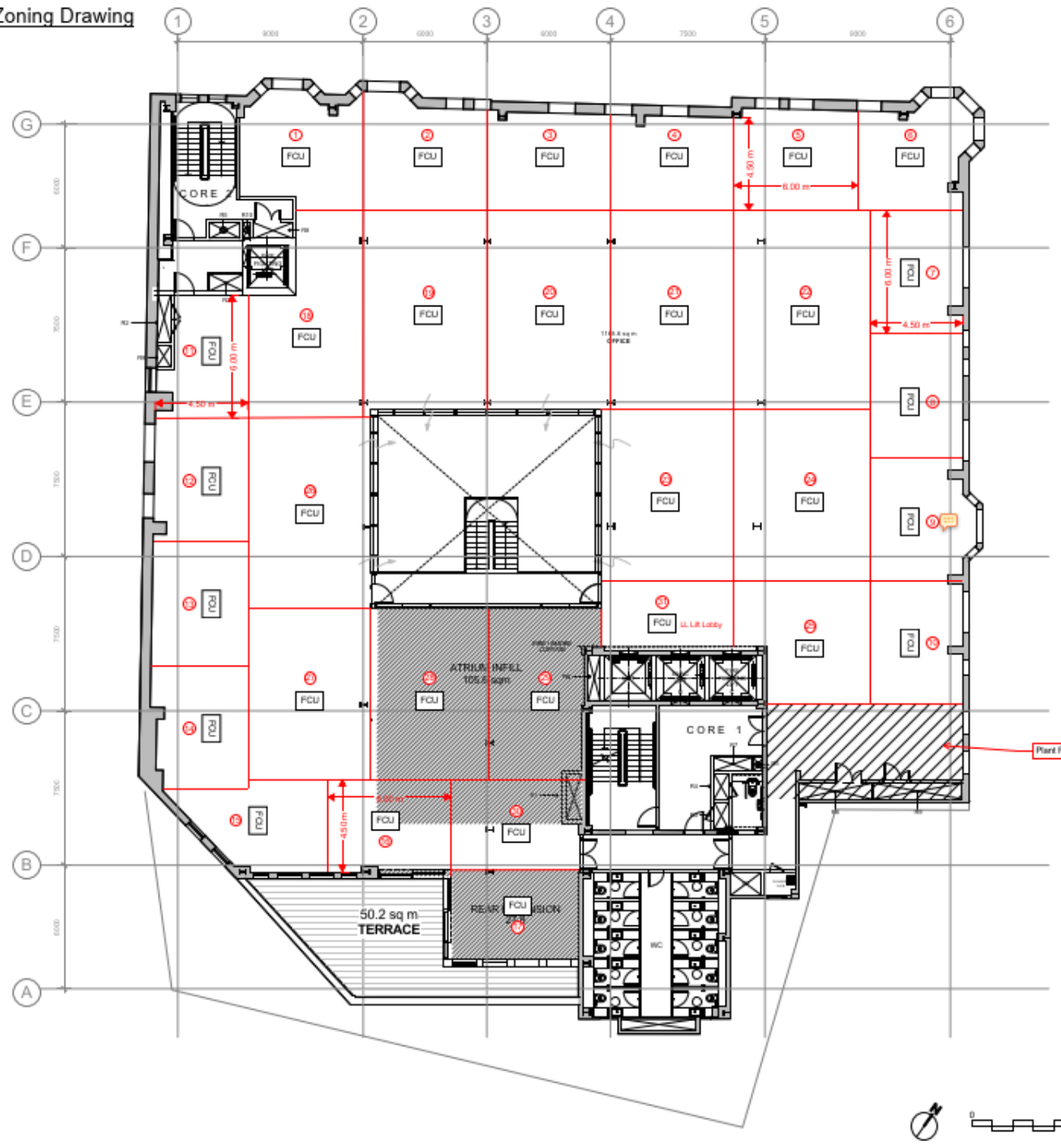
Operative temperature (°C) - % hours in range	
Location	> 25.00
LG_Office peri NW1	0
LG_Office peri NW2	0
LG_Office peri NE	0
LG_Office corner N	0
00_Office peri NW1	0
00_Office peri NE	0
00_Office corner N	0
00_Reception	0.8
00_Office peri S	1.1
00_Office peri SE	0
01_Office int1	0
01_Office peri NW1	0
01_Office peri S	0
01_Office peri SE	0
01_Office int2	0
04_Office int1	0
04_Office peri NE	0
04_Office corner N	0
04_Office int2	0
05_Office int1	0
05_Office peri NW1	0
05_Office int2	0
05_Office peri NW1	0
05_Office peri NW1	0
06_Office peri NW1	0
03_Office int1	0
01_Office peri NE	0
01_Office corner N	0
04_Office peri NW1	0
02_Office int1	0
01_Office peri SW	0
05_Office peri SE2	3
05_Office peri S	0
05_Office peri SE1	0.3
05_Office peri NE	0
00_Office int	0
02_Office peri NE	0
03_Office peri NE	0
02_Office corner N	0
03_Office corner N	0
03_Office peri NW1	0
03_Office int2	0
02_Office int2	0
02_Office peri NW1	0
02_Office peri SE2	0.9
02_Office peri S	0
02_Office peri SE1	0
03_Office peri SE2	1.5
04_Office peri SE2	3
03_Office peri S	0
04_Office peri S	0
03_Office peri SE1	0
04_Office peri SE1	0
02_Office peri SW	0
03_Office peri SW	0
04_Office peri SW	0
05_Office peri SW	0
LG_Office peri NW3	0
LG_Office int	0
06_Office peri SW	0.1
06_Office corner S	1
06_Office peri SE	0.1
06_Office peri NW2	0
06_Office int1	0
06_Office int2	0

Appendices

Appendix C – FCU Zoning drawing

FAN COIL UNITS ZONING DRAWING

21 Bloomsbury Street - FCU Zoning Drawing
Typical Floor



1 Second Floor Plan, Proposed
4677-ST-PR-02-102 Scale: 1:100

0 5 10 M

Key Plan

Do not scale from this drawing.

Check drawing on receipt and immediately report any discrepancies to the Architect.

Verify all dimensions and levels on site prior to construction.

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Notes

RISERS KEY:

No.	DESCRIPTION	AVRL
R1	SUPPLY AIR	3.5
R2	SUPPLY AIR	1.7
R3	CAT SHAFT	0.4
R4	EXTRACT AIR	0.8
R5	DRY RISER	1.5
R6	ELECTRICAL AND COMMS	1
R7	LANDLORD RISER	1.5
R8	ELECTRICAL RISER	1.5
R9	REFRIGERANT	1.5
R10	FLUE	0.2

A 16/02/22 PRELIMINARY ISSUE

Rev. Date Note Approved

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Client
Capital 38

Project
21 Bloomsbury Street

Drawing Title
Second Floor Plan
As Proposed

Drawing Status
PROPOSED

Date	Scale @ A1	Scale @ A3
16/02/2022	1:100	1:200

Project No.	Drawing No.	Revision
4677	ST-PR-02-102	-

Appendix C – BREEAM Pre-Assessment

BREEAM 2014 RFO (Non-Domestic)

Design & Procurement Assessment

21 Bloomsbury - Part 1, 2 & 3

Issue	Date	Reason for Issue	Prepared		Checked		Approved	
1	14.02.22	Pre Assessment	KC	17.02.	RC	17.02.	AD	17.02.
2	04.04.2022	Stage 2 items	RC	04.04.	KA	04.04.	AD	04.04.
3	10.05.2022	For Information	RC	10.05.	KA	10.05.	AD	10.05.
4	19.05.2022	For Information	RC	19.05.	KA	19.05.	AD	19.05.
5	26.05.2022	For Planning Issue	NYO	26.05.	RC	26.05.	AD	26.05.

BREEAM 2014 RFO (Non-Domestic)
26.05.2022
Revision5

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Credit Review

26.05.2022 Revision5

Project Name	**21 Bloomsbury - Part 1, 2 & 3**	Targeted BREEAM rating %	**77.14**	**Excellent**	Credit awarded
Building Type	**Office**	Potential BREEAM rating %	**84.31**	**Excellent**	Credit not targeted
Project Type	**Shell and Core**	Achieved scoring %	**5.88**	**Unclassified**	Potential additional credit
					Further information required

Credit Ref.	Credit Title	Credit Name	Credits Available	Credits Targeted	Potential Additional	Credits Achieved	Mandatory Elements	Responsibilities	RIBA Stage	Status	Comments / Actions
			109.99%	**77.14%**	**84.31%**	**5.88%**	✕				
MANAGEMENT 0.73% per credit											
Man 01	**Project brief and design**	Stakeholder Consultation (Project Delivery)	1	1				Design Team*	2		**Data collection tool to be completed - minutes and additional supporting evidence received** Design team meetings, scope of work & formal agreements on performance targets with project team members from Stage 2 all available
		Stakeholder Consultation (Third Party)	1	1				Client*PM*Architect*	2		**DRAFT received - a few items outstanding in progress** Completed the community consultation exercises as part of the pre-application process. Design team to confirm how the consultation influenced the design.
		Sustainability Champion (Design)	1	1				BREEAM AP*	1 - 2		Minutes, presentation and trackers issued to project team as well as trackers and BREEAM report throughout Stage 2 of design.
		Sustainability Champion (Monitoring Process)	1	1				BREEAM AP*	4		Minutes, presentation and trackers issued to project team as well as trackers and BREEAM report throughout Stage 3 of design.
Man 02	**Life cycle cost and service life planning**	Elemental Life Cycle Cost (LCC)	2	2				Client*PM*Architect*	2		An Elemental LCC Analysis is required to be carried out at RIBA Stage 2, then updated at RIBA Stage 4 for component level. (20, 30, 50 or 60 years LCC analysis targeting - Envelope, Services, Finishes & External spaces).
		Component Level LCC Plan	1	1				Client*PM*Architect*	4		Updated RIBA Stage 4 LCC analysis
		Capital Cost Reporting	1	1				PM*Client*QS*	4		**Draft letter** Sweco to issue draft letter to report the estimate capital costs for the project at Stage 4 in accordance with BREEAM RFO 2014 requirements
Man 03	**Responsible construction practices**	Timber used on site to be responsibly sourced.					Yes	Contractor*			**Letter of Commitment once contractor is appointed** **This is a minimum requirement for achieving any BREEAM rating.**
		Environmental Management	1	1				Contractor*	4		**Letter of Commitment once contractor is appointed** Main contractor to operate ISO 14001:2015 and pollution prevention policies in accordance with PPG6
		Sustainability Champion (Construction)	1	1				Contractor*	4		**Letter of Commitment once contractor is appointed** The main contractor must appoint a formally qualified Sustainability Champion for the construction stage. Sweco will not be providing this service. This is critical to the successful delivery of the construction stage certificate.
		Considerate Construction (Minimum Standard 1 credit for Excellent, 2 for Outstanding)	2	2			Yes	Contractor*	4		**Letter of Commitment once contractor is appointed** The contractor will be required to comply in full here. The contractor will need to achieve as CCS score of >40 with at least 7 in each section to achieve 2+ exemplary BREEAM credits.
		Monitoring of Construction Site Impacts - Utility Consumption	1	1				Contractor*	4		**Letter of Commitment once contractor is appointed** Contractor to set targets, monitor and report water and energy use through construction, as well as display figures on site
		Monitoring of Construction Site Impacts - Transport of Construction Materials & Waste	1	1				Contractor*	4		**Letter of Commitment once contractor is appointed** Vehicle monitoring of materials deliveries from point of supply to site gate (main contractor) and vehicle monitoring of waste away (demolition and main contractor) to establish carbon impact.
Man 04	**Commissioning & Handover**	Commissioning & Testing Schedule & Responsibilities	1	1				Contractor*	4		**Letter of Commitment once contractor is appointed** Third party commissioning manager to be appointed. Testing schedule and responsibilities to be provided.
		Commissioning Building Services	1	1				MEP*	4		Appointment of an appropriate project team member or specialist commissioning manager during the design stage, provided they are not involved in the general installation works provide commissioning management and advise during the design stage.
		Testing and inspecting building fabric	1	0	1						Sweco experience shows that this is a credit many contractors are not keen to pursue. May be critical for ensuring construction meets standards and mitigates air leakage and thermal bridging issues. Credit in 'potential' until discussed.
		Handover	1	1				Client*Contractor*	4		**Letter of Commitment once contractor is appointed** A technical training schedule for the premises facilities managers.
Man		**TOTAL:**	**18**	**17**	**1**	**0**					
		% of total score:	**13.08%**	**12.35%**	**0.73%**	**0.00%**					

Credit Ref.	Credit Title	Credit Name	Credits Available	Credits Targeted	Potential Additional	Credits Achieved	Mandatory Elements	Responsibilities	RIBA Stage	Status	Comments / Actions
HEALTH & WELLBEING 0.87% per credit											
Hea 01	**Visual comfort**	Daylighting	3	0	2			Architect*Contractor*	4		Up to three credits are awarded on a sliding scale depending on the percentage of relevant building areas that comply with good practice daylight factor and average and minimum point daylight illuminance criteria. To be investigated by a daylighting study, i.e. 2% DF over 80% of the floor plate.
		View Out	2	2				Architect*	4		95% of the floor area in 95% of spaces for each relevant building area is within 8 m of an external wall. The window or opening must be ≥ 20% of the surrounding wall area. Or compliance is seeked via BS 8206: part 2.The architect to provide the calculations of room depth and glazing-wall ratio
		Internal & External Lighting Levels, Zoning & Controls	1	1				M&E Consultant*	4		**M&E Letter** Internal lighting in all relevant areas of the building is designed to provide illuminance (lux) levels and colouring rendering index in accordance with the SLL Code for Lighting 2012 and areas with PC CIBSE LG7. External lighting in compliance with BS5489 and BS12464. All internal zoned to allow for occupant control.
Hea 02	**Indoor air quality**	Indoor Air Quality Plan	1	1				IAQ Consultant*	2-3		**Additional Appointment of IAQ Specialist** IAQP to be developed to facilitate good practice in VOC emissions.
		Ventilation	1	1				M&E Consultant*	4		Ventilation pathways to minimise the build-up of air pollutants in the building. For air conditioned and mixed mode the building's air intakes and exhausts are over 10m apart and intakes are over 20m from sources of external pollution;OR in accordance with BS EN 13779:2007. carbon dioxide (CO2) or air quality sensors specified.
		Adaptability - Potential for natural ventilation	1	0	1			M&E Consultant*	4		Occupied spaces of the building are designed to be capable of providing fresh air entirely via a natural ventilation strategy. Room depths are designed in accordance with CIBSE AM 10 (Section 2.4) to ensure effectiveness of any natural ventilation system. At the design stage meeting this credit was considered unachievable.
Hea 04	**Thermal comfort**	Thermal modelling	1	1				Energy Consultant*	3		A full dynamic thermal modelling has been carried out using software in accordance with CIBSE AM11 for summer and winter overstressing CIBSE Guide A and TM52. Report the PMV and PPD.
		Adaptability - for a projected climate change scenario	1	1				M&E Consultant*	3		As above for a projected climate change environment. Where thermal comfort criteria are not met for the projected climate change environment, the project team demonstrates how the building has been adapted, or designed to be easily adapted in the future using passive design solutions
		Thermal zoning and controls	1	1				M&E Consultant*	4		The heating/cooling system strategy is zoned, designed to ensure they do not conflict with core services, have a degree of occupant control and details of how the systems will interact with each other with the affect on the thermal comfort.
Hea 05	**Acoustic performance**	Acoustic performance standards	2	2				Acoustician*	3-4		**Additional Appointment of SQA Specialist** SQA to produce acoustic report confirming the building meets the appropriate acoustic performance standards and testing requirements for: a. Sound insulation b. Indoor ambient noise level c. Reverberation times.
Hea 06	**Safety & Security**	Security of Site & Building	1	1				Security Consultant*	2		**Additional Appointment of SQSS** A Suitably Qualified Security Specialist (SQSS) conducts an evidence based Security Needs Assessment (SNA) during RIBA Stage 2. Recommendations are incorporated into the design, any deviation is confirmed and agreed with the SQSS.
Hea		**TOTAL:**	**15**	**11**	**3**	**0**					
		% of total score:	**13.00%**	**9.53%**	**2.60%**	**0.00%**					

Credit Ref.	Credit Title	Credit Name	Credits Available	Credits Targeted	Potential Additional	Credits Achieved	Mandatory Elements	Responsibilities	RIBA Stage	Status	Comments / Actions
ENERGY 0.73% per credit											
Ene 01	**Reduction of Emissions**	Reduction of Emissions	12	10			Yes	Energy Consultant*	3		Minimum Standard: E-8; O-10 Opt 1: Energy Assessor to provide BRUKL for existing and designed scheme. Credits via IES Modelling Tool (up to 15 credits) Opt 2: calculate the energy score using the BREEAM Refurbishment and Fit-out energy model for the applicable assessment parts to determine the number of credits awarded. (up to 12 credits)
Ene 02	**Energy Monitoring**	Sub-Metering of Major Energy Consuming Systems	1	1			Yes	M&E Consultant*	3		**M&E Letter & Schedule** Energy metering of at least 90% of the estimated annual energy consumption of each fuel is assigned to the end-use categories. Metering in accordance with CIBSE TM39. Sweco to issue data collection tool.
		Sub-Metering of High Energy Load & Tenancy Areas	1	1				M&E Consultant*Contractor*	3		Sub-metering on a floor by floor basis and tenancy areas.
Ene 03	**External Lighting**	External Lighting	1	1				External lighting specialist*	4		**M&E Letter & Schedule** Average initial luminous efficacy of not less than 60 luminaire lumens per circuit Watt. Automatic control to prevent operation during daylight hours and presence detection in areas of intermittent pedestrian traffic. Sweco to issue data collection tool.
Ene 04	**Low Carbon Design**	Passive Design Analysis	1	1				M&E Consultant*	2		analysis of the existing building fabric, form, site location and outline scheme design at RIBA Stage 2 to identifies opportunities for the implementation of passive design solutions
		Free Cooling	1	0				M&E Consultant*	2		Produce a free cooling analysis considering Night time cooling, Ground coupled air cooling, Displacement ventilation, Ground water cooling, Surface water cooling, Evaporative cooling, direct or indirect, Desiccant dehumidification and evaporative cooling, using waste heat, Absorption cooling, using waste heat and the building is naturally ventilated.
		Low Zero Carbon Feasibility Study	1	1				M&E Consultant*	2		Low zero carbon feasibility study carried out at RIBA Stage 2 by and energy specialist to establish the most appropriate recognised local (on-site or near-site) low or zero carbon (LZC) energy source(s)
Ene 06	**Energy Efficient Transportation Systems**	Energy Consumption	1	1				Lift Specialist*	2		Lift analysis to determine transportation demand and usage patterns in compliance with BS EN ISO 25745 Part 2 and 3.
		Energy Efficient Features	2	2				Lift Specialist*Contractor*	2		Energy-efficient features offering the greatest potential energy savings will be part of the system i.e. a standby condition for off-peak periods.
Ene		**TOTAL:**	**21**	**18**	**0**	**0**					
		% of total score:	**15.37%**	**13.17%**	**0.00%**	**0.00%**					

Credit Ref.	Credit Title	Credit Name	Credits Available	Credits Targeted	Potential Additional	Credits Achieved	Mandatory Elements	Responsibilities	RIBA Stage	Status	Comments / Actions
TRANSPORT 0.85% per credit											
Tra 01	**Public Transport Accessibility**	Accessibility Index / Dedicated Bus Service	3	3		3		BREEAM AP*	2		Assesses availability of transport links & frequency (London sites usually score well).
Tra 02	**Proximity to Amenities**	Proximity to Local Amenities	1	1		1		BREEAM AP*	2		Assess and detail the number of amenities within 500m of the site.
Tra 03	**Cyclist Facilities**	Cycle Storage & Facilities	2	2		2		Architect*Transport Consultant*	4		Based on NIA and BREEAM default occupancy - determines the number of cycle spaces required. Specification and drawings of cycle stands & location is required. Showers, changing facilities, lockers or drying space to be provided.
Tra 05	**Travel Plan**	Travel Plan	1	1				Transport Consultant*	2		**Feedback provided - Final document to be provided** Travel Plan to be commissioned for the development clearly considering the impact onto the surrounding infrastructure etc.
Tra		**TOTAL:**	**7**	**7**	**0**	**6**					
		% of total score:	**5.93%**	**5.93%**	**0.00%**	**5.08%**					
WATER 0.85% per credit											
Wat 01	**Water Consumption**	Water Consumption	5	3	1		Yes	Architect*	3		**Minimum Standard: VG/E-1; O-2** The spec/manufacturers details confirming water fittings and their flush volumes & controls to be provided as evidence. i.e. Dual flush as a minimum.
Wat 02	**Water Monitoring**	Water Monitoring	1	1			Yes	M&E Consultant*	3		**M&E Letter & Schedule** **Minimum Standard: VG/E/O-Criterion 1 only - water meter on mains.** Meter on mains supply. Meters to water-consuming plant or building areas consuming 10% or more of the building's total water demand. Meters to have BMS connection.
Wat 03	**Water Leak Detection**	Leak Detection System	1	1				M&E Consultant*	4		**M&E Letter** To detect any major leaks within the buildings a leak detection via BMS with audible alarm.
		Flow Control Devices	1	1				M&E Consultant*	4		**M&E Clause** Sanitary supply shut-off valves specified to each toilet area.
Wat 04	**Water efficient equipment**	Large water consuming systems are designed to minimise unregulated consumption	1	1				Landscape Architect*	4		Mitigate 'unregulated water usage'. Where possible, avoid the need for irrigation systems through clever planting design.
Wat		**TOTAL:**	**9**	**7**	**1**	**0**					
		% of total score:	**7.63%**	**5.93%**	**0.85%**	**0.00%**					
MATERIALS 1.22% per credit											
Mat 01	**Life Cycle Impacts**	Life Cycle Impacts	6	6				Architect*Contractor*	3		Option 1: life cycle assessment (LCA) tool or undertakes a building information model life cycle assessment Option 2: environmental performance information has been collected for newly specified materials or where materials are retained in situ, for elements listed in CN7 and entered into the MAT 01 Calculator
Mat 03	**Responsible Sourcing of Materials**	Pre-requisite: Timber procurement details					Yes	Architect*Contractor*			**Letter of Commitment once contractor is appointed** **This is a minimum requirement for achieving any BREEAM rating.**
		Sustainable Procurement Plan	1	1				Contractor*	4		Contractor to produce a Sustainable Procurement Plan.
		Responsible Sourcing of Materials	3	1	1			Architect*Contractor*	3		Material should be specified with minimum levels of responsible sourcing certification for major material groups e.g. EMS Certification (ISO 14001 etc.) Since the information is not available for the materials
Mat 04	**Insulation**	Embodied Impact	1	1				Architect*Contractor*	4		All insulation provided within the building needs to be "Green Guide A rated" and sourced from EMS Certified Suppliers.
Mat 05	**Designing for Durability & Resilience**	Designing for Durability & Resilience	1	1				Design Team*	3		Protecting vulnerable parts of the building from damage and exposed parts of the building from material degradation
Mat 06	**Material Efficiency**	Material Efficiency	1	1				Design Team*	1-6		Set targets, opportunities and methods for optimise the use of materials (i.e. pre-fabrication, WRAP compliance etc.). Pre-fabrication & WRAP compliance to be shown in minutes of meetings and/or drawings mark-ups.
Mat		**TOTAL:**	**13**	**11**	**1**	**0**					
		% of total score:	**15.89%**	**13.45%**	**1.22%**	**0.00%**					

Credit Ref.	Credit Title	Credit Name	Credits Available	Credits Targeted	Potential Additional	Credits Achieved	Mandatory Elements	Responsibilities	RIBA Stage	Status	Comments / Actions
WASTE 0.79% per credit											
Wst 01	**Construction Waste Management**	Pre-refurbishment audit	1	1				Contractor*	4		pre-refurbishment audit of all existing buildings, structures or hard surfaces within the scope of the refurbishment or fit-out zone is completed) prior to strip-out or demolition works and by the end of RIBA Stage 2.
		Reuse and direct recycling of materials	2	2				Contractor*	4		Material detailed in Table 64 are either directly re-used on-site or off-site or are sent back to the manufacturer for closed loop recycling One credit - 50% of the total available points for the waste material types Two credits - 75% of the total available points for the waste material types
		Construction Resource Efficiency	3	2	1			Contractor*	4		**Letter of Commitment once contractor is appointed** Develop and implement a compliant resource management plan covering the waste arisings from the refurbishment or fit-out project with the aim of minimising waste. One credit: ≤ 3.5 tonnes construction waste generated per 100m² (gross internal floor area) 2 credits: ≤ 1.2 tonnes construction waste generated per 100m² (gross internal floor area)
		Diversion of Resources from Landfill	1	1				Contractor*	4		90% (tonnes) of demolition and 80% non-demolition waste to be diverted from landfill.
Wst 03	**Operational Waste**	Operational Waste	1	1			Yes	Architect*Contractor*	3		**Letter of commitment** Waste and servicing strategy is required for the project - typically provided as part of the planning application process. Provision of space for general waste, recycling and organic waste to be provided in accordance with the findings of this report.
Wst 04	**Speculative Floor and Ceiling Finishes**	Speculative Floor and Ceiling Finishes	1	1		1		Client*	3		Client has provided a letter confirming that no interior finishes will be installed. Site photos are required at the later stages
Wst 05	**Adaptation to Climate Change**	Adaptation to Climate Change - Structural & Fabric Resilience	1	1				Design Team*	2		Conduct a climate change adaptation strategy of new & existing fabric and it's durability to deal with extremes in weather condition. Develop recommendations/ solutions at RIBA Stage 2.
Wst 06	**Functional Adaptability**	Functional Adaptability	1	1				Design Team*	2		Conduct study by the end of RIBA Stage 2 and develop recommendations prior to RIBA Stage 2. (i.e. alternative building uses, functions, major plant replacement, ventilation strategy to adapt to future building occupant needs, adaptability to changes of in-use etc). Confirm these have been picked up at Stage 4. . Omissions have been justified in writing to the assessor.
Wst		**TOTAL:**	**11**	**10**	**1**	**1**					
		% of total score:	**8.74%**	**7.95%**	**0.79%**	**0.79%**					

LAND USE & ECOLOGY 2.54% per credit											
LE 04	**Enhancing Site Ecology**	Ecologist's Report & Recommendations	1	1				Ecologist*	2		Ecologist (SQE) appointed at RIBA Stage 1 to advise on enhancing the ecology. Ecology Report based on a site visit/survey produced at RIBA Stage 2 has appropriate recommendations for the enhancement of the site's ecology. Recommendations of the Ecology Report for the enhancement of site ecology have been, or will be, implemented in the refurbishment or fit-out.
LE 05	**Long Term Impact on Biodiversity**	Long Term Impact on Biodiversity	2	2				Ecologist*Contractor*	2		EU and UK legislation to be adhere to. 5-year landscape and habitat management plan will be produced. A number of additional measures to improve the assessed site's long term biodiversity are adopted.
LE		**TOTAL:**	**3**	**3**	**0**	**0**					
		% of total score:	**7.63%**	**7.63%**	**0.00%**	**0.00%**					

Credit Ref.	Credit Title	Credit Name	Credits Available	Credits Targeted	Potential Additional	Credits Achieved	Mandatory Elements	Responsibilities	RIBA Stage	Status	Comments / Actions
POLLUTION 0.98% per credit											
Pol 01	**Impact of Refrigerants**	Pre-Requisite: systems with electric compressors					Yes	M&E Consultant*			All systems (with electric compressors) must comply with the requirements of BS EN 378:2008.
		Impact of Refrigerants	2	1	1			M&E Consultant*	4		2 Credits: Refrigerant's Direct Effect Life Cycle CO2 equivalent emissions (DELC CO2e) of ≤ 100 kgCO2e/kW cooling/heating capacity. OR Where air-conditioning or refrigeration systems are installed the refrigerants used have a Global Warming Potential (GWP) ≤ 10 1 Credits: Refrigerant's Direct Effect Life Cycle CO2 equivalent emissions (DELC CO2e) of ≤ 1000 kgCO2e/kW cooling/heating capacity.
		Leak Detection	1	1				M&E Consultant*	4		Permanent automated refrigerant leak detection system installed; OR where an inbuilt automated diagnostic procedure for detecting leakage is installed. In all instances a robust and tested refrigerant leak detection system must be installed and must be capable of continuously monitoring for leak. automatically isolating and containing the remaining refrigerant(s) charge in response to a leak detection incident
Pol 02	**NOx Emissions**	NOx Emissions	3	0				M&E Consultant*	4		1 Credit: ≤ 100 mg/kWh 2 Credits: ≤ 70 mg/kWh 3 Credits: ≤ 40 mg/kWh
Pol 03	**Surface Water Run Off**	Flood Resilience	2	2				Flood Risk Consultant*	3		FRA confirms the probability of flooding form all sources
		Neutral Impact on Surface Water and Reducing Run Off	2	2				Flood Risk Consultant*	3		Appropriate consultant designs SUDS strategy. There is no increase in the impermeable surfaces as a result of the refurbishment works, where and increase on-site SuDS to allow full infiltration of the additional volume
		Minimising Water Course Pollution	1	0				Flood Risk Consultant*	3		Requirement for no discharge from the developed site for rainfall up to 5 mm is tough to achieve
Pol 04	**Reduction of Night Time Light Pollution**	Reduction of Night Time Light Pollution	1	1				M&E Consultant*Contractor*	4		M&E Clause External Lighting Levels noted in elemneta MEP scope p.16 but some issued raised (internal lighting: SLL code compliance & External: permeant illuminated areas) in HEA01 to confirm ILP guidance.
Pol 05	**Reduction of Noise Pollution**	Reduction of Noise Pollution	1	1				Acoustician*	3		Where noise-sensitive areas or buildings within 800m radius of the site, a noise impact assessment in compliance with BS 74451 must be carried out. Noise levels must no greater than +5dB during the day (07:00 to 23:00) and +3dB at night (23:00 to 07:00) compared to the background noise level. Where this is not the case attenuation measures should be installed.
Pol			**13**	**8**	**1**	**0**					
		% of total score:	**12.72%**	**7.83%**	**0.98%**	**0.00%**					

INNOVATION 1.00% per credit											
Inn 01	**Man 03**	Considerate Construction	1	1				Contractor*	4		With reference to the considerate construction criterion 7, in addition to meeting the criteria for two credits, the contractor achieves compliance with the criteria of the compliant scheme to an exemplary level of practice. A Score of 40+ with 7 in each section
Inn		**TOTAL:**	**10**	**1**	**0**	**0**					
		% of total score:	**10.00%**	**1.00%**	**0.00%**	**0.00%**					