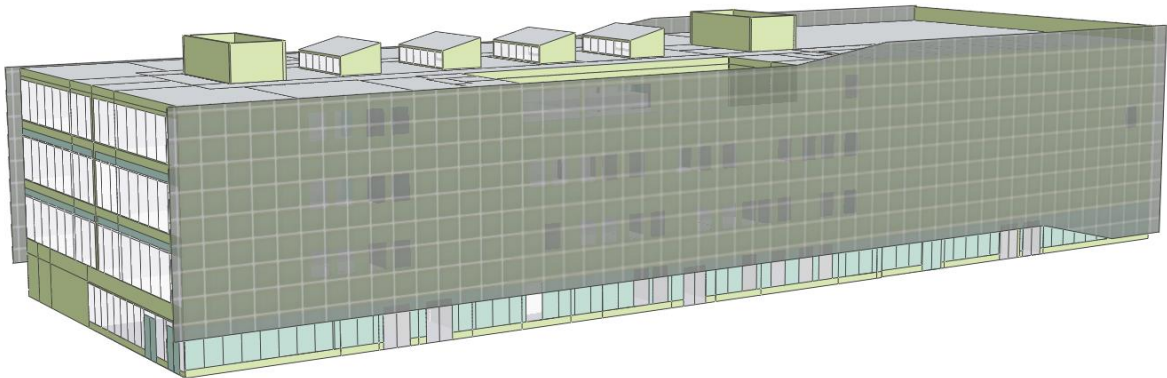


Global Academy UTC

THE OLD VINYL FACTORY,
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April 2015

Energy Strategy Report

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Executive Summary

Planning permission is being sought to construct a new University Technical College (UTC) on the 'Picturehouse' site within the wider master-planned regeneration area of The Old Vinyl Factory area.

The UTC is sponsored by Global Radio ('Global') working in conjunction with its University partner, the University of the Arts London, and will specialise in offering up to 800 14-19 year olds the vocational skills to work in the broadcast and media industry. UTCs are a relatively new concept in secondary school provision and provide students with the opportunity to take a full-time, technically orientated course of study alongside the core academic subjects of English, Mathematics, Science and ICT. The UTC is being procured by the Education Funding Agency (EFA) and under a standard framework agreement.

The Construction is of a proposed of a 4-storey largely modular building (arranged over ground and three upper floors).

The design team have considered all the available options and opportunities associated with the scheme and site constraints and believe they have a robust approach which will meet the planning conditions and the London Plan requirements delivering a 35% reduction in regulated carbon emissions [tonnes /annum] based on a ADL2A 2013 baseline model approach.

The design will incorporate the following with a fabric first approach:

- Improved U Values
- Design to Maximise Natural Daylight
- LED Lighting
- Mixed Mode ventilation
- Demand controlled Ventilation
- Mitigate the need for High Capacity Cooling Systems
- High efficiency Heat pumps
- Connection into a District Heating Network

The following Extract shows the Baseline, and savings for the Hierarchy actions to be implemented:



Technical data and Supporting BRUKL documents are included in the Appendix sections.

The carbon factor of the private district heating plant is unknown and the team are led to believe that the displaced electrical energy may be allocated to third parties. In this case the team feel that the resulting carbon factor used in the analysis should be based on the SAP 2012, 3 year average detailed in Appendix F and based on Natural gas value of 0.212 kgCO₂/kWh.

The following table details the overall Carbon Target and reduction for the Baseline and H1 to H3 analysis reported in Table 1 and Table 2 formats.

Table 1.0 Carbon Dioxide Emissions after each stage of the energy Hierarchy

	Carbon Dioxide emissions [Tonnes CO ₂ per annum]	
	Regulated	Unregulated
Baseline: Part L 2013 of the building Regulations Compliant Development	156.56	
After energy Demand reduction	102.80	
After CHP	101.46	
After renewable energy	98.10	

Table 2.0 Regulated Carbon Dioxide Emissions after each stage of the energy Hierarchy

	Regulated Carbon Dioxide Savings	
	[Tonnes CO2 per annum]	[%]
Savings from Energy Demand reduction	54	34.33%
Savings from CHP	1	0.86%
Savings from Renewable energy	3	2.15%
Total Cumulative Savings	58	37.34%
Total Target savings	55	35.00%
Annual Surplus	4	

The estimated savings anticipated from implementing this energy strategy on the baseline 2013 energy demand for the development can be seen in table 1 and 2 above. It is anticipated that these measures in combination would achieve a 37.34%, 58 tonnes of Carbon reduction in emissions compared to the baseline analysis with the use of renewable technologies and Private District heating network.

As requested within the London plan the cooling demand of the combined analysis is detailed below with clarity as to why the actual cooling demand exceeds the Notional building.

	Cooling Demand [MJ/m2]
Actual	1408.2
Notional	1132.8

The detailed analysis and consideration of offsite modular design and practical implications of physical size and structure as well as the need to provide meet the TM52 comfort criterion with these physical constraints is the primary reason for the cooling demands variance.

The team are committed to further investigate this design issue and solar performance of glazing and high performance blinds are to be further investigated.

1.0 Introduction

A number of regional and local policies exist which promote energy efficiency and the use of renewable technologies where appropriate.

The London Plan contains policies which set the following targets for new development within the London boroughs:

All development proposals should take the most appropriate action to minimising carbon emissions in accordance with the energy hierarchy: Be Lean- Be Clean- Be Green as well as consider the need to reduce cooling demand and asses impact of overheating.

The energy assessment is structured around the Energy Hierarchy which is generally accepted as the most effective way of reducing building carbon emissions. The three stage strategy targets energy use by consideration of the following actions:

Be Lean	Energy demand Reduction
Be Clean	Consideration of heating infrastructure including CHP
Be Green	Supply energy from renewable sources

The approach detailed in this document is based on and around the CIBSE methodology for Energy reports and follows 4 primary steps

Step 1	Identifying the Targets
Step 2	Assessing the Baseline
Step 3	Applying energy efficiency
Step 4	Applicability of Renewable and LZC's

2.0 Identifying the Targets

The scheme is a new build teaching facility with Part Modular building design.

The scheme and the target has been assessed based around applying the energy hierarchy in relation to Part L2A of the 2013 building regulations to the new build areas generally in accordance with the London Plan and the setting of a baseline energy target based around the existing building fabric and services.

The London Plan Target for 2013 to 2016 new build schemes is 35% beyond Part L2A 2013.

This is the target adopted in this report and used as the basis of comparison.

The planning conditions is as detailed below and uses the 35% improvements over ADL2A 2013. The 2013 notional building performance has been selected to set the Target Value as detailed below.

Element	Side lit or unlit (where HVAC specification is heating only)	Side lit or unlit (where HVAC specification includes cooling)
Roof U-value (W/m ² .K)	0.18	0.18
Wall U-value (W/m ² .K)	0.26	0.26
Floor U-value (W/m ² .K)	0.22	0.22
Window U-value (W/m ² .K)	1.6 (10% FF)	1.6 (10% FF)
G-Value (%)	40%	40%
Light Transmittance (%)	71%	71%
Roof light U-value (W/m ² .K)	N/A	N/A
G-Value (%)	N/A	N/A
Light Transmittance (%)	N/A	N/A
Air-permeability (m ³ /m ² /hour) Gross Internal Area less than or equal to 250m ²	5	5
Air-permeability (m ³ /m ² /hour) Gross Internal Area greater than 250m ² and less than 3,500m ²	3	3
Air-permeability (m ³ /m ² /hour) Gross Internal Area greater than or equal to 3,500m ² and less than 10,000m ²	3	3
Air-permeability (m ³ /m ² /hour) Gross Internal Area greater than or equal to 10,000m ²	3	3
Lighting Luminaire (lm / circuit watt)	60	60
Occupancy control (Yes/No)	Yes	Yes
Daylight control (Yes/No)	Yes	Yes
Maintenance Factor	0.8	0.8
Constant illuminance control	No	No
Heating efficiency (Heating and hot water)	91%	91%
Central Ventilation SFP (W/L/s)	1.8	1.8
Terminal Unit SFP (W/L/s)	0.3	0.3
Cooling (air-conditioned) (SEER / SSEE)	N/A	4.5 / 3.6
Cooling (mixed mode) (SSEER) ¹	N/A	2.7
Heat recovery efficiency (%)	70%	70%
Variable speed control of fans and pumps, controlled via multiple sensors	Yes	Yes
Demand control (mechanical ventilation only). Variable speed control of fans via CO ₂ sensors	Yes	Yes

Fig 1: ADL2A 2013 extract

3.0 Assessing Baseline Emissions

Using DSM modelling baseline energy consumption for the proposed development using the existing fabric and Services specification has been assessed using a primary DSM model [Baseline] taking account baseline data, results are as follows with the supporting BRUKL in Appendix A

Performance	BER	23.3	kgCO2/m2
	Model Floor Area	6719.1	m2
	Regulated Energy	59.66	Kwh/m2
	Total Energy	83.82	Kwh/m2
	Total Carbon	156.56	TCO2

Table 3: Baseline Emissions

Building Regulations take account of energy used to heat, cool, light, provide hot water and ventilate the building. This is detailed as the 'regulated' energy use. Unregulated Small power (other equipment etc.) is not considered within these figures. London Borough of Hillingdon does not require inclusion of these 'unregulated' energy loads in the calculation of energy consumption and associated emissions.

The baseline emissions are based on the building specification before the application of energy efficiency measures. The following assumptions have been made in the calculations and generally based on the notional building performance:

Drawings Provided	Ground floor Plan	Planning	
	First Floor Plan	Planning	
	Second Floor Plan	Planning	
	Third Floor Plan	Planning	
	Sections	Planning	
	Elevations	Planning	
New Build U Values	Walls	0.26	W/m2K
	Ground Floor	0.22	W/m2K
	Exposed Floor	0.22	W/m2K
	Windows and roof Lights	1.6	W/m2K
	Roof	0.18	W/m2K
Building Type	Modular Building		
Air Permeability	New Build	3.00	m3/hr/m2 @ 50Pa
Renewable	New Build	None	
Power Factor Correction	Not Installed	< 0.9	
Heating [ECA List]	Natural Gas	0.91	
Heat Recovery Eff	AHU and FCU	0.7	
Cooling	Air Cooled [ECA List]	4.5	SEER
	Air Cooled [ECA List]	3.125	EER
Lighting	Lighting Metering	Yes	
	Out of Range Values	No	
	Lamp Type	60 lm/cW	
	Control	PC and PIR	

Table 4: Baseline Building input Data

The baseline emissions are based on the Services specification before application of energy efficiency measures. The following assumptions have been made in the calculations and generally based generally on the notional building services performance:

HVAC System Details	HVAC system name	BL01 LTHW Radiators	BL02 LTHW Radiators Local Extract
	NCM System Type	Central Heating using water : radiators	Fan coil systems
Heating	Heat source	LTHW Boiler	LTHW Boiler
	Fuel	Natural Gas	Natural Gas
	Qualify for ECAs?	Yes	Yes
	Inst. On or after 1998?	Yes	Yes
	Does system use CHP?	No	No
	Heat Gen. SEER	0.91	0.91
Cooling	Pack chiller type	-	-
	Pack chiller power	-	-
	Chiller fuel type	-	-
	Qualify for ECAs?	-	-
	SEER	-	-
	EER	-	-
System adjustment	Mixed Mode	Not a CMM system	Not a CMM system
	Heat rejection (Pump and Fan Power %)	-	-
	Ductwork Leakage tested	-	Class worse than A ₁ or not tested
	AHU Leakage Tested	-	Class worse than L3, or not Compliant
	SFP (W/I/S)	-	1.10
	Variable speed pumps	variable speed differential sensor across pump	variable speed differential sensor across pump
Metering Provision	Met.	Yes	Yes
	Alarm for out of range	No	No
Ventilation	Cooling/vent Mechanism	Natural Ventilation	Mechanical Ventilation
	Air supply mechanism	-	Zonal extract with remote fan
	Heat recovery method	-	-
	Variable Heat recovery efficiency	-	-
	Heat recovery efficiency	-	-
	Demand Control Ventilation	-	-
System Controls (EPC only)	Central Time Control	Yes	Yes
	Optimum start/stop control	Yes	Yes
	Local time control	No	No
	Local temp control	Yes	Yes
	Weather Comp control	Yes	Yes
	Heat source	-	-
Bivalent systems	Fuel	-	-
	Gen Seff	-	-
	% load	-	-
	% load	-	-
HVAC System Details	HVAC system name	BL03 LTHW_CHW FCU	BL05 LTHW_CHW Central AHU
	NCM System Type	Fan coil systems	Fan coil systems
Heating	Heat source	LTHW Boiler	LTHW Boiler
	Fuel	Natural Gas	Natural Gas
	Qualify for ECAs?	Yes	No
	Inst. On or after 1998?	Yes	No
	Does system use CHP?	No	No
	Heat Gen. SEER	0.91	0.91
Cooling	Pack chiller type	Air Cooled	Air Cooled
	Pack chiller power	101 - 500 kW	101 - 500 kW
	Chiller fuel type	Grid supplied electricity	Grid supplied electricity
	Qualify for ECAs?	Yes	Yes
	SEER	4.50	4.50
	EER	3.125	3.125
System adjustment	Mixed Mode	Not a CMM system	Not a CMM system
	Heat rejection (Pump and Fan Power %)	-	-
	Ductwork Leakage tested	Class worse than A ₁ or not tested	Class worse than A ₁ or not tested
	AHU Leakage Tested	Class worse than L3, or not Compliant	Class worse than L3, or not Compliant
	SFP (W/I/S)	1.8 and 0.3 [terminal unit]	1.80
	Variable speed pumps	variable speed differential sensor across pump	variable speed differential sensor across pump
Metering Provision	Met.	Yes	Yes
	Alarm for out of range	No	No
Ventilation	Cooling/vent Mechanism	Air Conditioning	Air Conditioning
	Air supply mechanism	Central balanced A/C or mech vent system	Central balanced A/C or mech vent system
	Heat recovery method	plate heat exchanger	plate heat exchanger
	Variable Heat recovery efficiency	No	No
	Heat recovery efficiency	0.7	0.7
	Demand Control Ventilation	Yes	Yes
System Controls (EPC only)	Central Time Control	Yes	Yes
	Optimum start/stop control	Yes	Yes
	Local time control	No	No
	Local temp control	Yes	Yes
	Weather Comp control	Yes	Yes
	Heat source	-	-
Bivalent systems	Fuel	-	-
	Gen Seff	-	-
	% load	-	-
	% load	-	-

Table 5: Baseline Building Services input Data

The following details the Baseline analysis full summary table:

		Baseline rev 3 ADL2A Notional Building [2013]	
Summary			
Drawings Provided	Ground floor Plan	Planning	
	First Floor Plan	Planning	
	Second Floor Plan	Planning	
	Third Floor	Planning	
	Sections	Planning	
	Elevations	Planning	
New Build U Values	Walls	0.26	W/m2K
	Ground Floor	0.22	W/m2K
	Exposed Floor	0.22	W/m2K
	Windows	1.6	W/m2K
	Roof	0.18	W/m2K
Building Type		Modular	
Air Permeability	New Build	3	m3/hr/m2 @ 50Pa
	Renewable	None	
Power Factor Correction	Not Installed	< 0.9	
Lighting	Lighting Metering	Yes	
	Out of Range Values	No	
	Lamp Type	T5 Inference Lamp Type	
	Luminarie Efficacy	60 lI/cW	
	Control	PIR and Daylight Control	
Performance	BER	23.3	kgCO2/m2
	Model Floor Area	6719.1	m2
	Regulated Energy	59.66	Kwh/m2
	Total Energy	83.82	Kwh/m2
	Total Carbon	156.56	TCO2

Table 6: Baseline summary

The Base line analysis sets a baseline Carbon emission based on the data used of 156.56 tonnes of carbon.

	Carbon Dioxide emissions [Tonnes CO2 per annum]	
	Regulated	Unregulated
Baseline: Part L 2013 of the building Regulations Compliant Development	156.56	

4.0 Demand Reduction [Be lean]

4.1 Passive Measures

A number of passive design measures have been considered and where applicable incorporated into the proposed scheme in order to reduce total energy demand.

The proposed development is new modular building design on an urban site in central London. There is very little opportunity to orientate the building to benefit from passive solar design as the site is restricted by adjacent buildings and physical constraints.

The internal layout has been designed to maximise the use of natural light and borrowed light between spaces and the central Atrium.

A natural ventilation strategy has been provided but its proximity to the adjacent roads means the use of natural ventilation can't be relied upon without impacting on the use of spaces and alternate ventilation systems are required. However, natural ventilation has been incorporated and user guide and training will explain and show the occupiers the best use of natural ventilation to reduce dependence on Mechanical ventilation and cooling systems.

User controlled blinds will be provided to all windows serving occupied spaces to control glare and reduce overheating. However, the external perforated screening will provide building generated shade and the design of the screen shall be developed to maximise natural light to the spaces that will benefit from natural light without impacting on the internal intended uses.

All external building elements; floors, walls, roof and openings, are proposed to be upgraded where possible and financially viable above the notional U Values detailed in Table 2 beyond those required by Part L. New glazing Units (improved solar g values to solar exposed windows where necessary) will reduce the energy required to heat the building during the heating season while also reducing overheating in the summer and therefore reducing cooling loads.

Building air tightness has been reviewed by the team and the designers feel a target air permeability rate of 5.0 m³/(h.m²) at 50Pa for the new build areas shall be achieved if not reduced further during detailed design and building junction detailing.

4.2 Active Measures

The new and existing building and communal areas will all be fitted with a low energy, lighting scheme. Lighting to communal spaces, circulation and stairwells will include adequate controls to maximise efficiency sensing, proximity control or timed control, whichever proves most suitable to a given area shall be reviewed and considered.

The proposed HVAC system will utilise highly efficient systems to provide space heating. The system will be fully controlled by a Building Management System (BMS) to maximise efficiency and ensure adequate levels of environmental control to

provide thermal comfort to building occupiers. Local control within the teaching spaces will be possible within limits set by the BMS.

Because of the proposed activities within the project emitting high casual loads and to meet the comfort requirements of the users cooling will be required and the team have considered that the most effective systems will be the incorporation of Air sourced heat pumps and heat recovery systems that shall allow heat and coolth to be recovered reducing the energy demands of the systems and that will also facilitate free cooling when possible.

Occupant presence and CO2 controls shall be incorporated into the design so systems operate in low speed and or off when spaces are unoccupied and systems shall have a night purge capability to maximise free cooling opportunities.

HVAC System Details	HVAC system name	Hierarchy 1	Hierarchy 1
		01 VRF Ducted Units	02 VRF HRU Ducted Units
Heating	NCM System Type	Split or multi-split system	Split or multi-split system
	Heat source	Heat pump [Electric]: air source	Heat pump [Electric]: air source
	Fuel	Grid supplied electricity	Grid supplied electricity
	Qualify for ECAs?	-	-
	Inst. On or after 1998?	Yes	Yes
	Does system use CHP?	No	No
	Heat Gen. SEER	4.00	4.00
Cooling	Pack chiller type	Heat pump [Electric]	Heat pump [Electric]
	Pack chiller power	Upto 100kW	Upto 100kW
	Chiller fuel type	Grid supplied electricity	Grid supplied electricity
	Qualify for ECAs?	Yes	Yes
	SEER	5.00	5.00
	EER	3.13	3.13
	Mixed Mode	Mechanical Ventilation	Mechanical Ventilation
System adjustment	Heat rejection [Pump and Fan Power %]		
	Ductwork Leakage tested	Class A	Class A
	AHU Leakage Tested	Class L3	Class L3
	SFP (W/I/S)	1.6 and 0.3 terminal SFP [CO2 Speed Control]	1.6 and 0.3 terminal SFP [CO2 Speed Control]
Metering Provision	Variable speed pumps	-	-
	Met.	Yes	Yes
	Alarm for out of range	Yes	Yes
Ventilation	Cooling/vent Mechanism	Air Conditioning	Air Conditioning
	Air supply mechanism	Local ventilation units	Local ventilation units
	Heat recovery method	plate heat exchanger	plate heat exchanger
	Variable Heat recovery efficiency	No	No
	Heat recovery efficiency	0.77	0.77
	Demand Control Ventilation	Yes	Yes
System Controls (EPC only)	Central Time Control	Yes	Yes
	Optimum start/stop control	Yes	Yes
	Local time control	Yes	Yes
	Local temp control	Yes	Yes
	Weather Comp control	No	No
Bivalent systems	Heat source	-	-
	Fuel	-	-
	Gen Seff		
	% load		

Table 7: Hierarchy 1 Building services improvements HVAC

HVAC System Details	HVAC system name	Hierarchy 1	Hierarchy 1
		03 LTHW Radiators Nat Vent	04 LTHW Radiant Panels Nat Vent
	NCM System Type	Central Heating using water : radiators	Central Heating using water : radiators
Heating	Heat source	LTHW Boiler	LTHW Boiler
	Fuel	Natural Gas	Natural Gas
	Qualify for ECAs?	Yes	Yes
	Inst. On or after 1998?	Yes	Yes
	Does system use CHP?	No	No
	Heat Gen. SEER	0.96	0.96
Cooling	Pack chiller type	-	-
	Pack chiller power	-	-
	Chiller fuel type	-	-
	Qualify for ECAs?	-	-
	SEER		
	EER		
	Mixed Mode	-	-
	Heat rejection [Pump and Fan Power %]		
System adjustment	Ductwork Leakage tested	-	-
	AHU Leakage Tested	-	-
	SFP (W/I/S)		
	Variable speed pumps	variable speed differential sensor across pump	variable speed differential sensor across pump
Metering Provision	Met.	Yes	Yes
	Alarm for out of range	Yes	Yes
Ventilation	Cooling/vent Mechanism	Natural Ventilation	Natural Ventilation
	Air supply mechanism	-	-
	Heat recovery method	-	-
	Variable Heat recovery efficiency	-	-
	Heat recovery efficiency		
	Demand Control Ventilation		
System Controls (EPC only)	Central Time Control	Yes	Yes
	Optimum start/stop control	Yes	Yes
	Local time control	No	No
	Local temp control	Yes	Yes
	Weather Comp control	Yes	Yes
Bivalent systems	Heat source	-	-
	Fuel	-	-
	Gen Seff		
	% load		

Table 8: Hierarchy 1 Building services improvements HVAC [cont]

HVAC System Details	HVAC system name	Hierarchy 1	Hierarchy 1
		05 LTHW Radiant Panels Local Extract	06 LTHW UFH Natural vent
	NCM System Type	Central Heating using water : radiators	Central Heating using water : Floor Heating
Heating	Heat source	LTHW Boiler	LTHW Boiler
	Fuel	Natural Gas	Natural Gas
	Qualify for ECAs?	Yes	Yes
	Inst. On or after 1998?	Yes	Yes
	Does system use CHP?	No	No
	Heat Gen. SEER	0.96	0.96
Cooling	Pack chiller type	-	
	Pack chiller power	-	
	Chiller fuel type	-	
	Qualify for ECAs?	-	
	SEER		
	EER		
	Mixed Mode	-	
	Heat rejection [Pump and Fan Power %]		
System adjustment	Ductwork Leakage tested	-	
	AHU Leakage Tested	-	
	SFP (W/I/S)	0.4 [Enhanced Control]	
	Variable speed pumps	variable speed differential sensor across pump	variable speed differential sensor across pump
Metering Provision	Met.	Yes	Yes
	Alarm for out of range	Yes	Yes
Ventilation	Cooling/vent Mechanism	Mechanical Ventilation	Natural Ventilation
	Air supply mechanism	Zonal extract with remote fan	-
	Heat recovery method	-	-
	Variable Heat recovery efficiency	-	-
	Heat recovery efficiency		
	Demand Control Ventilation	Yes	
System Controls (EPC only)	Central Time Control	Yes	Yes
	Optimum start/stop control	Yes	Yes
	Local time control	No	No
	Local temp control	Yes	Yes
	Weather Comp control	Yes	Yes
Bivalent systems	Heat source	-	
	Fuel	-	
	Gen Seff		
	% load		

Table 9: Hierarchy 1 Building services improvements HVAC [cont]

HVAC System Details	HVAC system name	Hierarchy 1	Hierarchy 1
		07 Comms Room	08 Packaged AHU
Heating	NCM System Type	Split or multi-split system	Single-duct VAV
	Heat source	Heat pump [Electric]: air source	Heat pump [Electric]: air source
	Fuel	Grid supplied electricity	Grid supplied electricity
	Qualify for ECAs?		No
	Inst. On or after 1998?	Yes	Yes
	Does system use CHP?	No	No
	Heat Gen. SEER	4.00	4.00
Cooling	Pack chiller type	Heat pump [Electric]	Heat pump [Electric]
	Pack chiller power	Upto 100kW	Upto 100kW
	Chiller fuel type	Grid supplied electricity	Grid supplied electricity
	Qualify for ECAs?	Yes	Yes
	SEER	3.50	5.00
	EER	3.13	3.13
	Mixed Mode	Not a CMM system	Mechanical Ventilation
System adjustment	Heat rejection [Pump and Fan Power %]		
	Ductwork Leakage tested	-	Class A
	AHU Leakage Tested	-	Class L3
	SFP (W/l/S)		1.6
Metering Provision	Variable speed pumps	-	-
	Met.	Yes	Yes
Ventilation	Alarm for out of range	Yes	Yes
	Cooling/vent Mechanism	Air Conditioning	Air Conditioning
	Air supply mechanism		Central balanced A/C or mech vent system
	Heat recovery method		Thermal Wheel
	Variable Heat recovery efficiency		Yes
	Heat recovery efficiency		0.77
	Demand Control Ventilation		Yes
System Controls (EPC only)	Central Time Control	No	Yes
	Optimum start/stop control	No	Yes
	Local time control	Yes	Yes
	Local temp control	Yes	Yes
	Weather Comp control	No	No
Bivalent systems	Heat source		-
	Fuel		-
	Gen Seff		
	% load		

Table 10: Hierarchy 1 Building services improvements HVAC [cont]

System Details	system name	System DHW01 Baseline New Build	System DHW02 Baseline Existing	Hierarchy 1	Hierarchy 2
				System DHW03 Proposed	System DHW03 Proposed
Domestic Hot Water	DHW Delivery Efficiency	1 [0.89]	0.8	1	1
	Generator Type	Same as Heating System	Same as Heating System	Same as Heating System	Same as Heating System
	Fuel Type	Gas	Gas	Gas	District heating
	Does the system have storage?	Yes	Yes	Yes	Yes
	Storage Volume (litres)	2000	1500	2000	2000
	Storage Losses (kWh/l day)	0.075	0.1	0.0045	0.0045
	Does the system have secondary circulation?	Yes	Yes	Yes	Yes
	Circulation Losses (W/m)	12.5	16	5	5
	Pump Power (kW)	0.1	0.1	0.1	0.1
	Loop Length (m)	400	400	400	400
	Time Switch?	Yes	No	Yes	Yes
	Does the system Use CHP	No	No	No	No
	Predicted CHP running Hours	0	0	0	0
Solar Water Heating		None	None	None	None
Solar Water Heating		None	None	None	None

Table 11: Hierarchy 1 Building services improvements DHWS

A second DSM model has been created [H1] taking account of passive and active improvements to establish the emission reductions possible through these actions. The results and input data are shown in the following tables.

The results and details of the H1 DSM modelling analysis are as follows:

	Carbon Dioxide emissions [Tonnes CO2 per annum]	
	Regulated	Unregulated
Baseline: Part L 2013 of the building Regulations Compliant Development	156.56	
After energy Demand reduction	102.80	
	Regulated Carbon Dioxide Savings	
	[Tonnes CO2 per annum]	[%]
Savings from Energy Demand reduction	54	34.33%

Table 12: Hierarchy 1 Emissions

		Baseline rev 3 ADL2A Notional Building [2013]		Hierarchy 1 rev 3 Be Lean Reduce the Need for Energy	
Summary					
Drawings Provided	Ground floor Plan	Planning		Planning	
	First Floor Plan	Planning		Planning	
	Second Floor Plan	Planning		Planning	
	Third Floor	Planning		Planning	
	Sections	Planning		Planning	
	Elevations	Planning		Planning	
New Build U Values	Walls	0.26	W/m2K	0.24	
	Ground Floor	0.22	W/m2K	0.20	
	Exposed Floor	0.22	W/m2K	0.21	
	Windows	1.6	W/m2K	1.6 [1.2 Punch windows]	
	Roof	0.18	W/m2K	0.14	
	Building Type		Modular		Modular
Air Permeability	New Build	3	m3/hr/m2 @ 50Pa	5	
	Renewable	None		None	
Power Factor Correction		Not Installed	< 0.9	>0.95	
Lighting	Lighting Metering	Yes		Yes	
	Out of Range Values	No		No	
	Lamp Type	T5 Inference Lamp Type		T5 Inference Lamp Type	
	Luminarie Efficacy	60 lI/cW		65 lI/cW	
	Control	PIR and Daylight Control		PIR and Daylight Control H2 Services Upgrade	
Performance	BER	23.3	kgCO2/m2	15.3	
	Model Floor Area	6719.1	m2	6719.1	
	Regulated Energy	59.66	Kwh/m2	35.02	
	Total Energy	83.82	Kwh/m2	59.18	
	Total Carbon	156.56	TCO2	102.80	

Table 13: Hierarchy 1 Building improvements

It can be seen from the analysis the H1 [Be Lean] actions provide a 34.33% improvements over the baseline DSM compliance results.

This equates to a reduction in carbon emissions of 54 tonnes of Carbon.

The H1 supporting BRUKL output is provided ion Appendix B for Information.

5.0 Heating Infrastructure [Be Clean]

A Third DSM model has been created [H2] taking account of passive and active improvements to establish the emission reductions possible through these actions. The results and input data are shown in the following tables.

5.1 Decentralised energy

Planning guidance and the London Plan and ADL2A requests that all developments investigate the feasibility of

- Connecting to an existing or planned decentralised energy scheme.
- Installing combined heat on power (CHP) or combined cooling, heat and power (CCHP).
- Designing in the flexibility to connect to any future decentralised energy network.

District heating networks are considered to provide more efficient energy delivery as network losses are often considerably less than conventional energy supplies.

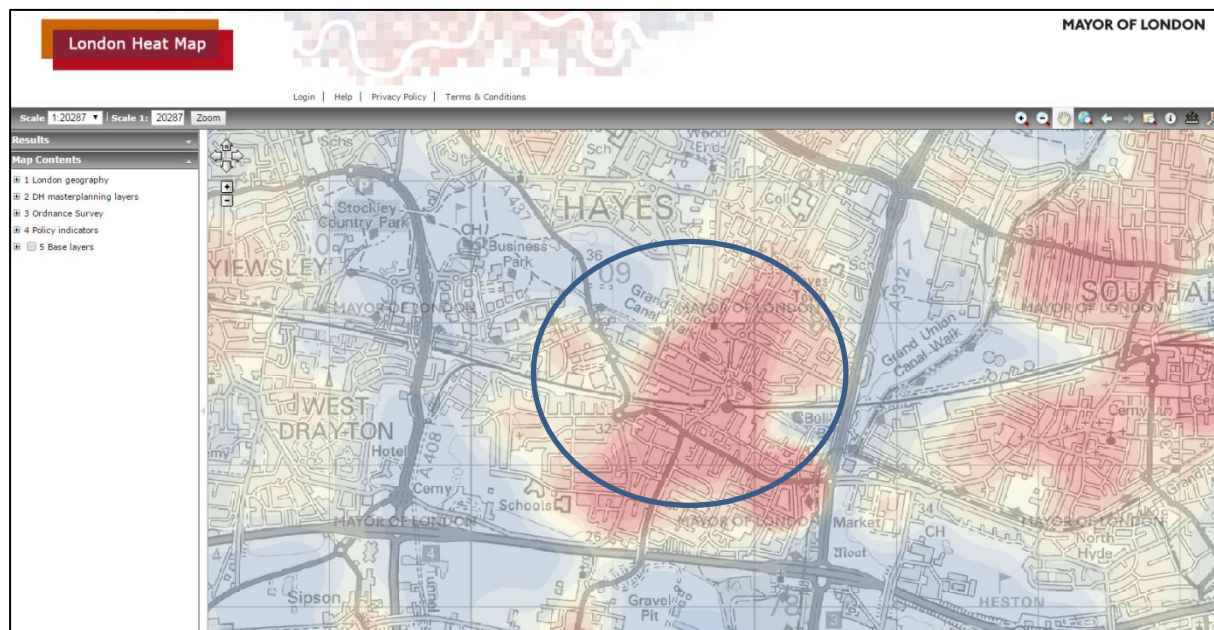


Figure 2: Extract from London Heat Map

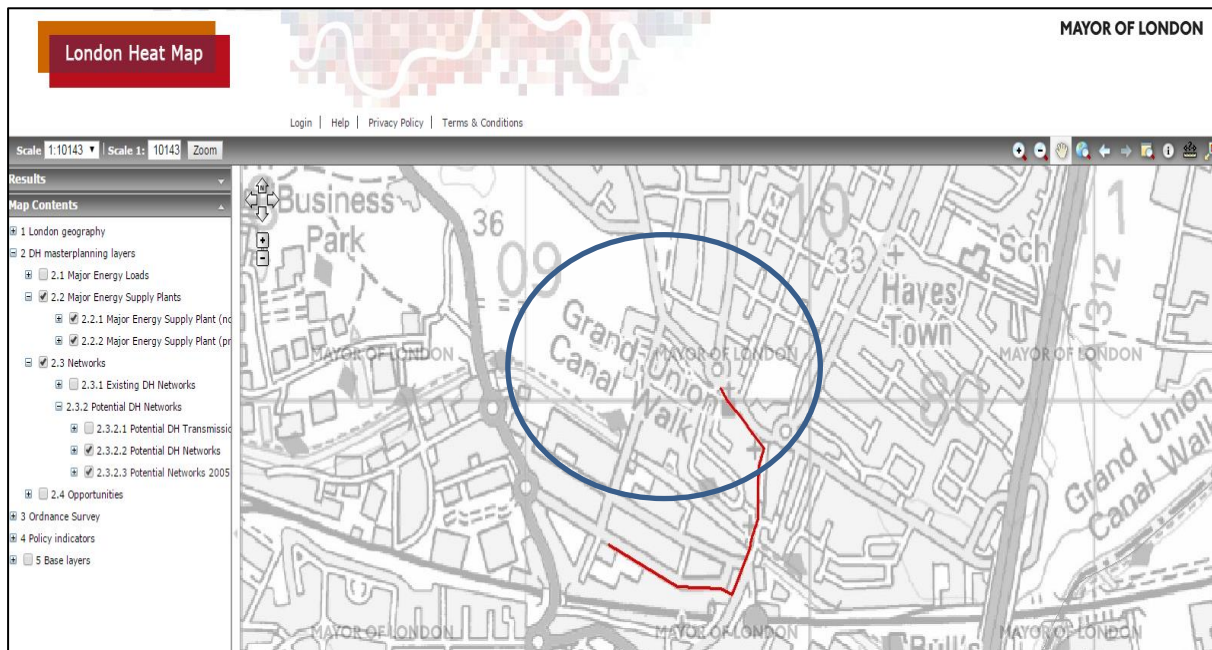


Figure 3: Extract from London Heat Map detailing available networks

There are no current large scale heating or cooling networks in economical proximity to the site. However, the London heat mapping information details potential network and master planning information indicates that there will be a local network within the time scale of the scheme.

Although modelling has generally indicated the building is cooling load with LTHW Under floor heating and DHWS heating needs the availability of a District heating network is of benefit and the scheme is committed to connecting into this network.

Based on this benefit the scheme intends to connect into a private adjacent Gas Fired CHP district heating network and this use of LTHW heating has been considered as the best approach, however, the actual carbon factor of the systems is unknown and this needs further consideration. Appendix F details the selected BRE carbon conversion factor used by the team in the Carbon analysis.

5.2 Combined heat and power

CHP (combined heat and power) provides both heat and electricity locally for use in a single building or larger heating network. Providing heat and electricity in this way has an efficiency benefit over conventional systems due to the relative inefficiency of grid supplied power.

Small to medium scale CHP most often uses purpose built or converted reciprocating internal combustion engines to drive a generator supplying three phase electricity. The efficiency of IC engines is relatively low because of the amount of energy lost as heat. In a CHP unit this otherwise waste heat is used to heat water. This water is used to provide space heating and DHW, either directly or via a heat exchanger.

The scheme has a DHWS base load however the selection of a CHP unit that will operate above 4500 hours is not considered viable for the project and there is greater benefit in connecting into the adjacent private LTHW export network.

The results and details of the H3 'Be Clean' DSM modelling analysis are as follows:

	Carbon Dioxide emissions [Tonnes CO2 per annum]	
	Regulated	Unregulated
Baseline: Part L 2013 of the building Regulations Compliant Development	156.56	
After energy Demand reduction	102.80	
After CHP	101.46	

	Regulated Carbon Dioxide Savings	
	[Tonnes CO2 per annum]	[%]
Savings from Energy Demand reduction	54	34.33%
Savings from CHP	1	0.86%

Table 14: Hierarchy 2 Building improvements

Summary		Baseline rev 3 ADL2A Notional Building [2013]		Hierarchy 2 rev 3 Be Clean Use energy More Efficiency	
Drawings Provided	Ground floor Plan	Planning		Planning	
	First Floor Plan	Planning		Planning	
	Second Floor Plan	Planning		Planning	
	Third Floor	Planning		Planning	
	Sections	Planning		Planning	
	Elevations	Planning		Planning	
New Build U Values	Walls	0.26	W/m2K	0.24	
	Ground Floor	0.22	W/m2K	0.20	
	Exposed Floor	0.22	W/m2K	0.21	
	Windows	1.6	W/m2K	1.6 [1.2 Punch windows]	
	Roof	0.18	W/m2K	0.14	
	Building Type		Modular		Modular
Air Permeability	New Build	3	m3/hr/m2 @ 50Pa	5	
	Renewable	None		None	
Power Factor Correction	Not Installed	< 0.9		> 0.95	
Lighting	Lighting Metering	Yes		Yes	
	Out of Range Values	No		Yes	
	Lamp Type	T5 Inference Lamp Type		T5 Inference Lamp Type	
	Luminarie Efficacy	60 lI/cW		65 lI/cW	
	Control	PIR and Daylight Control		PIR and Daylight Control H2 Services Upgrade District Carbon Factor 0.212	
Performance	BER	23.3	kgCO2/m2	15.1	kgCO2/m2
	Model Floor Area	6719.1	m2	6719.1	m2
	Regulated Energy	59.66	Kwh/m2	34.58	Kwh/m2
	Total Energy	83.82	Kwh/m2	58.74	Kwh/m2
	Total Carbon	156.56	TCO2	101.46	TCO2

Table 15: Hierarchy 2 summary

It can be seen from the analysis the H2 [Be Clean] actions provide a 0.86% reduction in carbon emissions of 1.0tonnes of Carbon improvements over the baseline DSM compliance results.

The H2 supporting BRUKL output is provided in Appendix C for Information.

6.0 Cooling Demand Reduction and Overheating mitigation

As a major development Policy 5.9 seeks to reduce impact of the urban heat island effect and encourages the design of developments to avoid overheating and excessive heat generation in order to reduce the demand for cooling.

The London Plan requires that measures are proposed to mitigate the demand for cooling under the following headings:

1. Minimise internal heat generation through energy efficient design
2. Reduce the amount of heat entering the building during in summer
3. Use of thermal mass and high ceiling to manage the heat within building's
4. Passive Ventilation
5. Mechanical Ventilation

It should be noted that the proposed development although a teaching facility, its is not a typical secondary type facility in that its projected internal casual loads are related to the curriculum and although this can be managed in terms of energy efficiency by the users its coupled with the modular approach to construction limit the physical adaptions to the building design.

The design team as a whole have considered and would provide the following statements under each of the above headings.

6.1 Minimise internal heat generation through energy efficient design

The design and distribution of services have been located into general circulation spaces reducing the implied casual load on the occupied zones.

The design team have considered spacial proximity of areas and located them to reduce circulation distances of Heating and Hot water services but also ductwork distribution and impact on auxiliary fan energy.

6.2 Reduce the amount of heat entering the building during in summer

As can be seen from the proposed planning drawings the building façade has been developed to provide solar screening to the large south elevation which provides effective solar screening.

6.3 Use of thermal mass and high ceiling to manage the heat within buildings

The use of the modular systems limits the amount of thermal mass that can be introduced into the building design and construction for practical reasons. However, the team have consider the holistic building design space adjacencies and have introduced open spaces off the large Atrium which we feel will absorb heat and propagate stack effect which is covered in the next section.

6.4 Passive Ventilation

As referenced in section 6.3 a fundamental design aspect of the scheme is a large Atrium which is used as part of a natural ventilation strategy which introduces air at low level through purposely design external louvers and ducts and exhausts naturally from the 4 glazed Atrium towers.

These Atrium towers also allow natural light to enter deep into the building maximising borrowed light into the occupied spaces at each level.

The atrium also allows the perimeter occupied spaces to benefit from cross ventilation with air entering the external opening windows, shaded via the external screen, and across the teaching area and then into the atrium where the stack effect in the atrium will assist in entraining the teaching zone stale air.

Section 6.7 reports thermal simulation results in detail.

6.5 Mechanical Ventilation

As indicated from outline analysis detailed in section 6.7 with the solar shading and passive ventilation measures there are still areas in the proposed development that do not meet the Adaptive comfort criterion and as part of the mitigation and developing design principles the team have considered the use of Mechanical mixed mode ventilation to further reduce the overheating potential and reduce any cooling demand.

The principle adopted by the team is to ventilate and provide heat recovery via the use of local heat Recovery units [HRU] with temperature and CO2 speed control to each of the spaces controlled via an occupancy sensor so that the mode of control is generally as follows:

Mode 1: Natural Ventilation

The occupants can open windows to manage internal conditions

Mode 2: Mechanical ventilation

The HRU will sense internal occupancy and start to monitor temperature and CO2 ramping up and down as necessary to maintain the preselected set point

The HRU will also facilitate pre occupancy Purge and Post occupancy Purge automatically as well as night time ventilation as necessary operating under the dictates of the Site BMS.

Section 6.7 reports thermal simulation results in detail.

6.6 ADL2A Criterion 3

Part L2013 Criterion 3 is a simple check to consider solar exposure and the potential for excessive solar gain that may influence the designer to consider the inclusion of cooling systems in mitigating overheating.

It is recognised that the building regulations 2013 Solar limit assessment in ADL2A and reported on the BRUKL output does not cover all the factors influencing overheating and the energy assessments guidance recommends that additional design assessments should be undertaken.

Criterion 3 output from the BRUKL documents is summarised below for thoroughness in this report to act as a comparator to Dynamic simulation analysis included in later sections.

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
10 Music Tech Classroom	NO (-62.9%)	NO
103 Electronics Lab	NO (-89.1%)	NO
104 Learning Base 1	NO (-91.6%)	NO
105 Learning Base 2	NO (-91.6%)	NO
11 Recording Audio Control Room	N/A	N/A
111 Sports Hall	N/A	N/A
12 Light recording Room	N/A	N/A
123 Radio E	N/A	N/A
124 Meeting E	N/A	N/A
13 Recording teaching Space	NO (-66.3%)	NO
131 Internal Learning 6	NO (-29.7%)	NO
132 Media Hub	NO (-87.7%)	NO
133 SEN	N/A	N/A
134 SEN Resources	N/A	N/A
135 IAG Careers	N/A	N/A
136 Radio F	YES (+11.5%)	NO
137 Radio G	YES (+7.3%)	NO
138 Meeting F	N/A	N/A
139 Meeting G	N/A	N/A
14 Practice 1	NO (-81.5%)	NO
140 Internal Learning 7	NO (-19.6%)	NO
144 LRC	NO (-88.6%)	NO
146 Media Hub	NO (-91%)	NO

Figure 4: Extract from H3 BRUKL Document

It can be seen from the above extract there are a number of spaces that exceed the compliance solar gain limit and design development in terms of glazing solar performance and use of Blinds shall be considered as design development.

6.7 Adaptive Thermal Comfort

The development as a whole has been modelled with regards to occupant comfort. IES dynamic thermal modelling software has been used to undertake the modelling. IES Virtual Environment v2014.2.1.0 thermal modelling software is approved by 2013 Building Regulations and is also compliant with CIBSE AM11 requirements.

The Priority School Building Programme (PSPB) overheating assessment is to be undertaken for natural, mechanical and mixed mode ventilation environments which are not mechanically cooled. The assessment is now based on the adaptive comfort model, which follows the methodology and recommendations from EN 15251, and is outlined in CIBSE TM52.

The Proposed scheme has been developed with Air Sourced Heat pumps for teaching and other internally occupied spaces and as a feature of this approach cooling is available from the same system. It should be noted the design philosophy is not to provide close control of cooling and internal conditions with the cooling capacity but to select systems and equipment for heating mode and the resulting cooling capacity used to control upper summer time internal temperatures [Peak lopping]

As a result all teaching spaces weather naturally ventilated, mechanical ventilated or peak lopping have been assessed in line with CIBSE TM52 adaptive comfort criterion.

The three criteria applied for overheating use is:

- Criteria 1: The number of hours that the predicted operative temperature exceeds the upper limit of the range of acceptable operative temperatures by 1K or more.
- Criteria 2: The number of days that the weighted exceedance is >6
- Criteria 3: The number of hours that the predicted operative temperature exceeds the θ_{max} by 4K or more

The building will be deemed to have 'Overheated' if any two of the three criteria are exceeded.

The modelling process has considered the entire building so that thermal interactions and air transfer between spaces are taken into account as well as night time ventilation and the building thermal mass.

It's important when considering thermal comfort all aspects of the integrated design have been taken into account. The design team as a whole has had input into the building shape and form and the use of screening to reduce solar gain and glare is

a key feature to comfort assessments and has been considered in the modelling process.

Design developments and information on the high casual load of internal equipment has identified that the building will need an elements of cooling to maintain adaptive comfort conditions.

The design solution was not to provide close control comfort cooling to spaces but to consider the cooling output from the VRF heating performance and the resulting cooling capacity used to peak loop high summer internal conditions only.

The principle of operation is as follows:

Mode 1: Natural Ventilation

The occupants can open windows to manage internal conditions

Mode 2: Mechanical ventilation

The HRU will sense internal occupancy and start to monitor temperature and CO2 ramping up and down as necessary to maintain the preselected set point

The HRU will also facilitate pre occupancy Purge and Post occupancy Purge automatically as well as night time ventilation as necessary operating under the dictates of the Site BMS.

Mode 3: Mechanical ventilation with cooling initiated

The HRU will sense internal occupancy and start to monitor temperature and CO2 ramping up and down as necessary to maintain the preselected set point

The HRU will also facilitate pre occupancy Purge and Post occupancy Purge automatically as well as night time ventilation as necessary operating under the dictates of the Site BMS.

Should the Mode 1 and Mode 2 control fail to maintain conditions below 25 Deg C the cooling will be permitted to operate should the space exceed 26 Deg C, out of range alarms shall be considered to inform the site management if any space is operating below 25 Deg C with cooling initiated

The following summary details this '3 modes' of control approach and the adaptive comfort assessment developed by the design team.

Overall	
Passed:	2 rooms:
Failed:	81 rooms:
Unoccupied:	279 rooms:

Data:			
Days data=	365	01-Jan	31-Dec
Days (summer)=	153	01-May	30-Sep
Data OK?	OK	Full summer	

Passed:	2 rooms:					
Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
180 Cafe Kiosk	18000002	71.2	2.9	10	3	2
37 Entrance lobby	48000001	71.2	2.2	7	2	2

Failed:	81 rooms:					
Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
10 Music Tech Classroom	10000000	71.2	4.8	12	3	1 & 2
103 Electronics Lab	10000005	71.2	6.4	13	4	1 & 2
104 Learning Base 1	10000004	71.2	7.2	17	4	1 & 2
105 Learning Base 2	10000003	71.2	7.3	17	4	1 & 2
111 Sports Hall	11000006	71.2	41.7	38	6	1 & 2 & 3
12 Light recording Room	12000000	71.2	76.5	62	9	1 & 2 & 3
123 Radio E	12000007	71.2	56.1	42	6	1 & 2 & 3
124 Meeting E	12000006	71.2	52.3	38	5	1 & 2 & 3
13 Recording teaching Space	13000000	71.2	4.4	12	3	1 & 2

Table 16 TM52 Results Natural Ventilation [extract from results table]

Failed:	81 rooms:
Unoccupied:	279 rooms:

Data:			
Days data=	365	01-Jan	31-Dec
Days (summer)=	153	01-May	30-Sep
Data OK?	OK	Full summer	

Passed:	2 rooms:					
Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
180 Cafe Kiosk	18000002	71.2	2.3	7	2	2
37 Entrance lobby	48000001	71.2	2.1	6	2	-

Failed:	81 rooms:					
Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
10 Music Tech Classroom	10000000	71.2	3.3	10	3	1 & 2
103 Electronics Lab	10000005	71.2	5.7	12	3	1 & 2
104 Learning Base 1	10000004	71.2	6	12	3	1 & 2
105 Learning Base 2	10000003	71.2	5.9	12	3	1 & 2
111 Sports Hall	11000006	71.2	35	34	5	1 & 2 & 3
12 Light recording Room	12000000	71.2	28.8	32	6	1 & 2 & 3
123 Radio E	12000007	71.2	52	40	6	1 & 2 & 3
124 Meeting E	12000006	71.2	43.7	36	5	1 & 2 & 3
13 Recording teaching Space	13000000	71.2	3.3	12	3	1 & 2
131 Internal Learning 6	1300000C	71.2	71.8	88	15	1 & 2 & 3
132 Media Hub	1300000B	71.2	8.2	18	4	1 & 2
133 SEN	1300000A	71.2	53.5	61	11	1 & 2 & 3
134 SEN Resources	13000009	71.2	56	64	11	1 & 2 & 3

Table 17 TM52 Results Mixed mode Mechanical Ventilation [extract from results table]

Overall	
Passed:	80 rooms:
Failed:	3 rooms:
Unoccupied:	279 rooms:

Data:			
Days data=	365	01-Jan	31-Dec
Days (summer)=	153	01-May	30-Sep
Data OK?	OK	Full summer	

Passed:	80 rooms:					
Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg. Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
10 Music Tech Classroom	10000000	71.2	0	0	0	-
103 Electronics Lab	10000005	71.2	0	0	0	-
104 Learning Base 1	10000004	71.2	0	0	0	-
105 Learning Base 2	10000003	71.2	0	0	0	-
12 Light recording Room	12000000	71.2	0.4	4	1	-
123 Radio E	12000007	71.2	0	0	0	-
124 Meeting E	12000006	71.2	0	0	0	-
13 Recording teaching Space	13000000	71.2	0	0	0	-

Failed:	3 rooms:					
Room Name	Room ID	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg. Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
111 Sports Hall	11000006	71.2	11.4	20	4	1 & 2
32 Stair Lobby	32000000	71.2	10	18	4	1 & 2
Kitchen 4	4_000000	71.2	95.2	72	8	1 & 2 & 3

Table 18 TM52 Results Mixed mode peak looping VRF [extract from results table]

7.0 Applicability of Renewable and LZC's [Be Green]

The following sections details the considerations and practicalities of Renewable and low Zero Carbon technologies.

7.1 Renewable technologies

Energy resources accepted as renewable or low carbon technologies are defined by the Department of Energy & Climate change Low Carbon Buildings Program. Those which are suitable for consideration in this case are:

- Solar photovoltaics
- Wind turbines
- Solar thermal hot water
- Heat pumps

7.2 Solar Photovoltaics

Photovoltaic's (PVs) generate electricity from daylight using semiconductors.. PV's are also a simple technology requiring little in the way of maintenance and offer a proven way of generating zero carbon, renewable electricity. Photovoltaics generate electricity which displaces that which would otherwise be provided by the national grid. Grid supplied electricity is very polluting when compared to other conventional fuels producing more than 2.5 times more CO₂/kWh than natural gas. Given the area of available roof space and minimal over shading, PV is considered to be a suitable low carbon technology for the project.

7.3 Wind turbines

Wind turbines generate electricity via a conventional generator connected to turbine blades which are in turn powered by the prevailing wind. Given the location of the development, building mounted turbines would be required, and for this type of application vertical axis turbines would be best suited. However, for structural implications of mounting wind turbines to the buildings frame, both in terms of Location adjacent the existing higher building, loading and vibration means wind turbines are not viable.

7.4 Solar Thermal

The proposed development has a reasonable DHWS Load but limited plant space internally and it may not be the best and most viable option for the scheme.

7.5 Heat Pumps

The design team have considered the use of Heat pumps in detail and feel it's the best solution for the schemes heating and cooling demands.

The heat pump technology proposed is 3 Pipe Variable Refrigerant Flow [VRF] and the design and apportionment of load allows very efficient transfer of Heating and

cooling between zone of variable heating and cooling demand providing high SCoP's and SEER's. Details of the proposed systems are included in Appendix E.

The Be lean H1 approach has considered the carbon benefits in previous analysis and the H3 Be Clean analysis shall report the renewable carbon reduction only.

Description	Comments applicable to the scheme
District Heating	There is a private network within a economical distance of the proposed building and extension. However, the carbon factor needs further investigation.
Air Sourced Heat Pumps	Possible to serve the Building Heating and Cooling Peak looping Demands
Ground Sourced Heat Pumps	Possible to serve the Building Heating and Cooling Demands but the number of bore holes means it's not financial viable
Biomass Boiler Plant	Not applicable to the scheme because of cost, building location and space requirements
Solar Thermal (solar water heating)	Possible to serve the Domestic hot water systems but would require roof mounted plant and equipment and considering the limited plant space this is felt unsuitable
Active Solar (Photovoltaic)	Appropriate for this scheme and could be integrated into the roof fabric
Small Hydro	Not applicable to the scheme
Combined Heat and Power (CHP)	Not most applicable technology for the scheme based on limited running hours, but this scheme would give a base load to the Local district heating network
Energy From Waste	Not applicable to the scheme
Anaerobic Digestion	Not applicable to the scheme

Table 19: LZC Summary of Considerations

A Fourth DSM model has been created [H3] taking account Renewable improvements to establish the emission reductions possible through these actions. The results and input data are shown in the following tables:

	Carbon Dioxide emissions [Tonnes CO2 per annum]	
	Regulated	Unregulated
Baseline: Part L 2013 of the building Regulations Compliant Development	156.56	
After energy Demand reduction	102.80	
After CHP	101.46	
After renewable energy	98.10	
	Regulated Carbon Dioxide Savings	
	[Tonnes CO2 per annum]	[%]
Savings from Energy Demand reduction	54	34.33%
Savings from CHP	1	0.86%
Savings from Renewable energy	3	2.15%
Total Cumulative Savings	58	37.34%

Table 20: Hierarchy 3 Improvements

It can be seen from the analysis the H3 [Be Green] actions provide a total 2.15% 3.0 tonnes of Carbon improvement over the baseline DSM compliance results

The H3 supporting BRUKL output is provided in Appendix D for Information.

System Details		Hierarchy 3	
system name	System LZC01 Base Line new and Existing	System LZC01 Proposed	
PVS Generator	PV array type	Monocrystalline	
	Derive performance parameters from PV array type?	Estimated Data	
	PV module efficiency	17.00%	
	Reference irradiance for NOCT (W/m ²)	1000	
	Nominal cell temp. (NOCT) (°C)	45	
	Temp. Coefficient for module efficiency		
	Degradation factor	0.99	
	Shading factor	1	
	Electrical conversion efficiency	0.95	
	Area (m ²)	50	
	Azimuth (° clockwise from North)	270	
	Inclination (° from horizontal)	5	
Wind Generator	Hub height (m)	None	
	Rated power (kW)		
CHP Generator	Fuel type	None	
	Performance at rated output		
	Heat at output (kW)		
	Thermal efficiency		
	Power efficiency		
	Performance at minimum output		
	fraction of rated heat output		
	Thermal efficiency		
	Power efficiency		
	Base Load Matched to		

Table 21: Hierarchy 3 Solae PV Performance

8.0 Summary of Energy Strategy

The energy strategy considered is based on the Energy Hierarchy as detailed in the introduction of this report.

The building fabric will be improved beyond current regulatory requirements by improving levels of insulation where practical considering the offsite modular design construction methods.

Passive and Active design features have been incorporated including designing internal layouts to maximise the use of natural light and high thermal insulation to reduce energy demand and help moderate internal temperatures throughout the year. A mixed mode mechanical and natural ventilation strategy will be used to provide fresh air to occupied spaces when internal spaces feel ambient noise levels are acceptable to open windows.

Energy efficient lighting and heating systems will be installed which use less energy and have suitable control so as to be operated at optimum performance while providing a comfortable internal environment. This shows that a 34.44% (54 tonnes) improvement is predicted over the baseline energy analysis.

Connecting the complementary systems into the adjacent site wide district heating network, even based on an assumed carbon factor of 0.212 kgCO₂/kWh, shows that a 0.86% 1.0tonne improvement is predicted over the baseline energy analysis.

The Use of solar PV, shows that a 2.15% (3.0 tonne) improvement is predicted over the baseline energy analysis is also possible. As responsible designers, we have allowed enough PV area (150sqm shown on the plans) to allow some margin for any changes during construction. The exact amount of PV will be adjusted to ensure the target reduction is achieved when at as built status. It should also be noted that this amount of PV would preclude the use of a green roof for practical reasons.

The estimated savings anticipated from implementing this energy strategy on the baseline energy demand for the development can be seen in the tables 1 and 2 It is anticipated that these measures in combination would achieve a 37.34%, 58 tonnes of Carbon reduction in emissions compared to the baseline analysis with the use of renewable technologies and Private District heating network. This indicates a savings surplus over the 35% target of 4 Tonnes of Carbon.

Sub-meters will be provided for all substantial energy uses with automated monitoring back and the main site BMS to assist the FM teams in monitoring consumption.

All external lighting will be energy efficient and controlled for the presence of daylight.

				Baseline rev 3 ADL2A Notional Building [2013]	Hierarchy 1 rev 3 Be Lean Reduce the Need for Energy	Hierarchy 2 rev 3 Be Clean Use energy More Efficiency	Hierarchy 3 rev 3 Be Green Use Renewable Energy
Summary							
Drawings Provided	Ground floor Plan	Planning		Planning	Planning	Planning	Planning
	First Floor Plan	Planning		Planning	Planning	Planning	Planning
	Second Floor Plan	Planning		Planning	Planning	Planning	Planning
	Third Floor	Planning		Planning	Planning	Planning	Planning
	Sections	Planning		Planning	Planning	Planning	Planning
	Elevations	Planning		Planning	Planning	Planning	Planning
New Build U Values	Walls	0.26	W/m2K	0.24	0.24	0.24	0.24
	Ground Floor	0.22	W/m2K	0.20	0.20	0.20	0.20
	Exposed Floor	0.22	W/m2K	0.21	0.21	0.21	0.21
	Windows	1.6	W/m2K	1.6 [1.2 Punch windows]	1.6 [1.2 Punch windows]	1.6 [1.2 Punch windows]	1.6 [1.2 Punch windows]
	Roof	0.18	W/m2K	0.14	0.14	0.14	0.17
Building Type		Modular		Modular	Modular	Modular	Modular
Air Permeability	New Build	3	m3/hr/m2 @ 50Pa	5	5	5	5
	Renewable	None		None	None	None	50m2 PV
Power Factor Correction	Not Installed	<0.9		>0.95	>0.95	>0.95	>0.95
Lighting	Lighting Metering	Yes		Yes	Yes	Yes	Yes
	Out of Range Values	No		No	Yes	Yes	Yes
	Lamp Type	T5 Inference Lamp Type		T5 Inference Lamp Type	T5 Inference Lamp Type	T5 Inference Lamp Type	LED
	Luminarie Efficacy	60 lI/cW		65 lI/cW	65 lI/cW	65 lI/cW	65 lI/cW
	Control	PIR and Daylight Control		PIR and Daylight Control	PIR and Daylight Control	PIR and Daylight Control	PIR and Daylight Control
				H2 Services Upgrade	H2 Services Upgrade	H2 Services Upgrade	H2 Services Upgrade
					District Carbon Factor 0.212	District Carbon Factor 0.212	H3 renewables
							District Carbon Factor 0.212
Performance	BER	23.3	kgCO2/m2	15.3	kgCO2/m2	15.1	kgCO2/m2
	Model Floor Area	6719.1	m2	6719.1	m2	6719.1	m2
	Regulated Energy	59.66	Kwh/m2	35.02	Kwh/m2	34.58	Kwh/m2
	Total Energy	83.82	Kwh/m2	59.18	Kwh/m2	58.74	Kwh/m2
	Total Carbon	156.56	TCO2	102.80	TCO2	101.46	TCO2
							98.10
							TCO2

Table 22: LZC Summary of Analysis

Appendix A : Baseline BRUKL

Appendix B : H1 BRUKL

Appendix C : H2 BRUKL

Appendix D : H3 BRUKL

Appendix E : Building regulations Report

Appendix F : District heating carbon Factor

Appendix A

Project name

Modular and Portable

150429 UTC Model BL Modular rev 1

As designed

Date: Fri May 01 09:09:01 2015

Administrative information

Building Details

Address: UTC Heathrow, London,

Owner Details

Name:

Telephone number: Phone

Address: , , Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.2

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.2

BRUKL compliance check version: v5.2.b.1

Certifier details

Name: Nicholas Roy Bradley

Telephone number: 07899 797945

Address: The Croft, 10 Birchwood Court, Bessacarr,
Doncaster, DN4 6SXCriterion 1: The calculated CO₂ emission rate for the building should not exceed the target

The building does not comply with England Building Regulations Part L 2013

1.1	CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	17.4
1.2	Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	17.4
1.3	Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	26.8
1.4	Are emissions from the building less than or equal to the target?	BER > TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

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

Values which do not meet standards in the 2013 Non-Domestic Building Services Compliance Guide are displayed in red.

2.a Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	1_000000:Surf[6]
Floor	0.25	0.22	0.22	1_000000:Surf[0]
Roof	0.25	0.18	0.18	10000009:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.18	1.98	14000007:Surf[6]
Personnel doors	2.2	2.18	2.18	24000000:Surf[1]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * There might be more than one surface where the maximum U-value occurs. ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. *** Display windows and similar glazing are excluded from the U-value check. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

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

2.b Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- BL01 LTHW Radiators

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0.11	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- BL03 LTHW_CHW FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.13	0	2.4	0.65
Standard value	0.91*	2.55	N/A	1.6	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- BL02 LTHW Radiators Local Extract

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0.9	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

4- BL05 LTHW_CHW Central AHU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.13	0	3	0.65
Standard value	0.91*	2.55	N/A	1.6	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(I/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I	Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
10 Music Tech Classroom	-	-	-	0.6	-	-	-	2.4	-	-	N/A
103 Electronics Lab	-	-	-	0.6	-	-	-	2.4	-	-	N/A
104 Learning Base 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A
105 Learning Base 2	-	-	-	0.6	-	-	-	2.4	-	-	N/A
11 Recording Audio Control Room	-	-	-	1.5	-	-	-	2.4	-	-	N/A
12 Light recording Room	-	-	-	0.6	-	-	-	2.4	-	-	N/A
123 Radio E	-	-	-	0.6	-	-	-	2.4	-	-	N/A
124 Meeting E	-	-	-	0.6	-	-	-	2.4	-	-	N/A
13 Recording teaching Space	-	-	-	0.6	-	-	-	2.4	-	-	N/A
131 Internal Learning 6	-	-	-	0.6	-	-	-	2.4	-	-	N/A
132 Media Hub	-	-	-	0.6	-	-	-	2.4	-	-	N/A
133 SEN	-	-	-	0.6	-	-	-	2.4	-	-	N/A
134 SEN Resources	-	-	-	0.6	-	-	-	2.4	-	-	N/A
135 IAG Careers	-	-	-	0.6	-	-	-	2.4	-	-	N/A
136 Radio F	-	-	-	0.6	-	-	-	2.4	-	-	N/A
137 Radio G	-	-	-	0.6	-	-	-	2.4	-	-	N/A
138 Meeting F	-	-	-	0.6	-	-	-	2.4	-	-	N/A
139 Meeting G	-	-	-	0.6	-	-	-	2.4	-	-	N/A
14 Practice 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A
140 Internal Learning 7	-	-	-	0.6	-	-	-	2.4	-	-	N/A
144 LRC	-	-	-	1.5	-	-	-	2.4	-	-	N/A
146 Media Hub	-	-	-	0.6	-	-	-	2.4	-	-	N/A
147 Internal Learning 8	-	-	-	0.6	-	-	-	2.4	-	-	N/A
148 Radio H	-	-	-	0.6	-	-	-	2.4	-	-	N/A
149 Meeting H	-	-	-	0.6	-	-	-	2.4	-	-	N/A
15 Practice 2	-	-	-	0.6	-	-	-	2.4	-	-	N/A
151 Seminar Room	-	-	-	0.6	-	-	-	2.4	-	-	N/A
16 Practice 3	-	-	-	0.6	-	-	-	2.4	-	-	N/A
161 Studio Control	-	-	-	1.5	-	-	-	2.4	-	-	N/A
169 Media Hub	-	-	-	0.6	-	-	-	2.4	-	-	N/A
175 Server and Hub Room	-	-	-	0.8	-	-	-	2.4	-	-	N/A
176 Hub Room	-	-	-	0.8	-	-	-	2.4	-	-	N/A
18 Practice 4	-	-	-	0.6	-	-	-	2.4	-	-	N/A
184 Hub Room	-	-	-	0.8	-	-	-	2.4	-	-	N/A
186 Cafe	-	-	-	0.6	-	-	-	2.4	-	-	N/A
19 Recording Audio Control Room	-	-	-	1.5	-	-	-	2.4	-	-	N/A
196 Staff Office	-	-	-	0.6	-	-	-	2.4	-	-	N/A
20 Live Music Studio	-	-	-	0.6	-	-	-	2.4	-	-	N/A
209 Hub Room	-	-	-	0.8	-	-	-	2.4	-	-	N/A
22 Drum Booth	-	-	-	0.6	-	-	-	2.4	-	-	N/A
23 Voice Booth	-	-	-	0.6	-	-	-	2.4	-	-	N/A
28 Sound Control Hub	-	-	-	1.5	-	-	-	2.4	-	-	N/A
35 Media Hub 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A

Zone name	SFP [W/(I/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
36 Board Room	-	-	-	0.6	-	-	-	2.4	-	-	N/A
38 Reception_Admin	-	-	-	0.6	-	-	-	2.4	-	-	N/A
39 Interview Meeting	-	-	-	0.6	-	-	-	2.4	-	-	N/A
40 Sick Bay	-	-	-	0.6	-	-	-	2.4	-	-	N/A
41 Principle	-	-	-	0.6	-	-	-	2.4	-	-	N/A
42 Principle PA	-	-	-	0.6	-	-	-	2.4	-	-	N/A
47 Production Booth 1	-	-	-	1.5	-	-	-	2.4	-	-	N/A
48 Production Booth 2	-	-	-	1.5	-	-	-	2.4	-	-	N/A
49 Internal Learning	-	-	-	0.6	-	-	-	2.4	-	-	N/A
5 Dining	-	-	-	0.6	-	-	-	2.4	-	-	N/A
50 Media Hub 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A
51 Faculty Office	-	-	-	0.6	-	-	-	2.4	-	-	N/A
52 Faculty Workroom	-	-	-	0.6	-	-	-	2.4	-	-	N/A
53 Store	-	-	-	0.6	-	-	-	2.4	-	-	N/A
54 General Office Finance	-	-	-	0.6	-	-	-	2.4	-	-	N/A
55 Radio A	-	-	-	0.6	-	-	-	2.4	-	-	N/A
56 Radio B	-	-	-	0.6	-	-	-	2.4	-	-	N/A
57 Meeting A	-	-	-	0.6	-	-	-	2.4	-	-	N/A
58 Meeting B	-	-	-	0.6	-	-	-	2.4	-	-	N/A
60 Internal Learning 2	-	-	-	0.6	-	-	-	2.4	-	-	N/A
61 Media Hub	-	-	-	0.6	-	-	-	2.4	-	-	N/A
68 Science Lab 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A
69 Science Lab 2	-	-	-	0.6	-	-	-	2.4	-	-	N/A
70 Science Prep	-	-	-	0.6	-	-	-	2.4	-	-	N/A
71 Science Studio 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A
72 Science Studio 2	-	-	-	0.6	-	-	-	2.4	-	-	N/A
73 IT Technician	-	-	-	0.6	-	-	-	2.4	-	-	N/A
76 First Aid	-	-	-	0.6	-	-	-	2.4	-	-	N/A
81 Science Lab 3	-	-	-	0.6	-	-	-	2.4	-	-	N/A
82 Internal Learning 3	-	-	-	0.6	-	-	-	2.4	-	-	N/A
83 Media Hub 4	-	-	-	0.6	-	-	-	2.4	-	-	N/A
84 Radio C	-	-	-	0.6	-	-	-	2.4	-	-	N/A
85 Radio D	-	-	-	0.6	-	-	-	2.4	-	-	N/A
87 Meeting C	-	-	-	0.6	-	-	-	2.4	-	-	N/A
88 Meeting D	-	-	-	0.6	-	-	-	2.4	-	-	N/A
89 Internal Learning 4	-	-	-	0.6	-	-	-	2.4	-	-	N/A
90 Media Hub	-	-	-	0.6	-	-	-	2.4	-	-	N/A
91 Faculty Office	-	-	-	0.6	-	-	-	2.4	-	-	N/A
92 Faculty Workroom	-	-	-	0.6	-	-	-	2.4	-	-	N/A
93 Art and Electronics Store	-	-	-	0.6	-	-	-	2.4	-	-	N/A
95 Art and Design	-	-	-	0.6	-	-	-	2.4	-	-	N/A
96 Media Hub 6	-	-	-	0.6	-	-	-	2.4	-	-	N/A
97 Internal Learning 5	-	-	-	0.6	-	-	-	2.4	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
59 Lobby		-	60	-	55
1 Bin Store		60	-	-	15
10 Music Tech Classroom		60	-	-	603
100 Staff WC		-	60	-	56
103 Electronics Lab		60	-	-	1602
104 Learning Base 1		60	-	-	433
105 Learning Base 2		60	-	-	449
106 Pupil WC		-	60	-	140
107 Staff WC		-	60	-	46
11 Recording Audio Control Room		60	-	-	252
111 Sports Hall		-	60	-	3562
113 Lobby		-	60	-	60
114 Stair Lobby		-	60	-	35
116 Stair		-	60	-	96
12 Light recording Room		60	-	-	330
120 Circulation		-	60	-	296
121 Circulation		-	60	-	296
122 Stair		-	60	-	93
123 Radio E		60	-	-	168
124 Meeting E		60	-	-	223
125 Sports Lobby		-	60	-	129
128 Bridge		-	60	-	67
129 Circulation		-	60	-	247
13 Recording teaching Space		60	-	-	561
130		-	60	-	64
130 Circulation		-	60	-	250
131 Internal Learning 6		60	-	-	491
132 Media Hub		60	-	-	418
133 SEN		60	-	-	90
134 SEN Resources		60	-	-	92
135 IAG Careers		60	-	-	93
136 Radio F		60	-	-	182
137 Radio G		60	-	-	180
138 Meeting F		60	-	-	196
139 Meeting G		60	-	-	193
14 Practice 1		60	-	-	103
140 Internal Learning 7		60	-	-	502
142 Lobby		-	60	-	55
144 LRC		60	-	-	1031
146 Media Hub		60	-	-	415
147 Internal Learning 8		60	-	-	559
148 Radio H		60	-	-	168

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
149 Meeting H		60	-	-	223
15 Practice 2		60	-	-	100
150 Lobby		-	60	-	56
151 Seminar Room		60	-	-	159
152 Maintenance		-	60	-	73
153 Pupil WC 8		-	60	-	140
154 Staff WC		-	60	-	46
155 Exam Store		60	-	-	28
157 Sprinkler Tank		60	-	-	196
158 Stair Lobby		-	60	-	35
16 Practice 3		60	-	-	106
160 Stair		-	60	-	85
161 Studio Control		60	-	-	196
162 TV Studio		60	-	-	664
163 Circulation		-	60	-	143
164 Circulation		-	60	-	62
165 Stair Lobby		-	60	-	30
168 Stair		-	60	-	82
169 Media Hub		60	-	-	432
17 Lobby		-	60	-	49
171 Circulation		-	60	-	241
172 Circulation		-	60	-	241
175 Server and Hub Room		60	-	-	94
176 Hub Room		60	-	-	36
18 Practice 4		60	-	-	132
180 Cafe Kiosk		-	60	-	218
184 Hub Room		60	-	-	46
186 Cafe		-	60	-	194
19 Recording Audio Control Room		60	-	-	175
192 Music Store		60	-	-	17
193 Staff WC		-	60	-	54
194 Pupil Change		-	60	-	243
195 Acc Changing		-	60	-	86
196 Staff Office		60	-	-	142
197 Pupil Changing 2		-	60	-	266
198 Sports Hall Store		60	-	-	66
2 Kitchen Plant		60	-	-	71
20 Live Music Studio		60	-	-	420
200 Change Lobby		-	60	-	29
201 Change Lobby		-	60	-	23
209 Hub Room		60	-	-	13
21 Music Store		60	-	-	20
211 Cleaners Store		60	-	-	9

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
22 Drum Booth		60	-	-	204
23 Voice Booth		60	-	-	145
24 Theatre 1		60	-	-	2197
25 Theatre 2		60	-	-	659
26 Theatre Lobby		-	60	-	120
27 TV Studio		60	-	-	882
28 Sound Control Hub		60	-	-	202
29 Plant Room		60	-	-	127
3 Kitchen WC		-	60	-	46
30 Stair		-	60	-	89
32 Stair Lobby		60	-	-	474
33 Pupil WC		-	60	-	151
34 Staff WC		-	60	-	47
35 Media Hub 1		60	-	-	391
36 Board Room		60	-	-	340
37 Entrance lobby		-	60	15	155
38 Reception_Admin		60	-	-	459
39 Interview Meeting		60	-	-	174
40 Sick Bay		60	-	-	133
41 Principle		60	-	-	185
42 Principle PA		60	-	-	153
43 Pupil WC		-	60	-	146
44 Visitor WC		-	60	-	44
45 Stair		-	60	-	90
47 Production Booth 1		60	-	-	130
48 Production Booth 2		60	-	-	130
48 Pulse North Zone		-	60	-	434
48 Pulse		-	60	-	34
48 Pulse South Zone		-	60	-	636
49 Internal Learning		60	-	-	491
5 Dining		-	60	-	622
50 Media Hub 1		60	-	-	418
51 Faculty Office		60	-	-	142
52 Faculty Workroom		60	-	-	228
53 Store		60	-	-	18
54 General Office Finance		60	-	-	230
55 Radio A		60	-	-	182
56 Radio B		60	-	-	180
57 Meeting A		60	-	-	196
58 Meeting B		60	-	-	193
6 Music Store		60	-	-	41
60 Internal Learning 2		60	-	-	502
61 Media Hub		60	-	-	432

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
62 Stair		-	60	-	93
63 Stair Lobby		-	60	-	49
65 Staff WC		-	60	-	56
66 Pupil WC 3		-	60	-	150
67 Cleancers Store		60	-	-	9
68 Science Lab 1		60	-	-	1682
69 Science Lab 2		60	-	-	1688
7 Lobby		-	60	-	31
70 Science Prep		60	-	-	836
71 Science Studio 1		60	-	-	1495
72 Science Studio 2		60	-	-	1519
73 IT Technician		60	-	-	304
74 Pupil WC		-	60	-	142
75 Staff WC		-	60	-	47
76 First Aid		60	-	-	180
78 Stair Lobby		-	60	-	35
79 Stair		-	60	-	96
8 Chair Store		60	-	-	31
80		-	60	-	106
81 Science Lab 3		60	-	-	1849
82 Internal Learning 3		60	-	-	491
83 Media Hub 4		60	-	-	418
84 Radio C		60	-	-	182
85 Radio D		60	-	-	180
86 Lobby		-	60	-	55
87 Meeting C		60	-	-	196
88 Meeting D		60	-	-	193
89 Internal Learning 4		60	-	-	502
9 Stair Lobby		-	60	-	65
90 Media Hub		60	-	-	432
91 Faculty Office		60	-	-	142
92 Faculty Workroom		60	-	-	228
93 Art and Electronics Store		60	-	-	39
95 Art and Design		60	-	-	755
96 Media Hub 6		60	-	-	405
97 Internal Learning 5		60	-	-	559
98 Stair Lobby		-	60	-	49
Kitchen 4		-	60	-	877
Media Storage		60	-	-	38
119 Bridge		-	60	-	67
Stage Step Area		-	60	-	92

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
10 Music Tech Classroom	NO (-62.9%)	NO
103 Electronics Lab	NO (-89.1%)	NO
104 Learning Base 1	NO (-91.6%)	NO
105 Learning Base 2	NO (-91.6%)	NO
11 Recording Audio Control Room	N/A	N/A
111 Sports Hall	N/A	N/A
12 Light recording Room	N/A	N/A
123 Radio E	N/A	N/A
124 Meeting E	N/A	N/A
13 Recording teaching Space	NO (-66.3%)	NO
131 Internal Learning 6	NO (-29.7%)	NO
132 Media Hub	NO (-87.7%)	NO
133 SEN	N/A	N/A
134 SEN Resources	N/A	N/A
135 IAG Careers	N/A	N/A
136 Radio F	YES (+11.5%)	NO
137 Radio G	YES (+7.3%)	NO
138 Meeting F	N/A	N/A
139 Meeting G	N/A	N/A
14 Practice 1	NO (-81.5%)	NO
140 Internal Learning 7	NO (-19.6%)	NO
144 LRC	NO (-88.6%)	NO
146 Media Hub	NO (-91%)	NO
147 Internal Learning 8	NO (-88.5%)	NO
148 Radio H	N/A	N/A
149 Meeting H	N/A	N/A
15 Practice 2	N/A	N/A
151 Seminar Room	NO (-100%)	NO
16 Practice 3	N/A	N/A
161 Studio Control	N/A	N/A
162 TV Studio	N/A	N/A
169 Media Hub	NO (-87%)	NO
175 Server and Hub Room	N/A	N/A
176 Hub Room	N/A	N/A
18 Practice 4	NO (-83.7%)	NO
184 Hub Room	N/A	N/A
186 Cafe	N/A	N/A
19 Recording Audio Control Room	N/A	N/A
196 Staff Office	N/A	N/A
20 Live Music Studio	N/A	N/A
209 Hub Room	N/A	N/A
22 Drum Booth	N/A	N/A
23 Voice Booth	N/A	N/A
24 Theatre 1	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
25 Theatre 2	N/A	N/A
27 TV Studio	N/A	N/A
28 Sound Control Hub	N/A	N/A
32 Stair Lobby	NO (-64%)	NO
35 Media Hub 1	NO (-76.1%)	NO
36 Board Room	NO (-84.5%)	NO
37 Entrance lobby	NO (-71.3%)	NO
38 Reception_Admin	NO (-77.3%)	NO
39 Interview Meeting	NO (-82.3%)	NO
40 Sick Bay	N/A	N/A
41 Principle	N/A	N/A
42 Principle PA	N/A	N/A
47 Production Booth 1	N/A	N/A
48 Production Booth 2	N/A	N/A
49 Internal Learning	NO (-30.9%)	NO
5 Dining	NO (-53.9%)	NO
50 Media Hub 1	NO (-88.3%)	NO
51 Faculty Office	NO (-94.1%)	NO
52 Faculty Workroom	N/A	N/A
53 Store	N/A	N/A
54 General Office Finance	N/A	N/A
55 Radio A	YES (+10.6%)	NO
56 Radio B	YES (+6.9%)	NO
57 Meeting A	N/A	N/A
58 Meeting B	N/A	N/A
60 Internal Learning 2	NO (-19.9%)	NO
61 Media Hub	NO (-88.3%)	NO
68 Science Lab 1	NO (-88.2%)	NO
69 Science Lab 2	NO (-90.2%)	NO
70 Science Prep	NO (-91.3%)	NO
71 Science Studio 1	NO (-90.8%)	NO
72 Science Studio 2	NO (-88.5%)	NO
73 IT Technician	NO (-93.3%)	NO
76 First Aid	N/A	N/A
81 Science Lab 3	NO (-89.7%)	NO
82 Internal Learning 3	NO (-28.3%)	NO
83 Media Hub 4	NO (-88.2%)	NO
84 Radio C	YES (+12.4%)	NO
85 Radio D	YES (+9.5%)	NO
87 Meeting C	N/A	N/A
88 Meeting D	N/A	N/A
89 Internal Learning 4	NO (-16.2%)	NO
90 Media Hub	NO (-88.3%)	NO
91 Faculty Office	NO (-94.1%)	NO
92 Faculty Workroom	N/A	N/A
93 Art and Electronics Store	N/A	N/A
95 Art and Design	NO (-89.4%)	NO
96 Media Hub 6	NO (-91.2%)	NO
97 Internal Learning 5	NO (-88.8%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	6719.1	6719.1
External area [m ²]	7879.9	7879.9
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	2823.32	0
Average U-value [W/m ² K]	0.36	0
Alpha value* [%]	11.67	10

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

Building Use

% Area Building Type

A1/A2 Retail/Financial and Professional services
A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
B1 Offices and Workshop businesses
B2 to B7 General Industrial and Special Industrial Groups
B8 Storage or Distribution
C1 Hotels
C2 Residential Inst.: Hospitals and Care Homes
C2 Residential Inst.: Residential schools
C2 Residential Inst.: Universities and colleges
C2A Secure Residential Inst.
Residential spaces
D1 Non-residential Inst.: Community/Day Centre
D1 Non-residential Inst.: Libraries, Museums, and Galleries
99 D1 Non-residential Inst.: Education
D1 Non-residential Inst.: Primary Health Care Building
D1 Non-residential Inst.: Crown and County Courts
D2 General Assembly and Leisure, Night Clubs and Theatres
Others: Passenger terminals
Others: Emergency services
1 Others: Miscellaneous 24hr activities
Others: Car Parks 24 hrs
Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	12.93	12.52
Cooling	3.55	2.06
Auxiliary	18.63	10.75
Lighting	17.22	13.58
Hot water	16.33	6.07
Equipment*	24.16	24.16
TOTAL **	68.66	44.98

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

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

Energy Production by Technology [kWh/m²]

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

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	77.17	67
Primary energy* [kWh/m ²]	156.64	101.67
Total emissions [kg/m ²]	26.8	17.4

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

HVAC Systems Performance										
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	24.3	0	8.3	0	2.4	0.81	0	0.91	0	
Notional	21.4	0	6.9	0	1.1	0.86	0	----	----	
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	44.5	75.6	14.7	6.9	29.5	0.84	3.05	0.91	4.5	
Notional	42.4	55.2	13.7	4	17.4	0.86	3.79	----	----	
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	34.4	0	11.8	0	22	0.81	0	0.91	0	
Notional	47.6	0	15.3	0	12.3	0.86	0	----	----	
[ST] Constant volume system (variable fresh air rate), [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	77.1	16.7	23.8	2.5	25.8	0.9	1.88	0.91	4.5	
Notional	89.9	16.6	29	1.2	14.4	0.86	3.79	----	----	

Key to terms

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

Key Features

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

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.26	1_000000:Surf[6]
Floor	0.2	0.22	1_000000:Surf[0]
Roof	0.15	0.18	10000009:Surf[0]
Windows, roof windows, and rooflights	1.5	0.26	1_000000:Surf[2]
Personnel doors	1.5	2.18	24000000:Surf[1]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
U _{i-Typ} = Typical individual element U-values [W/(m²K)]		U _{i-Min} = Minimum individual element U-values [W/(m²K)]	
* There might be more than one surface where the minimum U-value occurs.			

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

Appendix B

Project name

Modular and Portable

150429 UTC Model H1 rev 1

As designed

Date: Fri May 01 09:39:14 2015

Administrative information

Building Details

Address: UTC Heathrow, London,

Owner Details

Name:

Telephone number: Phone

Address: , , Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.2

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.2

BRUKL compliance check version: v5.2.b.1

Certifier details

Name: Nicholas Roy Bradley

Telephone number: 07899 797945

Address: The Croft, 10 Birchwood Court, Bessacarr,
Doncaster, DN4 6SXCriterion 1: The calculated CO₂ emission rate for the building should not exceed the target

The building does not comply with England Building Regulations Part L 2013

1.1	CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	17.2
1.2	Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	17.2
1.3	Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	26.1
1.4	Are emissions from the building less than or equal to the target?	BER > TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

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

Values which do not meet standards in the 2013 Non-Domestic Building Services Compliance Guide are displayed in red.

2.a Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.24	0.24	1_000000:Surf[6]
Floor	0.25	0.2	0.2	1_000000:Surf[0]
Roof	0.25	0.14	0.14	10000009:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.02	1.6	17000006:Surf[1]
Personnel doors	2.2	2.18	2.18	24000000:Surf[1]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * There might be more than one surface where the maximum U-value occurs. ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. *** Display windows and similar glazing are excluded from the U-value check. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

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

2.b Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- BL01 LTHW Radiators

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0.12	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

2- BL03 LTHW_CHW FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.13	0	2.4	0.65
Standard value	0.91*	2.55	N/A	1.6	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- BL02 LTHW Radiators Local Extract

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0.9	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

4- BL05 LTHW_CHW Central AHU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	3.13	0	3	0.65
Standard value	0.91*	2.55	N/A	1.6	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(I/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I	Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1		
10 Music Tech Classroom	-	-	-	0.6	-	-	-	2.4	-	-	N/A
103 Electronics Lab	-	-	-	0.6	-	-	-	2.4	-	-	N/A
104 Learning Base 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A
105 Learning Base 2	-	-	-	0.6	-	-	-	2.4	-	-	N/A
11 Recording Audio Control Room	-	-	-	1.5	-	-	-	2.4	-	-	N/A
12 Light recording Room	-	-	-	0.6	-	-	-	2.4	-	-	N/A
123 Radio E	-	-	-	0.6	-	-	-	2.4	-	-	N/A
124 Meeting E	-	-	-	0.6	-	-	-	2.4	-	-	N/A
13 Recording teaching Space	-	-	-	0.6	-	-	-	2.4	-	-	N/A
131 Internal Learning 6	-	-	-	0.6	-	-	-	2.4	-	-	N/A
132 Media Hub	-	-	-	0.6	-	-	-	2.4	-	-	N/A
133 SEN	-	-	-	0.6	-	-	-	2.4	-	-	N/A
134 SEN Resources	-	-	-	0.6	-	-	-	2.4	-	-	N/A
135 IAG Careers	-	-	-	0.6	-	-	-	2.4	-	-	N/A
136 Radio F	-	-	-	0.6	-	-	-	2.4	-	-	N/A
137 Radio G	-	-	-	0.6	-	-	-	2.4	-	-	N/A
138 Meeting F	-	-	-	0.6	-	-	-	2.4	-	-	N/A
139 Meeting G	-	-	-	0.6	-	-	-	2.4	-	-	N/A
14 Practice 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A
140 Internal Learning 7	-	-	-	0.6	-	-	-	2.4	-	-	N/A
144 LRC	-	-	-	1.5	-	-	-	2.4	-	-	N/A
146 Media Hub	-	-	-	0.6	-	-	-	2.4	-	-	N/A
147 Internal Learning 8	-	-	-	0.6	-	-	-	2.4	-	-	N/A
148 Radio H	-	-	-	0.6	-	-	-	2.4	-	-	N/A
149 Meeting H	-	-	-	0.6	-	-	-	2.4	-	-	N/A
15 Practice 2	-	-	-	0.6	-	-	-	2.4	-	-	N/A
151 Seminar Room	-	-	-	0.6	-	-	-	2.4	-	-	N/A
16 Practice 3	-	-	-	0.6	-	-	-	2.4	-	-	N/A
161 Studio Control	-	-	-	1.5	-	-	-	2.4	-	-	N/A
169 Media Hub	-	-	-	0.6	-	-	-	2.4	-	-	N/A
175 Server and Hub Room	-	-	-	0.8	-	-	-	2.4	-	-	N/A
176 Hub Room	-	-	-	0.8	-	-	-	2.4	-	-	N/A
18 Practice 4	-	-	-	0.6	-	-	-	2.4	-	-	N/A
184 Hub Room	-	-	-	0.8	-	-	-	2.4	-	-	N/A
186 Cafe	-	-	-	0.6	-	-	-	2.4	-	-	N/A
19 Recording Audio Control Room	-	-	-	1.5	-	-	-	2.4	-	-	N/A
196 Staff Office	-	-	-	0.6	-	-	-	2.4	-	-	N/A
20 Live Music Studio	-	-	-	0.6	-	-	-	2.4	-	-	N/A
209 Hub Room	-	-	-	0.8	-	-	-	2.4	-	-	N/A
22 Drum Booth	-	-	-	0.6	-	-	-	2.4	-	-	N/A
23 Voice Booth	-	-	-	0.6	-	-	-	2.4	-	-	N/A
28 Sound Control Hub	-	-	-	1.5	-	-	-	2.4	-	-	N/A
35 Media Hub 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
36 Board Room	-	-	-	0.6	-	-	-	2.4	-	-	N/A
38 Reception_Admin	-	-	-	0.6	-	-	-	2.4	-	-	N/A
39 Interview Meeting	-	-	-	0.6	-	-	-	2.4	-	-	N/A
40 Sick Bay	-	-	-	0.6	-	-	-	2.4	-	-	N/A
41 Principle	-	-	-	0.6	-	-	-	2.4	-	-	N/A
42 Principle PA	-	-	-	0.6	-	-	-	2.4	-	-	N/A
47 Production Booth 1	-	-	-	1.5	-	-	-	2.4	-	-	N/A
48 Production Booth 2	-	-	-	1.5	-	-	-	2.4	-	-	N/A
49 Internal Learning	-	-	-	0.6	-	-	-	2.4	-	-	N/A
5 Dining	-	-	-	0.6	-	-	-	2.4	-	-	N/A
50 Media Hub 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A
51 Faculty Office	-	-	-	0.6	-	-	-	2.4	-	-	N/A
52 Faculty Workroom	-	-	-	0.6	-	-	-	2.4	-	-	N/A
53 Store	-	-	-	0.6	-	-	-	2.4	-	-	N/A
54 General Office Finance	-	-	-	0.6	-	-	-	2.4	-	-	N/A
55 Radio A	-	-	-	0.6	-	-	-	2.4	-	-	N/A
56 Radio B	-	-	-	0.6	-	-	-	2.4	-	-	N/A
57 Meeting A	-	-	-	0.6	-	-	-	2.4	-	-	N/A
58 Meeting B	-	-	-	0.6	-	-	-	2.4	-	-	N/A
60 Internal Learning 2	-	-	-	0.6	-	-	-	2.4	-	-	N/A
61 Media Hub	-	-	-	0.6	-	-	-	2.4	-	-	N/A
68 Science Lab 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A
69 Science Lab 2	-	-	-	0.6	-	-	-	2.4	-	-	N/A
70 Science Prep	-	-	-	0.6	-	-	-	2.4	-	-	N/A
71 Science Studio 1	-	-	-	0.6	-	-	-	2.4	-	-	N/A
72 Science Studio 2	-	-	-	0.6	-	-	-	2.4	-	-	N/A
73 IT Technician	-	-	-	0.6	-	-	-	2.4	-	-	N/A
76 First Aid	-	-	-	0.6	-	-	-	2.4	-	-	N/A
81 Science Lab 3	-	-	-	0.6	-	-	-	2.4	-	-	N/A
82 Internal Learning 3	-	-	-	0.6	-	-	-	2.4	-	-	N/A
83 Media Hub 4	-	-	-	0.6	-	-	-	2.4	-	-	N/A
84 Radio C	-	-	-	0.6	-	-	-	2.4	-	-	N/A
85 Radio D	-	-	-	0.6	-	-	-	2.4	-	-	N/A
87 Meeting C	-	-	-	0.6	-	-	-	2.4	-	-	N/A
88 Meeting D	-	-	-	0.6	-	-	-	2.4	-	-	N/A
89 Internal Learning 4	-	-	-	0.6	-	-	-	2.4	-	-	N/A
90 Media Hub	-	-	-	0.6	-	-	-	2.4	-	-	N/A
91 Faculty Office	-	-	-	0.6	-	-	-	2.4	-	-	N/A
92 Faculty Workroom	-	-	-	0.6	-	-	-	2.4	-	-	N/A
93 Art and Electronics Store	-	-	-	0.6	-	-	-	2.4	-	-	N/A
95 Art and Design	-	-	-	0.6	-	-	-	2.4	-	-	N/A
96 Media Hub 6	-	-	-	0.6	-	-	-	2.4	-	-	N/A
97 Internal Learning 5	-	-	-	0.6	-	-	-	2.4	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
59 Lobby		-	60	-	55
1 Bin Store		60	-	-	15
10 Music Tech Classroom		60	-	-	603
100 Staff WC		-	60	-	56
103 Electronics Lab		60	-	-	1602
104 Learning Base 1		60	-	-	433
105 Learning Base 2		60	-	-	449
106 Pupil WC		-	60	-	140
107 Staff WC		-	60	-	46
11 Recording Audio Control Room		60	-	-	252
111 Sports Hall		-	60	-	3562
113 Lobby		-	60	-	60
114 Stair Lobby		-	60	-	35
116 Stair		-	60	-	96
12 Light recording Room		60	-	-	330
120 Circulation		-	60	-	296
121 Circulation		-	60	-	296
122 Stair		-	60	-	93
123 Radio E		60	-	-	168
124 Meeting E		60	-	-	223
125 Sports Lobby		-	60	-	129
128 Bridge		-	60	-	67
129 Circulation		-	60	-	247
13 Recording teaching Space		60	-	-	561
130		-	60	-	64
130 Circulation		-	60	-	250
131 Internal Learning 6		60	-	-	491
132 Media Hub		60	-	-	418
133 SEN		60	-	-	90
134 SEN Resources		60	-	-	92
135 IAG Careers		60	-	-	93
136 Radio F		60	-	-	182
137 Radio G		60	-	-	180
138 Meeting F		60	-	-	196
139 Meeting G		60	-	-	193
14 Practice 1		60	-	-	103
140 Internal Learning 7		60	-	-	502
142 Lobby		-	60	-	55
144 LRC		60	-	-	1031
146 Media Hub		60	-	-	415
147 Internal Learning 8		60	-	-	559
148 Radio H		60	-	-	168

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
149 Meeting H		60	-	-	223
15 Practice 2		60	-	-	100
150 Lobby		-	60	-	56
151 Seminar Room		60	-	-	159
152 Maintenance		-	60	-	73
153 Pupil WC 8		-	60	-	140
154 Staff WC		-	60	-	46
155 Exam Store		60	-	-	28
157 Sprinkler Tank		60	-	-	196
158 Stair Lobby		-	60	-	35
16 Practice 3		60	-	-	106
160 Stair		-	60	-	85
161 Studio Control		60	-	-	196
162 TV Studio		60	-	-	664
163 Circulation		-	60	-	143
164 Circulation		-	60	-	62
165 Stair Lobby		-	60	-	30
168 Stair		-	60	-	82
169 Media Hub		60	-	-	432
17 Lobby		-	60	-	49
171 Circulation		-	60	-	241
172 Circulation		-	60	-	241
175 Server and Hub Room		60	-	-	94
176 Hub Room		60	-	-	36
18 Practice 4		60	-	-	132
180 Cafe Kiosk		-	60	-	218
184 Hub Room		60	-	-	46
186 Cafe		-	60	-	194
19 Recording Audio Control Room		60	-	-	175
192 Music Store		60	-	-	17
193 Staff WC		-	60	-	54
194 Pupil Change		-	60	-	243
195 Acc Changing		-	60	-	86
196 Staff Office		60	-	-	142
197 Pupil Changing 2		-	60	-	266
198 Sports Hall Store		60	-	-	66
2 Kitchen Plant		60	-	-	71
20 Live Music Studio		60	-	-	420
200 Change Lobby		-	60	-	29
201 Change Lobby		-	60	-	23
209 Hub Room		60	-	-	13
21 Music Store		60	-	-	20
211 Cleaners Store		60	-	-	9

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
22 Drum Booth		60	-	-	204
23 Voice Booth		60	-	-	145
24 Theatre 1		60	-	-	2197
25 Theatre 2		60	-	-	659
26 Theatre Lobby		-	60	-	120
27 TV Studio		60	-	-	882
28 Sound Control Hub		60	-	-	202
29 Plant Room		60	-	-	127
3 Kitchen WC		-	60	-	46
30 Stair		-	60	-	89
32 Stair Lobby		60	-	-	474
33 Pupil WC		-	60	-	151
34 Staff WC		-	60	-	47
35 Media Hub 1		60	-	-	391
36 Board Room		60	-	-	340
37 Entrance lobby		-	60	15	155
38 Reception_Admin		60	-	-	459
39 Interview Meeting		60	-	-	174
40 Sick Bay		60	-	-	133
41 Principle		60	-	-	185
42 Principle PA		60	-	-	153
43 Pupil WC		-	60	-	146
44 Visitor WC		-	60	-	44
45 Stair		-	60	-	90
47 Production Booth 1		60	-	-	130
48 Production Booth 2		60	-	-	130
48 Pulse North Zone		-	60	-	434
48 Pulse		-	60	-	34
48 Pulse South Zone		-	60	-	636
49 Internal Learning		60	-	-	491
5 Dining		-	60	-	622
50 Media Hub 1		60	-	-	418
51 Faculty Office		60	-	-	142
52 Faculty Workroom		60	-	-	228
53 Store		60	-	-	18
54 General Office Finance		60	-	-	230
55 Radio A		60	-	-	182
56 Radio B		60	-	-	180
57 Meeting A		60	-	-	196
58 Meeting B		60	-	-	193
6 Music Store		60	-	-	41
60 Internal Learning 2		60	-	-	502
61 Media Hub		60	-	-	432

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
62 Stair		-	60	-	93
63 Stair Lobby		-	60	-	49
65 Staff WC		-	60	-	56
66 Pupil WC 3		-	60	-	150
67 Cleancers Store		60	-	-	9
68 Science Lab 1		60	-	-	1682
69 Science Lab 2		60	-	-	1688
7 Lobby		-	60	-	31
70 Science Prep		60	-	-	836
71 Science Studio 1		60	-	-	1495
72 Science Studio 2		60	-	-	1519
73 IT Technician		60	-	-	304
74 Pupil WC		-	60	-	142
75 Staff WC		-	60	-	47
76 First Aid		60	-	-	180
78 Stair Lobby		-	60	-	35
79 Stair		-	60	-	96
8 Chair Store		60	-	-	31
80		-	60	-	106
81 Science Lab 3		60	-	-	1849
82 Internal Learning 3		60	-	-	491
83 Media Hub 4		60	-	-	418
84 Radio C		60	-	-	182
85 Radio D		60	-	-	180
86 Lobby		-	60	-	55
87 Meeting C		60	-	-	196
88 Meeting D		60	-	-	193
89 Internal Learning 4		60	-	-	502
9 Stair Lobby		-	60	-	65
90 Media Hub		60	-	-	432
91 Faculty Office		60	-	-	142
92 Faculty Workroom		60	-	-	228
93 Art and Electronics Store		60	-	-	39
95 Art and Design		60	-	-	755
96 Media Hub 6		60	-	-	405
97 Internal Learning 5		60	-	-	559
98 Stair Lobby		-	60	-	49
Kitchen 4		-	60	-	877
Media Storage		60	-	-	38
119 Bridge		-	60	-	67
Stage Step Area		-	60	-	92

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
10 Music Tech Classroom	NO (-59.7%)	YES
103 Electronics Lab	NO (-88.2%)	YES
104 Learning Base 1	NO (-90.9%)	YES
105 Learning Base 2	NO (-90.9%)	YES
11 Recording Audio Control Room	N/A	N/A
111 Sports Hall	N/A	N/A
12 Light recording Room	N/A	N/A
123 Radio E	N/A	N/A
124 Meeting E	N/A	N/A
13 Recording teaching Space	NO (-63.5%)	YES
131 Internal Learning 6	NO (-13%)	YES
132 Media Hub	NO (-86.7%)	YES
133 SEN	N/A	N/A
134 SEN Resources	N/A	N/A
135 IAG Careers	N/A	N/A
136 Radio F	YES (+39%)	YES
137 Radio G	YES (+35.7%)	YES
138 Meeting F	N/A	N/A
139 Meeting G	N/A	N/A
14 Practice 1	NO (-80%)	YES
140 Internal Learning 7	NO (-16.3%)	YES
144 LRC	NO (-87.6%)	YES
146 Media Hub	NO (-90.2%)	YES
147 Internal Learning 8	NO (-87.5%)	YES
148 Radio H	N/A	N/A
149 Meeting H	N/A	N/A
15 Practice 2	N/A	N/A
151 Seminar Room	NO (-100%)	NO
16 Practice 3	N/A	N/A
161 Studio Control	N/A	N/A
162 TV Studio	N/A	N/A
169 Media Hub	NO (-85.9%)	YES
175 Server and Hub Room	N/A	N/A
176 Hub Room	N/A	N/A
18 Practice 4	NO (-82.3%)	YES
184 Hub Room	N/A	N/A
186 Cafe	N/A	N/A
19 Recording Audio Control Room	N/A	N/A
196 Staff Office	N/A	N/A
20 Live Music Studio	N/A	N/A
209 Hub Room	N/A	N/A
22 Drum Booth	N/A	N/A
23 Voice Booth	N/A	N/A
24 Theatre 1	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
25 Theatre 2	N/A	N/A
27 TV Studio	N/A	N/A
28 Sound Control Hub	N/A	N/A
32 Stair Lobby	NO (-64%)	YES
35 Media Hub 1	NO (-75.4%)	YES
36 Board Room	NO (-84.4%)	YES
37 Entrance lobby	NO (-72.7%)	YES
38 Reception_Admin	NO (-77.5%)	YES
39 Interview Meeting	NO (-82.7%)	YES
40 Sick Bay	N/A	N/A
41 Principle	N/A	N/A
42 Principle PA	N/A	N/A
47 Production Booth 1	N/A	N/A
48 Production Booth 2	N/A	N/A
49 Internal Learning	NO (-12.1%)	YES
5 Dining	NO (-41%)	YES
50 Media Hub 1	NO (-87.3%)	YES
51 Faculty Office	NO (-93.6%)	YES
52 Faculty Workroom	N/A	N/A
53 Store	N/A	N/A
54 General Office Finance	N/A	N/A
55 Radio A	YES (+41.3%)	YES
56 Radio B	YES (+37.5%)	YES
57 Meeting A	N/A	N/A
58 Meeting B	N/A	N/A
60 Internal Learning 2	NO (-15%)	YES
61 Media Hub	NO (-87.3%)	YES
68 Science Lab 1	NO (-87.2%)	YES
69 Science Lab 2	NO (-89.4%)	YES
70 Science Prep	NO (-90.5%)	YES
71 Science Studio 1	NO (-90%)	YES
72 Science Studio 2	NO (-87.5%)	YES
73 IT Technician	NO (-92.7%)	YES
76 First Aid	N/A	N/A
81 Science Lab 3	NO (-88.8%)	YES
82 Internal Learning 3	NO (-9.4%)	YES
83 Media Hub 4	NO (-87.2%)	YES
84 Radio C	YES (+43.7%)	YES
85 Radio D	YES (+40.8%)	YES
87 Meeting C	N/A	N/A
88 Meeting D	N/A	N/A
89 Internal Learning 4	NO (-11.4%)	YES
90 Media Hub	NO (-87.3%)	YES
91 Faculty Office	NO (-93.6%)	YES
92 Faculty Workroom	N/A	N/A
93 Art and Electronics Store	N/A	N/A
95 Art and Design	NO (-88.5%)	YES
96 Media Hub 6	NO (-90.4%)	YES
97 Internal Learning 5	NO (-87.8%)	YES

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	6719.1	6719.1
External area [m ²]	7879.9	7879.9
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	2491.56	0
Average U-value [W/m ² K]	0.32	0
Alpha value* [%]	8.27	10

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

Building Use

% Area Building Type

A1/A2 Retail/Financial and Professional services
A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
B1 Offices and Workshop businesses
B2 to B7 General Industrial and Special Industrial Groups
B8 Storage or Distribution
C1 Hotels
C2 Residential Inst.: Hospitals and Care Homes
C2 Residential Inst.: Residential schools
C2 Residential Inst.: Universities and colleges
C2A Secure Residential Inst.
Residential spaces
D1 Non-residential Inst.: Community/Day Centre
D1 Non-residential Inst.: Libraries, Museums, and Galleries

99 D1 Non-residential Inst.: Education

D1 Non-residential Inst.: Primary Health Care Building
D1 Non-residential Inst.: Crown and County Courts
D2 General Assembly and Leisure, Night Clubs and Theatres
Others: Passenger terminals
Others: Emergency services

1 Others: Miscellaneous 24hr activities

Others: Car Parks 24 hrs
Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	11.47	11.98
Cooling	4	2.01
Auxiliary	18.49	10.75
Lighting	17.22	13.58
Hot water	16.33	6.07
Equipment*	24.16	24.16
TOTAL **	67.51	44.38

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

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

Energy Production by Technology [kWh/m²]

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

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	78.03	64.56
Primary energy* [kWh/m ²]	152.77	100.85
Total emissions [kg/m ²]	26.1	17.2

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

HVAC Systems Performance										
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	28.4	0	9.7	0	2.4	0.81	0	0.91	0	
Notional	19.2	0	6.2	0	1.1	0.86	0	----	----	
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	30.2	87.3	10	8	29.2	0.84	3.05	0.91	4.5	
Notional	41.6	54	13.4	4	17.4	0.86	3.79	----	----	
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	30.4	0	10.4	0	22	0.81	0	0.91	0	
Notional	46	0	14.8	0	12.3	0.86	0	----	----	
[ST] Constant volume system (variable fresh air rate), [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
Actual	91	11.6	28.2	1.7	25.8	0.9	1.88	0.91	4.5	
Notional	85.7	14.5	27.6	1.1	14.4	0.86	3.79	----	----	

Key to terms

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

Key Features

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

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.24	1_000000:Surf[6]
Floor	0.2	0.2	1_000000:Surf[0]
Roof	0.15	0.14	10000009:Surf[0]
Windows, roof windows, and rooflights	1.5	0.24	1_000000:Surf[2]
Personnel doors	1.5	2.18	24000000:Surf[1]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
U _{i-Typ} = Typical individual element U-values [W/(m²K)]		U _{i-Min} = Minimum individual element U-values [W/(m²K)]	
* There might be more than one surface where the minimum U-value occurs.			

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

Appendix C

Project name

Modular and Portable

150429 UTC Model H2 rev 1

As designed

Date: Fri May 01 10:02:01 2015

Administrative information

Building Details

Address: UTC Heathrow, London,

Owner Details

Name:

Telephone number: Phone

Address: , , Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.2

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.2

BRUKL compliance check version: v5.2.b.1

Certifier details

Name: Nicholas Roy Bradley

Telephone number: 07899 797945

Address: The Croft, 10 Birchwood Court, Bessacarr,
Doncaster, DN4 6SXCriterion 1: The calculated CO₂ emission rate for the building should not exceed the target

The building does not comply with England Building Regulations Part L 2013

1.1	CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	14.8
1.2	Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	14.8
1.3	Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	15.3
1.4	Are emissions from the building less than or equal to the target?	BER > TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

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

Values which do not meet standards in the 2013 Non-Domestic Building Services Compliance Guide are displayed in red.

2.a Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.24	0.24	1_000000:Surf[6]
Floor	0.25	0.21	0.21	1_000000:Surf[0]
Roof	0.25	0.14	0.14	10000009:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.47	1.98	14000007:Surf[6]
Personnel doors	2.2	2.11	2.2	24000000:Surf[1]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * There might be more than one surface where the maximum U-value occurs. ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. *** Display windows and similar glazing are excluded from the U-value check. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

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

2.b Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- 02 VRF HRU Ducted Units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.13	0	0	0.77
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

2- 05 LTHW Radiant Panels Local Extract

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.9	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

3- 01 VRF Ducted Units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.13	0	0	0.77
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

4- 06 LTHW UFH Natural vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.3	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

5- 03 LTHW Radiators Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.15	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

6- 04 LTHW Radiant Panels Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.9	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

7- 08 Packaged AHU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.13	0	1.6	0.75
Standard value	2.5*	3.2	N/A	1.6	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.5	0	0	-
Standard value	2.5*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
10 Music Tech Classroom	1.9	-	-	-	-	-	-	-	-	-	N/A	
103 Electronics Lab	1.9	-	-	-	-	-	-	-	-	-	N/A	
104 Learning Base 1	1.9	-	-	-	-	-	-	-	-	-	N/A	
105 Learning Base 2	1.9	-	-	-	-	-	-	-	-	-	N/A	
11 Recording Audio Control Room	1.9	-	-	-	-	-	-	-	-	-	N/A	
12 Light recording Room	1.9	-	-	-	-	-	-	-	-	-	N/A	
123 Radio E	1.9	-	-	-	-	-	-	-	-	-	N/A	
124 Meeting E	1.9	-	-	-	-	-	-	-	-	-	N/A	
13 Recording teaching Space	1.9	-	-	-	-	-	-	-	-	-	N/A	
131 Internal Learning 6	1.9	-	-	-	-	-	-	-	-	-	N/A	
132 Media Hub	1.9	-	-	-	-	-	-	-	-	-	N/A	
133 SEN	1.9	-	-	-	-	-	-	-	-	-	N/A	
134 SEN Resources	1.9	-	-	-	-	-	-	-	-	-	N/A	
135 IAG Careers	1.9	-	-	-	-	-	-	-	-	-	N/A	
136 Radio F	1.9	-	-	-	-	-	-	-	-	-	N/A	
137 Radio G	1.9	-	-	-	-	-	-	-	-	-	N/A	
138 Meeting F	1.9	-	-	-	-	-	-	-	-	-	N/A	
139 Meeting G	1.9	-	-	-	-	-	-	-	-	-	N/A	
14 Practice 1	1.9	-	-	-	-	-	-	-	-	-	N/A	
140 Internal Learning 7	1.9	-	-	-	-	-	-	-	-	-	N/A	
144 LRC	1.9	-	-	-	-	-	-	-	-	-	N/A	
146 Media Hub	1.9	-	-	-	-	-	-	-	-	-	N/A	
147 Internal Learning 8	1.9	-	-	-	-	-	-	-	-	-	N/A	

Zone name	SFP [W/(I/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
148 Radio H	1.9	-	-	-	-	-	-	-	-	-	N/A
149 Meeting H	1.9	-	-	-	-	-	-	-	-	-	N/A
15 Practice 2	1.9	-	-	-	-	-	-	-	-	-	N/A
151 Seminar Room	1.9	-	-	-	-	-	-	-	-	-	N/A
16 Practice 3	1.9	-	-	-	-	-	-	-	-	-	N/A
161 Studio Control	1.9	-	-	-	-	-	-	-	-	-	N/A
169 Media Hub	1.9	-	-	-	-	-	-	-	-	-	N/A
18 Practice 4	1.9	-	-	-	-	-	-	-	-	-	N/A
186 Cafe	1.9	-	-	-	-	-	-	-	-	-	N/A
19 Recording Audio Control Room	1.9	-	-	-	-	-	-	-	-	-	N/A
196 Staff Office	1.9	-	-	-	-	-	-	-	-	-	N/A
20 Live Music Studio	1.9	-	-	-	-	-	-	-	-	-	N/A
22 Drum Booth	1.9	-	-	-	-	-	-	-	-	-	N/A
23 Voice Booth	1.9	-	-	-	-	-	-	-	-	-	N/A
28 Sound Control Hub	1.9	-	-	-	-	-	-	-	-	-	N/A
35 Media Hub 1	1.9	-	-	-	-	-	-	-	-	-	N/A
36 Board Room	1.9	-	-	-	-	-	-	-	-	-	N/A
38 Reception_Admin	1.9	-	-	-	-	-	-	-	-	-	N/A
39 Interview Meeting	1.9	-	-	-	-	-	-	-	-	-	N/A
40 Sick Bay	1.9	-	-	-	-	-	-	-	-	-	N/A
41 Principle	1.9	-	-	-	-	-	-	-	-	-	N/A
42 Principle PA	1.9	-	-	-	-	-	-	-	-	-	N/A
47 Production Booth 1	1.9	-	-	-	-	-	-	-	-	-	N/A
48 Production Booth 2	1.9	-	-	-	-	-	-	-	-	-	N/A
49 Internal Learning	1.9	-	-	-	-	-	-	-	-	-	N/A
5 Dining	1.9	-	-	-	-	-	-	-	-	-	N/A
50 Media Hub 1	1.9	-	-	-	-	-	-	-	-	-	N/A
51 Faculty Office	1.9	-	-	-	-	-	-	-	-	-	N/A
52 Faculty Workroom	1.9	-	-	-	-	-	-	-	-	-	N/A
53 Store	1.9	-	-	-	-	-	-	-	-	-	N/A
54 General Office Finance	1.9	-	-	-	-	-	-	-	-	-	N/A
55 Radio A	1.9	-	-	-	-	-	-	-	-	-	N/A
56 Radio B	1.9	-	-	-	-	-	-	-	-	-	N/A
57 Meeting A	1.9	-	-	-	-	-	-	-	-	-	N/A
58 Meeting B	1.9	-	-	-	-	-	-	-	-	-	N/A
60 Internal Learning 2	1.9	-	-	-	-	-	-	-	-	-	N/A
61 Media Hub	1.9	-	-	-	-	-	-	-	-	-	N/A
68 Science Lab 1	1.9	-	-	-	-	-	-	-	-	-	N/A
69 Science Lab 2	1.9	-	-	-	-	-	-	-	-	-	N/A
70 Science Prep	1.9	-	-	-	-	-	-	-	-	-	N/A
71 Science Studio 1	1.9	-	-	-	-	-	-	-	-	-	N/A
72 Science Studio 2	1.9	-	-	-	-	-	-	-	-	-	N/A
73 IT Technician	1.9	-	-	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
76 First Aid	1.9	-	-	-	-	-	-	-	-	-	N/A
81 Science Lab 3	1.9	-	-	-	-	-	-	-	-	-	N/A
82 Internal Learning 3	1.9	-	-	-	-	-	-	-	-	-	N/A
83 Media Hub 4	1.9	-	-	-	-	-	-	-	-	-	N/A
84 Radio C	1.9	-	-	-	-	-	-	-	-	-	N/A
85 Radio D	1.9	-	-	-	-	-	-	-	-	-	N/A
87 Meeting C	1.9	-	-	-	-	-	-	-	-	-	N/A
88 Meeting D	1.9	-	-	-	-	-	-	-	-	-	N/A
89 Internal Learning 4	1.9	-	-	-	-	-	-	-	-	-	N/A
90 Media Hub	1.9	-	-	-	-	-	-	-	-	-	N/A
91 Faculty Office	1.9	-	-	-	-	-	-	-	-	-	N/A
92 Faculty Workroom	1.9	-	-	-	-	-	-	-	-	-	N/A
93 Art and Electronics Store	1.9	-	-	-	-	-	-	-	-	-	N/A
95 Art and Design	1.9	-	-	-	-	-	-	-	-	-	N/A
96 Media Hub 6	1.9	-	-	-	-	-	-	-	-	-	N/A
97 Internal Learning 5	1.9	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
59 Lobby		-	60	-	55
1 Bin Store		60	-	-	15
10 Music Tech Classroom		60	-	-	603
100 Staff WC		-	60	-	56
103 Electronics Lab		60	-	-	1602
104 Learning Base 1		60	-	-	433
105 Learning Base 2		60	-	-	449
106 Pupil WC		-	60	-	140
107 Staff WC		-	60	-	46
11 Recording Audio Control Room		60	-	-	252
111 Sports Hall		-	60	-	3562
113 Lobby		-	60	-	60
114 Stair Lobby		-	60	-	35
116 Stair		-	60	-	96
12 Light recording Room		60	-	-	330
120 Circulation		-	60	-	296
121 Circulation		-	60	-	296
122 Stair		-	60	-	93
123 Radio E		60	-	-	168
124 Meeting E		60	-	-	223
125 Sports Lobby		-	60	-	129
128 Bridge		-	60	-	67
129 Circulation		-	60	-	247

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
13 Recording teaching Space		60	-	-	561
130		-	60	-	64
130 Circulation		-	60	-	250
131 Internal Learning 6		60	-	-	491
132 Media Hub		60	-	-	418
133 SEN		60	-	-	90
134 SEN Resources		60	-	-	92
135 IAG Careers		60	-	-	93
136 Radio F		60	-	-	182
137 Radio G		60	-	-	180
138 Meeting F		60	-	-	196
139 Meeting G		60	-	-	193
14 Practice 1		60	-	-	103
140 Internal Learning 7		60	-	-	502
142 Lobby		-	60	-	55
144 LRC		60	-	-	1031
146 Media Hub		60	-	-	415
147 Internal Learning 8		60	-	-	559
148 Radio H		60	-	-	168
149 Meeting H		60	-	-	223
15 Practice 2		60	-	-	100
150 Lobby		-	60	-	56
151 Seminar Room		60	-	-	159
152 Maintenance		-	60	-	73
153 Pupil WC 8		-	60	-	140
154 Staff WC		-	60	-	46
155 Exam Store		60	-	-	28
157 Sprinkler Tank		60	-	-	196
158 Stair Lobby		-	60	-	35
16 Practice 3		60	-	-	106
160 Stair		-	60	-	85
161 Studio Control		60	-	-	196
162 TV Studio		60	-	-	664
163 Circulation		-	60	-	143
164 Circulation		-	60	-	62
165 Stair Lobby		-	60	-	30
168 Stair		-	60	-	82
169 Media Hub		60	-	-	432
17 Lobby		-	60	-	49
171 Circulation		-	60	-	241
172 Circulation		-	60	-	241
175 Server and Hub Room		60	-	-	94
176 Hub Room		60	-	-	36

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
18 Practice 4		60	-	-	132
180 Cafe Kiosk		-	60	-	218
184 Hub Room		60	-	-	46
186 Cafe		-	60	-	194
19 Recording Audio Control Room		60	-	-	175
192 Music Store		60	-	-	17
193 Staff WC		-	60	-	54
194 Pupil Change		-	60	-	243
195 Acc Changing		-	60	-	86
196 Staff Office		60	-	-	142
197 Pupil Changing 2		-	60	-	266
198 Sports Hall Store		60	-	-	66
2 Kitchen Plant		60	-	-	71
20 Live Music Studio		60	-	-	420
200 Change Lobby		-	60	-	29
201 Change Lobby		-	60	-	23
209 Hub Room		60	-	-	13
21 Music Store		60	-	-	20
211 Cleaners Store		60	-	-	9
22 Drum Booth		60	-	-	204
23 Voice Booth		60	-	-	145
24 Theatre 1		60	-	-	2197
25 Theatre 2		60	-	-	659
26 Theatre Lobby		-	60	-	120
27 TV Studio		60	-	-	882
28 Sound Control Hub		60	-	-	202
29 Plant Room		60	-	-	127
3 Kitchen WC		-	60	-	46
30 Stair		-	60	-	89
32 Stair Lobby		60	-	-	474
33 Pupil WC		-	60	-	151
34 Staff WC		-	60	-	47
35 Media Hub 1		60	-	-	391
36 Board Room		60	-	-	340
37 Entrance lobby		-	60	15	155
38 Reception_Admin		60	-	-	459
39 Interview Meeting		60	-	-	174
40 Sick Bay		60	-	-	133
41 Principle		60	-	-	185
42 Principle PA		60	-	-	153
43 Pupil WC		-	60	-	146
44 Visitor WC		-	60	-	44
45 Stair		-	60	-	90

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
47 Production Booth 1		60	-	-	130
48 Production Booth 2		60	-	-	130
48 Pulse North Zone		-	60	-	434
48 Pulse		-	60	-	34
48 Pulse South Zone		-	60	-	636
49 Internal Learning		60	-	-	491
5 Dining		-	60	-	622
50 Media Hub 1		60	-	-	418
51 Faculty Office		60	-	-	142
52 Faculty Workroom		60	-	-	228
53 Store		60	-	-	18
54 General Office Finance		60	-	-	230
55 Radio A		60	-	-	182
56 Radio B		60	-	-	180
57 Meeting A		60	-	-	196
58 Meeting B		60	-	-	193
6 Music Store		60	-	-	41
60 Internal Learning 2		60	-	-	502
61 Media Hub		60	-	-	432
62 Stair		-	60	-	93
63 Stair Lobby		-	60	-	49
65 Staff WC		-	60	-	56
66 Pupil WC 3		-	60	-	150
67 Cleancers Store		60	-	-	9
68 Science Lab 1		60	-	-	1682
69 Science Lab 2		60	-	-	1688
7 Lobby		-	60	-	31
70 Science Prep		60	-	-	836
71 Science Studio 1		60	-	-	1495
72 Science Studio 2		60	-	-	1519
73 IT Technician		60	-	-	304
74 Pupil WC		-	60	-	142
75 Staff WC		-	60	-	47
76 First Aid		60	-	-	180
78 Stair Lobby		-	60	-	35
79 Stair		-	60	-	96
8 Chair Store		60	-	-	31
80		-	60	-	106
81 Science Lab 3		60	-	-	1849
82 Internal Learning 3		60	-	-	491
83 Media Hub 4		60	-	-	418
84 Radio C		60	-	-	182
85 Radio D		60	-	-	180

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
86 Lobby		-	60	-	55
87 Meeting C		60	-	-	196
88 Meeting D		60	-	-	193
89 Internal Learning 4		60	-	-	502
9 Stair Lobby		-	60	-	65
90 Media Hub		60	-	-	432
91 Faculty Office		60	-	-	142
92 Faculty Workroom		60	-	-	228
93 Art and Electronics Store		60	-	-	39
95 Art and Design		60	-	-	755
96 Media Hub 6		60	-	-	405
97 Internal Learning 5		60	-	-	559
98 Stair Lobby		-	60	-	49
Kitchen 4		-	60	-	877
Media Storeage		60	-	-	38
119 Bridge		-	60	-	67
Stage Step Area		-	60	-	92

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
10 Music Tech Classroom	NO (-59.6%)	YES
103 Electronics Lab	NO (-88.2%)	YES
104 Learning Base 1	NO (-90.8%)	YES
105 Learning Base 2	NO (-90.9%)	YES
11 Recording Audio Control Room	N/A	N/A
111 Sports Hall	N/A	N/A
12 Light recording Room	N/A	N/A
123 Radio E	N/A	N/A
124 Meeting E	N/A	N/A
13 Recording teaching Space	NO (-63.4%)	YES
131 Internal Learning 6	NO (-12.8%)	YES
132 Media Hub	NO (-86.7%)	YES
133 SEN	N/A	N/A
134 SEN Resources	N/A	N/A
135 IAG Careers	N/A	N/A
136 Radio F	YES (+39.2%)	YES
137 Radio G	YES (+35.9%)	YES
138 Meeting F	N/A	N/A
139 Meeting G	N/A	N/A
14 Practice 1	NO (-79.9%)	YES
140 Internal Learning 7	NO (-7.8%)	YES
144 LRC	NO (-87.6%)	YES
146 Media Hub	NO (-90.2%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
147 Internal Learning 8	NO (-87.5%)	YES
148 Radio H	N/A	N/A
149 Meeting H	N/A	N/A
15 Practice 2	N/A	N/A
151 Seminar Room	N/A	N/A
16 Practice 3	N/A	N/A
161 Studio Control	N/A	N/A
162 TV Studio	N/A	N/A
169 Media Hub	NO (-85.9%)	YES
175 Server and Hub Room	N/A	N/A
176 Hub Room	N/A	N/A
18 Practice 4	NO (-82.3%)	YES
184 Hub Room	N/A	N/A
186 Cafe	N/A	N/A
19 Recording Audio Control Room	N/A	N/A
196 Staff Office	N/A	N/A
20 Live Music Studio	N/A	N/A
209 Hub Room	N/A	N/A
22 Drum Booth	N/A	N/A
23 Voice Booth	N/A	N/A
24 Theatre 1	N/A	N/A
25 Theatre 2	N/A	N/A
27 TV Studio	N/A	N/A
28 Sound Control Hub	N/A	N/A
32 Stair Lobby	NO (-68.2%)	YES
35 Media Hub 1	NO (-75.3%)	YES
36 Board Room	NO (-84.4%)	YES
37 Entrance lobby	NO (-75.7%)	YES
38 Reception_Admin	NO (-77.5%)	YES
39 Interview Meeting	NO (-82.7%)	YES
40 Sick Bay	N/A	N/A
41 Principle	N/A	N/A
42 Principle PA	N/A	N/A
47 Production Booth 1	N/A	N/A
48 Production Booth 2	N/A	N/A
49 Internal Learning	NO (-11.9%)	YES
5 Dining	NO (-40.8%)	YES
50 Media Hub 1	NO (-87.3%)	YES
51 Faculty Office	NO (-93.6%)	YES
52 Faculty Workroom	N/A	N/A
53 Store	N/A	N/A
54 General Office Finance	N/A	N/A
55 Radio A	YES (+41.7%)	YES
56 Radio B	YES (+37.8%)	YES
57 Meeting A	N/A	N/A
58 Meeting B	N/A	N/A
60 Internal Learning 2	NO (-6.8%)	YES
61 Media Hub	NO (-87.3%)	YES
68 Science Lab 1	NO (-87.2%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
69 Science Lab 2	NO (-89.4%)	YES
70 Science Prep	NO (-90.5%)	YES
71 Science Studio 1	NO (-90%)	YES
72 Science Studio 2	NO (-87.5%)	YES
73 IT Technician	NO (-92.7%)	YES
76 First Aid	N/A	N/A
81 Science Lab 3	NO (-88.8%)	YES
82 Internal Learning 3	NO (-9.1%)	YES
83 Media Hub 4	NO (-87.2%)	YES
84 Radio C	YES (+44%)	YES
85 Radio D	YES (+41%)	YES
87 Meeting C	N/A	N/A
88 Meeting D	N/A	N/A
89 Internal Learning 4	NO (-2.9%)	YES
90 Media Hub	NO (-87.3%)	YES
91 Faculty Office	NO (-93.6%)	YES
92 Faculty Workroom	N/A	N/A
93 Art and Electronics Store	N/A	N/A
95 Art and Design	NO (-88.5%)	YES
96 Media Hub 6	NO (-90.4%)	YES
97 Internal Learning 5	NO (-87.8%)	YES

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	6719.1	6719.1
External area [m ²]	7879.9	7879.9
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	2544.21	0
Average U-value [W/m ² K]	0.32	0
Alpha value* [%]	7.49	10

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

Building Use

% Area Building Type

A1/A2 Retail/Financial and Professional services
A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
B1 Offices and Workshop businesses
B2 to B7 General Industrial and Special Industrial Groups
B8 Storage or Distribution
C1 Hotels
C2 Residential Inst.: Hospitals and Care Homes
C2 Residential Inst.: Residential schools
C2 Residential Inst.: Universities and colleges
C2A Secure Residential Inst.
Residential spaces
D1 Non-residential Inst.: Community/Day Centre
D1 Non-residential Inst.: Libraries, Museums, and Galleries
99 D1 Non-residential Inst.: Education
D1 Non-residential Inst.: Primary Health Care Building
D1 Non-residential Inst.: Crown and County Courts
D2 General Assembly and Leisure, Night Clubs and Theatres
Others: Passenger terminals
Others: Emergency services
1 Others: Miscellaneous 24hr activities
Others: Car Parks 24 hrs
Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	3.17	6.91
Cooling	2.18	1.31
Auxiliary	5.6	4.59
Lighting	14.71	13.61
Hot water	8.27	5.82
Equipment*	24.16	24.16
TOTAL **	33.94	32.23

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

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

Energy Production by Technology [kWh/m²]

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

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	52.14	72.24
Primary energy* [kWh/m ²]	89.25	100.54
Total emissions [kg/m ²]	15.3	14.8

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

HVAC Systems Performance										
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Central heating using water: radiators, [HS] District heating, [HFT] Natural Gas, [CFT] Electricity										
Actual	39.4	0	12.3	0	2.1	0.89	0	1	0	
Notional	31.6	0	8.8	0	1.2	1	0	----	----	
[ST] Central heating using water: radiators, [HS] District heating, [HFT] Natural Gas, [CFT] Electricity										
Actual	25.2	0	7.8	0	9.8	0.89	0	1	0	
Notional	40.4	0	11.2	0	12.3	1	0	----	----	
[ST] Central heating using water: radiators, [HS] District heating, [HFT] Natural Gas, [CFT] Electricity										
Actual	22.2	0	6.9	0	2.2	0.89	0	1	0	
Notional	5.8	0	1.6	0	1.2	1	0	----	----	
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
Actual	24.5	66.3	1.8	5.2	7	3.73	3.55	4	5	
Notional	113.3	20.7	12.3	2	5	2.56	2.84	----	----	
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
Actual	26	27.5	1.8	2	6.8	3.92	3.74	4	5	
Notional	90.6	11.1	9.8	1.1	5.2	2.56	2.84	----	----	
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
Actual	0	1487.6	0	110.6	0	3.92	3.74	4	5	
Notional	9.2	1010.5	1	74.1	0	2.56	3.79	----	----	
[ST] Single-duct VAV, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
Actual	57	12.3	5	1	15.8	3.14	3.33	4	5	
Notional	82.2	18.2	8.9	1.3	14.4	2.56	3.79	----	----	
[ST] Central heating using water: radiators, [HS] District heating, [HFT] Natural Gas, [CFT] Electricity										
Actual	19.2	0	6	0	2.1	0.89	0	1	0	
Notional	8.2	0	2.3	0	1.2	1	0	----	----	

Key to terms

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

Key Features

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

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	1_000000:Surf[2]
Floor	0.2	0.21	1_000000:Surf[0]
Roof	0.15	0.14	10000009:Surf[0]
Windows, roof windows, and rooflights	1.5	1.2	10000000:Surf[1]
Personnel doors	1.5	2	30000000:Surf[1]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
U _{i-Typ} = Typical individual element U-values [W/(m²K)]		U _{i-Min} = Minimum individual element U-values [W/(m²K)]	
* There might be more than one surface where the minimum U-value occurs.			

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

Appendix D

Project name

Modular and Portable

150429 UTC Model H3 rev 4

As designed

Date: Fri May 01 11:13:45 2015

Administrative information

Building Details

Address: Global Academy UTC, London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.2

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.2

BRUKL compliance check version: v5.2.b.1

Owner Details

Name:

Telephone number: Phone

Address: , , Postcode

Certifier details

Name: Nicholas Roy Bradley

Telephone number: 07899 797945

Address: The Croft, 10 Birchwood Court, Bessacarr,
Doncaster, DN4 6SXCriterion 1: The calculated CO₂ emission rate for the building should not exceed the target

1.1	CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	14.8
1.2	Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	14.8
1.3	Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	14
1.4	Are emissions from the building less than or equal to the target?	BER ≤ TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

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

Values which do not meet standards in the 2013 Non-Domestic Building Services Compliance Guide are displayed in red.

2.a Building fabric

Element	U _a -Limit	U _a -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.24	0.24	1_000000:Surf[6]
Floor	0.25	0.21	0.21	1_000000:Surf[0]
Roof	0.25	0.14	0.14	10000009:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.47	1.98	14000007:Surf[6]
Personnel doors	2.2	2.11	2.2	24000000:Surf[1]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] U _i -Calc = Calculated maximum individual element U-values [W/(m ² K)] * There might be more than one surface where the maximum U-value occurs. ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. *** Display windows and similar glazing are excluded from the U-value check. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

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

2.b Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- 02 VRF HRU Ducted Units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.13	0	0	0.77
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

2- 05 LTHW Radiant Panels Local Extract

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.9	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

3- 01 VRF Ducted Units

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.13	0	0	0.77
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

4- 06 LTHW UFH Natural vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.3	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

5- 03 LTHW Radiators Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.15	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

6- 04 LTHW Radiant Panels Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.9	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

7- 08 Packaged AHU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.13	0	1.6	0.75
Standard value	2.5*	3.2	N/A	1.6	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.5	0	0	-
Standard value	2.5*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
10 Music Tech Classroom	1.9	-	-	-	-	-	-	-	-	-	N/A	
103 Electronics Lab	1.9	-	-	-	-	-	-	-	-	-	N/A	
104 Learning Base 1	1.9	-	-	-	-	-	-	-	-	-	N/A	
105 Learning Base 2	1.9	-	-	-	-	-	-	-	-	-	N/A	
11 Recording Audio Control Room	1.9	-	-	-	-	-	-	-	-	-	N/A	
12 Light recording Room	1.9	-	-	-	-	-	-	-	-	-	N/A	
123 Radio E	1.9	-	-	-	-	-	-	-	-	-	N/A	
124 Meeting E	1.9	-	-	-	-	-	-	-	-	-	N/A	
13 Recording teaching Space	1.9	-	-	-	-	-	-	-	-	-	N/A	
131 Internal Learning 6	1.9	-	-	-	-	-	-	-	-	-	N/A	
132 Media Hub	1.9	-	-	-	-	-	-	-	-	-	N/A	
133 SEN	1.9	-	-	-	-	-	-	-	-	-	N/A	
134 SEN Resources	1.9	-	-	-	-	-	-	-	-	-	N/A	
135 IAG Careers	1.9	-	-	-	-	-	-	-	-	-	N/A	
136 Radio F	1.9	-	-	-	-	-	-	-	-	-	N/A	
137 Radio G	1.9	-	-	-	-	-	-	-	-	-	N/A	
138 Meeting F	1.9	-	-	-	-	-	-	-	-	-	N/A	
139 Meeting G	1.9	-	-	-	-	-	-	-	-	-	N/A	
14 Practice 1	1.9	-	-	-	-	-	-	-	-	-	N/A	
140 Internal Learning 7	1.9	-	-	-	-	-	-	-	-	-	N/A	
144 LRC	1.9	-	-	-	-	-	-	-	-	-	N/A	
146 Media Hub	1.9	-	-	-	-	-	-	-	-	-	N/A	
147 Internal Learning 8	1.9	-	-	-	-	-	-	-	-	-	N/A	

Zone name	SFP [W/(I/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
148 Radio H	1.9	-	-	-	-	-	-	-	-	-	N/A	
149 Meeting H	1.9	-	-	-	-	-	-	-	-	-	N/A	
15 Practice 2	1.9	-	-	-	-	-	-	-	-	-	N/A	
151 Seminar Room	1.9	-	-	-	-	-	-	-	-	-	N/A	
16 Practice 3	1.9	-	-	-	-	-	-	-	-	-	N/A	
161 Studio Control	1.9	-	-	-	-	-	-	-	-	-	N/A	
169 Media Hub	1.9	-	-	-	-	-	-	-	-	-	N/A	
18 Practice 4	1.9	-	-	-	-	-	-	-	-	-	N/A	
186 Cafe	1.9	-	-	-	-	-	-	-	-	-	N/A	
19 Recording Audio Control Room	1.9	-	-	-	-	-	-	-	-	-	N/A	
196 Staff Office	1.9	-	-	-	-	-	-	-	-	-	N/A	
20 Live Music Studio	1.9	-	-	-	-	-	-	-	-	-	N/A	
22 Drum Booth	1.9	-	-	-	-	-	-	-	-	-	N/A	
23 Voice Booth	1.9	-	-	-	-	-	-	-	-	-	N/A	
28 Sound Control Hub	1.9	-	-	-	-	-	-	-	-	-	N/A	
35 Media Hub 1	1.9	-	-	-	-	-	-	-	-	-	N/A	
36 Board Room	1.9	-	-	-	-	-	-	-	-	-	N/A	
38 Reception_Admin	1.9	-	-	-	-	-	-	-	-	-	N/A	
39 Interview Meeting	1.9	-	-	-	-	-	-	-	-	-	N/A	
40 Sick Bay	1.9	-	-	-	-	-	-	-	-	-	N/A	
41 Principle	1.9	-	-	-	-	-	-	-	-	-	N/A	
42 Principle PA	1.9	-	-	-	-	-	-	-	-	-	N/A	
47 Produuction Booth 1	1.9	-	-	-	-	-	-	-	-	-	N/A	
48 Production Booth 2	1.9	-	-	-	-	-	-	-	-	-	N/A	
49 Internal Learning	1.9	-	-	-	-	-	-	-	-	-	N/A	
5 Dining	1.9	-	-	-	-	-	-	-	-	-	N/A	
50 Media Hub 1	1.9	-	-	-	-	-	-	-	-	-	N/A	
51 Faculty Office	1.9	-	-	-	-	-	-	-	-	-	N/A	
52 Faculty Workroom	1.9	-	-	-	-	-	-	-	-	-	N/A	
53 Store	1.9	-	-	-	-	-	-	-	-	-	N/A	
54 General Office Finance	1.9	-	-	-	-	-	-	-	-	-	N/A	
55 Radio A	1.9	-	-	-	-	-	-	-	-	-	N/A	
56 Radio B	1.9	-	-	-	-	-	-	-	-	-	N/A	
57 Meeting A	1.9	-	-	-	-	-	-	-	-	-	N/A	
58 Meeting B	1.9	-	-	-	-	-	-	-	-	-	N/A	
60 Internal Learning 2	1.9	-	-	-	-	-	-	-	-	-	N/A	
61 Media Hub	1.9	-	-	-	-	-	-	-	-	-	N/A	
68 Science Lab 1	1.9	-	-	-	-	-	-	-	-	-	N/A	
69 Science Lab 2	1.9	-	-	-	-	-	-	-	-	-	N/A	
70 Science Prep	1.9	-	-	-	-	-	-	-	-	-	N/A	
71 Science Studio 1	1.9	-	-	-	-	-	-	-	-	-	N/A	
72 Science Studio 2	1.9	-	-	-	-	-	-	-	-	-	N/A	
73 IT Technician	1.9	-	-	-	-	-	-	-	-	-	N/A	

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
76 First Aid	1.9	-	-	-	-	-	-	-	-	-	N/A	
81 Science Lab 3	1.9	-	-	-	-	-	-	-	-	-	N/A	
82 Internal Learning 3	1.9	-	-	-	-	-	-	-	-	-	N/A	
83 Media Hub 4	1.9	-	-	-	-	-	-	-	-	-	N/A	
84 Radio C	1.9	-	-	-	-	-	-	-	-	-	N/A	
85 Radio D	1.9	-	-	-	-	-	-	-	-	-	N/A	
87 Meeting C	1.9	-	-	-	-	-	-	-	-	-	N/A	
88 Meeting D	1.9	-	-	-	-	-	-	-	-	-	N/A	
89 Internal Learning 4	1.9	-	-	-	-	-	-	-	-	-	N/A	
90 Media Hub	1.9	-	-	-	-	-	-	-	-	-	N/A	
91 Faculty Office	1.9	-	-	-	-	-	-	-	-	-	N/A	
92 Faculty Workroom	1.9	-	-	-	-	-	-	-	-	-	N/A	
93 Art and Electronics Store	1.9	-	-	-	-	-	-	-	-	-	N/A	
95 Art and Design	1.9	-	-	-	-	-	-	-	-	-	N/A	
96 Media Hub 6	1.9	-	-	-	-	-	-	-	-	-	N/A	
97 Internal Learning 5	1.9	-	-	-	-	-	-	-	-	-	N/A	

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
59 Lobby		-	65	-	51
1 Bin Store		65	-	-	14
10 Music Tech Classroom		65	-	-	557
100 Staff WC		-	65	-	52
103 Electronics Lab		65	-	-	1479
104 Learning Base 1		65	-	-	400
105 Learning Base 2		65	-	-	414
106 Pupil WC		-	65	-	129
107 Staff WC		-	65	-	42
11 Recording Audio Control Room		65	-	-	233
111 Sports Hall		-	65	-	3288
113 Lobby		-	65	-	55
114 Stair Lobby		-	65	-	33
116 Stair		-	65	-	89
12 Light recording Room		65	-	-	305
120 Circulation		-	65	-	273
121 Circulation		-	65	-	274
122 Stair		-	65	-	86
123 Radio E		65	-	-	155
124 Meeting E		65	-	-	206
125 Sports Lobby		-	65	-	119
128 Bridge		-	65	-	62
129 Circulation		-	65	-	228

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
13 Recording teaching Space		65	-	-	518
130		-	65	-	59
130 Circulation		-	65	-	230
131 Internal Learning 6		65	-	-	453
132 Media Hub		65	-	-	386
133 SEN		65	-	-	83
134 SEN Resources		65	-	-	85
135 IAG Careers		65	-	-	86
136 Radio F		65	-	-	168
137 Radio G		65	-	-	166
138 Meeting F		65	-	-	181
139 Meeting G		65	-	-	178
14 Practice 1		65	-	-	95
140 Internal Learning 7		65	-	-	464
142 Lobby		-	65	-	51
144 LRC		65	-	-	952
146 Media Hub		65	-	-	383
147 Internal Learning 8		65	-	-	516
148 Radio H		65	-	-	155
149 Meeting H		65	-	-	206
15 Practice 2		65	-	-	92
150 Lobby		-	65	-	52
151 Seminar Room		65	-	-	147
152 Maintenance		-	65	-	67
153 Pupil WC 8		-	65	-	129
154 Staff WC		-	65	-	42
155 Exam Store		65	-	-	26
157 Sprinkler Tank		65	-	-	181
158 Stair Lobby		-	65	-	33
16 Practice 3		65	-	-	98
160 Stair		-	65	-	79
161 Studio Control		65	-	-	181
162 TV Studio		65	-	-	613
163 Circulation		-	65	-	132
164 Circulation		-	65	-	57
165 Stair Lobby		-	65	-	28
168 Stair		-	65	-	76
169 Media Hub		65	-	-	399
17 Lobby		-	65	-	46
171 Circulation		-	65	-	223
172 Circulation		-	65	-	222
175 Server and Hub Room		65	-	-	87
176 Hub Room		65	-	-	33

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
18 Practice 4		65	-	-	122
180 Cafe Kiosk		-	65	-	201
184 Hub Room		65	-	-	43
186 Cafe		-	65	-	179
19 Recording Audio Control Room		65	-	-	161
192 Music Store		65	-	-	15
193 Staff WC		-	65	-	50
194 Pupil Change		-	65	-	224
195 Acc Changing		-	65	-	80
196 Staff Office		65	-	-	131
197 Pupil Changing 2		-	65	-	246
198 Sports Hall Store		65	-	-	61
2 Kitchen Plant		65	-	-	65
20 Live Music Studio		65	-	-	388
200 Change Lobby		-	65	-	27
201 Change Lobby		-	65	-	21
209 Hub Room		65	-	-	12
21 Music Store		65	-	-	18
211 Cleaners Store		65	-	-	8
22 Drum Booth		65	-	-	188
23 Voice Booth		65	-	-	134
24 Theatre 1		65	-	-	2028
25 Theatre 2		65	-	-	608
26 Theatre Lobby		-	65	-	110
27 TV Studio		65	-	-	814
28 Sound Control Hub		65	-	-	187
29 Plant Room		65	-	-	118
3 Kitchen WC		-	65	-	42
30 Stair		-	65	-	82
32 Stair Lobby		65	-	-	438
33 Pupil WC		-	65	-	139
34 Staff WC		-	65	-	43
35 Media Hub 1		65	-	-	361
36 Board Room		65	-	-	314
37 Entrance lobby		-	65	15	143
38 Reception_Admin		65	-	-	423
39 Interview Meeting		65	-	-	160
40 Sick Bay		65	-	-	122
41 Principle		65	-	-	171
42 Principle PA		65	-	-	141
43 Pupil WC		-	65	-	135
44 Visitor WC		-	65	-	40
45 Stair		-	65	-	83

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
47 Production Booth 1		65	-	-	120
48 Production Booth 2		65	-	-	120
48 Pulse North Zone		-	65	-	401
48 Pulse		-	65	-	32
48 Pulse South Zone		-	65	-	587
49 Internal Learning		65	-	-	453
5 Dining		-	65	-	574
50 Media Hub 1		65	-	-	386
51 Faculty Office		65	-	-	131
52 Faculty Workroom		65	-	-	210
53 Store		65	-	-	17
54 General Office Finance		65	-	-	212
55 Radio A		65	-	-	168
56 Radio B		65	-	-	166
57 Meeting A		65	-	-	181
58 Meeting B		65	-	-	178
6 Music Store		65	-	-	38
60 Internal Learning 2		65	-	-	464
61 Media Hub		65	-	-	399
62 Stair		-	65	-	86
63 Stair Lobby		-	65	-	45
65 Staff WC		-	65	-	52
66 Pupil WC 3		-	65	-	138
67 Cleancers Store		65	-	-	8
68 Science Lab 1		65	-	-	1553
69 Science Lab 2		65	-	-	1558
7 Lobby		-	65	-	29
70 Science Prep		65	-	-	771
71 Science Studio 1		65	-	-	1380
72 Science Studio 2		65	-	-	1402
73 IT Technician		65	-	-	281
74 Pupil WC		-	65	-	131
75 Staff WC		-	65	-	44
76 First Aid		65	-	-	166
78 Stair Lobby		-	65	-	33
79 Stair		-	65	-	89
8 Chair Store		65	-	-	29
80		-	65	-	98
81 Science Lab 3		65	-	-	1706
82 Internal Learning 3		65	-	-	453
83 Media Hub 4		65	-	-	386
84 Radio C		65	-	-	168
85 Radio D		65	-	-	166

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
86 Lobby		-	65	-	51
87 Meeting C		65	-	-	181
88 Meeting D		65	-	-	178
89 Internal Learning 4		65	-	-	464
9 Stair Lobby		-	65	-	60
90 Media Hub		65	-	-	399
91 Faculty Office		65	-	-	131
92 Faculty Workroom		65	-	-	210
93 Art and Electronics Store		65	-	-	36
95 Art and Design		65	-	-	697
96 Media Hub 6		65	-	-	374
97 Internal Learning 5		65	-	-	516
98 Stair Lobby		-	65	-	45
Kitchen 4		-	65	-	810
Media Storeage		65	-	-	35
119 Bridge		-	65	-	62
Stage Step Area		-	65	-	85

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
10 Music Tech Classroom	NO (-59.6%)	YES
103 Electronics Lab	NO (-88.2%)	YES
104 Learning Base 1	NO (-90.8%)	YES
105 Learning Base 2	NO (-90.9%)	YES
11 Recording Audio Control Room	N/A	N/A
111 Sports Hall	N/A	N/A
12 Light recording Room	N/A	N/A
123 Radio E	N/A	N/A
124 Meeting E	N/A	N/A
13 Recording teaching Space	NO (-63.4%)	YES
131 Internal Learning 6	NO (-12.8%)	YES
132 Media Hub	NO (-86.7%)	YES
133 SEN	N/A	N/A
134 SEN Resources	N/A	N/A
135 IAG Careers	N/A	N/A
136 Radio F	YES (+39.2%)	YES
137 Radio G	YES (+35.9%)	YES
138 Meeting F	N/A	N/A
139 Meeting G	N/A	N/A
14 Practice 1	NO (-79.9%)	YES
140 Internal Learning 7	NO (-7.8%)	YES
144 LRC	NO (-87.6%)	YES
146 Media Hub	NO (-90.2%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
147 Internal Learning 8	NO (-87.5%)	YES
148 Radio H	N/A	N/A
149 Meeting H	N/A	N/A
15 Practice 2	N/A	N/A
151 Seminar Room	N/A	N/A
16 Practice 3	N/A	N/A
161 Studio Control	N/A	N/A
162 TV Studio	N/A	N/A
169 Media Hub	NO (-85.9%)	YES
175 Server and Hub Room	N/A	N/A
176 Hub Room	N/A	N/A
18 Practice 4	NO (-82.3%)	YES
184 Hub Room	N/A	N/A
186 Cafe	N/A	N/A
19 Recording Audio Control Room	N/A	N/A
196 Staff Office	N/A	N/A
20 Live Music Studio	N/A	N/A
209 Hub Room	N/A	N/A
22 Drum Booth	N/A	N/A
23 Voice Booth	N/A	N/A
24 Theatre 1	N/A	N/A
25 Theatre 2	N/A	N/A
27 TV Studio	N/A	N/A
28 Sound Control Hub	N/A	N/A
32 Stair Lobby	NO (-68.2%)	YES
35 Media Hub 1	NO (-75.3%)	YES
36 Board Room	NO (-84.4%)	YES
37 Entrance lobby	NO (-75.7%)	YES
38 Reception_Admin	NO (-77.5%)	YES
39 Interview Meeting	NO (-82.7%)	YES
40 Sick Bay	N/A	N/A
41 Principle	N/A	N/A
42 Principle PA	N/A	N/A
47 Production Booth 1	N/A	N/A
48 Production Booth 2	N/A	N/A
49 Internal Learning	NO (-11.9%)	YES
5 Dining	NO (-40.8%)	YES
50 Media Hub 1	NO (-87.3%)	YES
51 Faculty Office	NO (-93.6%)	YES
52 Faculty Workroom	N/A	N/A
53 Store	N/A	N/A
54 General Office Finance	N/A	N/A
55 Radio A	YES (+41.7%)	YES
56 Radio B	YES (+37.8%)	YES
57 Meeting A	N/A	N/A
58 Meeting B	N/A	N/A
60 Internal Learning 2	NO (-6.8%)	YES
61 Media Hub	NO (-87.3%)	YES
68 Science Lab 1	NO (-87.2%)	YES

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
69 Science Lab 2	NO (-89.4%)	YES
70 Science Prep	NO (-90.5%)	YES
71 Science Studio 1	NO (-90%)	YES
72 Science Studio 2	NO (-87.5%)	YES
73 IT Technician	NO (-92.7%)	YES
76 First Aid	N/A	N/A
81 Science Lab 3	NO (-88.8%)	YES
82 Internal Learning 3	NO (-9.1%)	YES
83 Media Hub 4	NO (-87.2%)	YES
84 Radio C	YES (+44%)	YES
85 Radio D	YES (+41%)	YES
87 Meeting C	N/A	N/A
88 Meeting D	N/A	N/A
89 Internal Learning 4	NO (-2.9%)	YES
90 Media Hub	NO (-87.3%)	YES
91 Faculty Office	NO (-93.6%)	YES
92 Faculty Workroom	N/A	N/A
93 Art and Electronics Store	N/A	N/A
95 Art and Design	NO (-88.5%)	YES
96 Media Hub 6	NO (-90.4%)	YES
97 Internal Learning 5	NO (-87.8%)	YES

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m ²]	6719.1	6719.1
External area [m ²]	7879.9	7879.9
Weather	LON	LON
Infiltration [m ³ /hm ² @ 50Pa]	5	3
Average conductance [W/K]	2544.21	2939.93
Average U-value [W/m ² K]	0.32	0.37
Alpha value* [%]	7.49	10

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

Building Use

% Area Building Type

A1/A2 Retail/Financial and Professional services
A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
B1 Offices and Workshop businesses
B2 to B7 General Industrial and Special Industrial Groups
B8 Storage or Distribution
C1 Hotels
C2 Residential Inst.: Hospitals and Care Homes
C2 Residential Inst.: Residential schools
C2 Residential Inst.: Universities and colleges
C2A Secure Residential Inst.
Residential spaces
D1 Non-residential Inst.: Community/Day Centre
D1 Non-residential Inst.: Libraries, Museums, and Galleries
99 D1 Non-residential Inst.: Education
D1 Non-residential Inst.: Primary Health Care Building
D1 Non-residential Inst.: Crown and County Courts
D2 General Assembly and Leisure, Night Clubs and Theatres
Others: Passenger terminals
Others: Emergency services
1 Others: Miscellaneous 24hr activities
Others: Car Parks 24 hrs
Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	3.28	6.91
Cooling	2.13	1.31
Auxiliary	5.58	4.59
Lighting	13.67	13.61
Hot water	8.27	5.82
Equipment*	24.16	24.16
TOTAL **	32.93	32.23

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

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	1	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	52.15	72.24
Primary energy* [kWh/m ²]	84.28	100.54
Total emissions [kg/m ²]	14	14.8

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

HVAC Systems Performance										
System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER	
[ST] Central heating using water: radiators, [HS] District heating, [HFT] Natural Gas, [CFT] Electricity										
Actual	40.8	0	12.7	0	2.1	0.89	0	1	0	
Notional	31.6	0	8.8	0	1.2	1	0	----	----	
[ST] Central heating using water: radiators, [HS] District heating, [HFT] Natural Gas, [CFT] Electricity										
Actual	26	0	8.1	0	9.8	0.89	0	1	0	
Notional	40.4	0	11.2	0	12.3	1	0	----	----	
[ST] Central heating using water: radiators, [HS] District heating, [HFT] Natural Gas, [CFT] Electricity										
Actual	23.1	0	7.2	0	2.2	0.89	0	1	0	
Notional	5.8	0	1.6	0	1.2	1	0	----	----	
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
Actual	24.8	64.5	1.9	5	7	3.73	3.55	4	5	
Notional	113.3	20.7	12.3	2	5	2.56	2.84	----	----	
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
Actual	26.5	26.5	1.9	2	6.8	3.92	3.74	4	5	
Notional	90.6	11.1	9.8	1.1	5.2	2.56	2.84	----	----	
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
Actual	0	1480.5	0	110.1	0	3.92	3.74	4	5	
Notional	9.2	1010.5	1	74.1	0	2.56	3.79	----	----	
[ST] Single-duct VAV, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
Actual	59.1	11.3	5.2	0.9	15.6	3.14	3.33	4	5	
Notional	82.2	18.2	8.9	1.3	14.4	2.56	3.79	----	----	
[ST] Central heating using water: radiators, [HS] District heating, [HFT] Natural Gas, [CFT] Electricity										
Actual	20.2	0	6.3	0	2.1	0.89	0	1	0	
Notional	8.2	0	2.3	0	1.2	1	0	----	----	

Key to terms

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

Key Features

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

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.2	1_000000:Surf[2]
Floor	0.2	0.21	1_000000:Surf[0]
Roof	0.15	0.14	10000009:Surf[0]
Windows, roof windows, and rooflights	1.5	1.2	10000000:Surf[1]
Personnel doors	1.5	2	30000000:Surf[1]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
U _{i-Typ} = Typical individual element U-values [W/(m²K)]			U _{i-Min} = Minimum individual element U-values [W/(m²K)]
* There might be more than one surface where the minimum U-value occurs.			

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

Energy Performance Certificate

Non-Domestic Building



Global Academy UTC
H3 Compliance Model
London

Certificate Reference Number:
0900-0035-0009-0004-0002

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Asset Rating

More energy efficient

A+

Net zero CO₂ emissions

A 0-25

B 26-50

C 51-75

D 76-100

E 101-125

F 126-150

G Over 150

◀ 36

This is how energy efficient the building is.

Less energy efficient

Technical information

Main heating fuel:	District Heating
Building environment:	Air Conditioning
Total useful floor area (m ²):	6719.117
Building complexity (NOS level):	5
Building emission rate (kgCO ₂ /m ²):	13.97

Benchmarks

Buildings similar to this one could have ratings as follows:

38 If newly built

102 If typical of the existing stock

Administrative information

This is an Energy Performance Certificate as defined in SI2007:991 as amended

Assessment Software: Virtual Environment v7.0.2 using calculation engine ApacheSim v7.0.2

Property Reference: 000000000000

Assessor Name: Nicholas Roy Bradley

Assessor Number: LCEA002521

Accreditation Scheme: CIBSE Certification Ltd

Employer/Trading Name: Bryerny Builing Physics Ltd

Employer/Trading Address:

Issue Date: 01 May 2015

Valid Until: 30 Apr 2025 (unless superseded by a later certificate)

Related Party Disclosure: Not related to the owner

Recommendations for improving the property are contained in Report Reference Number: 0090-0040-0040-9000-0503

If you have a complaint or wish to confirm that the certificate is genuine

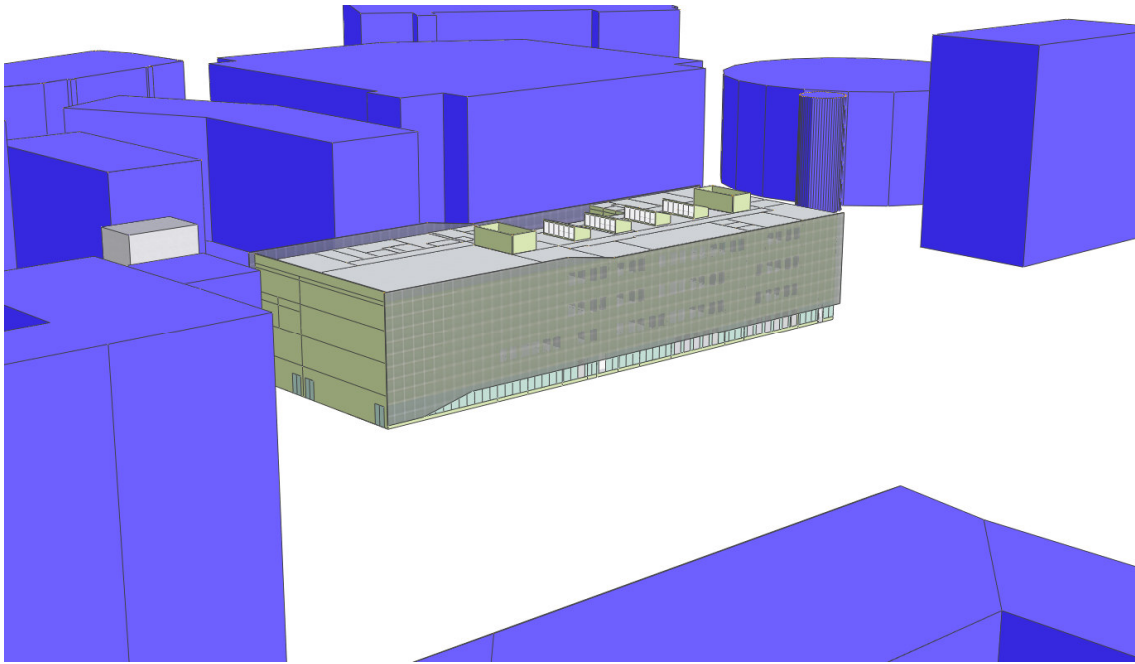
Details of the assessor and the relevant accreditation scheme are on the certificate. You can get contact details of the accreditation scheme from the Government's website at www.communities.gov.uk/epbd, together with details of the procedures for confirming authenticity of a certificate and for making a complaint.



For advice on how to take action and to find out about technical and financial assistance schemes to help make buildings more energy efficient visit www.carbontrust.co.uk or call us on 0800 085 2005

Appendix E

Global Academy UTC



April 2015

ADL2A Building Regulations Report

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1.0	Introduction
2.0	UK Building Regulations Part L2A (2013)
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4.0	Construction data
5.0	Weather data and site orientation
6.0	Room templates and building definition
7.0	Lighting loads and control
8.0	HVAC systems
9.0	Electrical systems
10.0	PART L2A Model H3 RESULTS

Appendices

Appendix A	BRUKL [PDF] Document H3
Appendix B	EPC [PDF] Document
Appendix C	BRUKL [PDF] Document H3 Rev 3

1.0 Introduction

The purpose of this report is to outline the preliminary Building Regulations Part L2A (2013) analysis carried out for the Global Academy UTC building. The report should be taken as a guide because the accuracy and detail of information used is not confirmed due to the procurement stage of the project. The report does, however, show how the building performs in compliance terms and is thus intended to assist the design rationale of the building.

The model and analysis have been created using the latest version of the IES Virtual Environment software (v.2014.2.1.0) and following Non-Domestic EPC Regulatory Conventions Issue 5.0 (August 2014 with amendments 1st September 2014). The specific function of the software relative to compliance analysis has the approval of the Building Research Establishment (BRE) and is accredited to the requirements of the guidelines as set out in CIBSE publications AM11 and TM33.

2.0 UK Building Regulations Part L2A (2013)

Approved Document Part L2A (2013) is concerned with the conservation of fuel and power in new buildings other than dwellings. The main calculation tool behind the compliance analysis has been developed by the BRE and cannot be edited or manipulated in any way. Furthermore, a specific set of conventions must be adhered to with respect to the input and use of data. The requirements of the regulations are outlined below.

2.1 Criterion 1: Achieving the Building Emission Rate

As a minimum, the calculated CO₂ Building Emission Rate (BER) should not exceed the Target Emission Rate (TER).

2.2 Criterion 2: Limits on design flexibility

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

2.3 Criterion 3: Limiting the effects of solar gains

Building spaces should have appropriate passive control measures in order to limit solar gains.

2.4 Criterion 4: Building performance is consistent with the BER

The performance of the building, as-built, should be consistent with the BER.

2.5 Criterion 5: Provisions for energy efficient operation of the building

The necessary provisions for enabling energy efficient operation of the building should be in place.

2.6 Regulation 25: Consideration of Alternative Systems

The Consideration of alternative energy systems such as

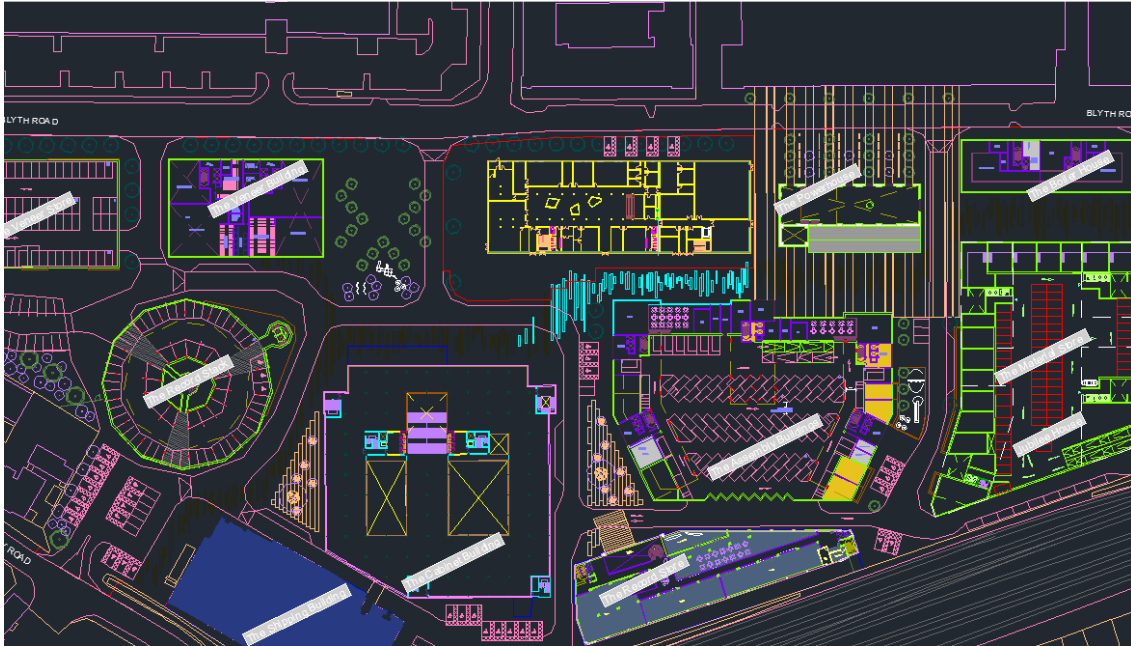
- Renewable Energy System
- CHP
- District Heating and/or Cooling
- Heat Pumps

3.0 Building form and geometry

The Building is a bespoke New, part modular, teaching Academy facility

The proposed building layout is detailed below indicating the form and massing of the project.

Figure 3.1: Proposed building layout



The model geometry has been extracted from the following architectural drawings to ensure geometrical accuracy and thus be a detailed representation of the proposed building form:

- 495_S2A-A-Global-Ground Floor
- 495_S2A-A-Global-First Floor
- 495_S2A-A-Global-Second Floor
- 495_S2A-A-Global - Third Floor
- 495_S2A-A-Global - Roof Plan
- 495_00-00_S2A_MasterPlan

Figure 3.2: Model image

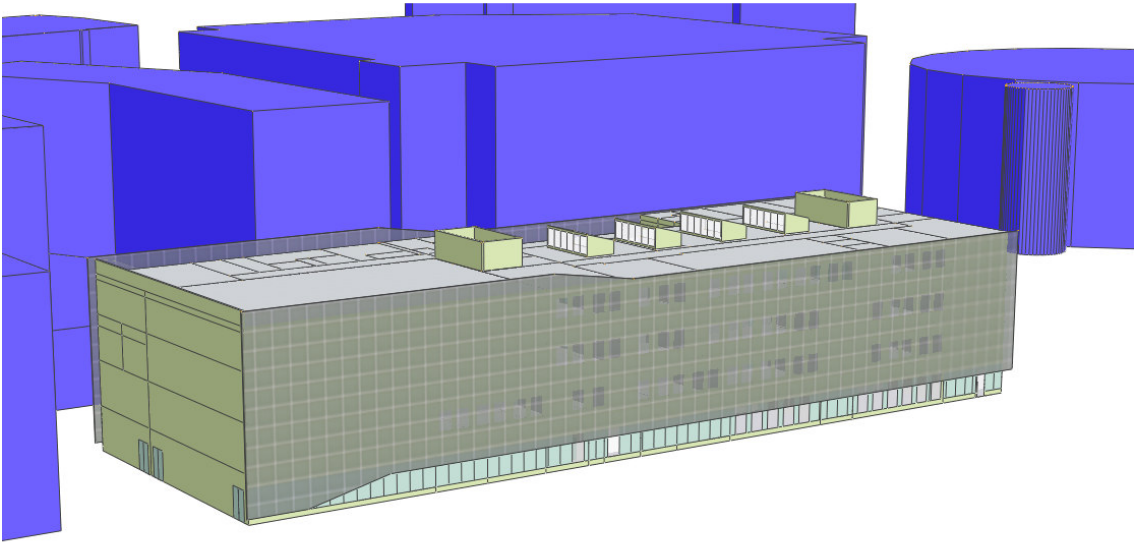


Figure 3.3: Model image

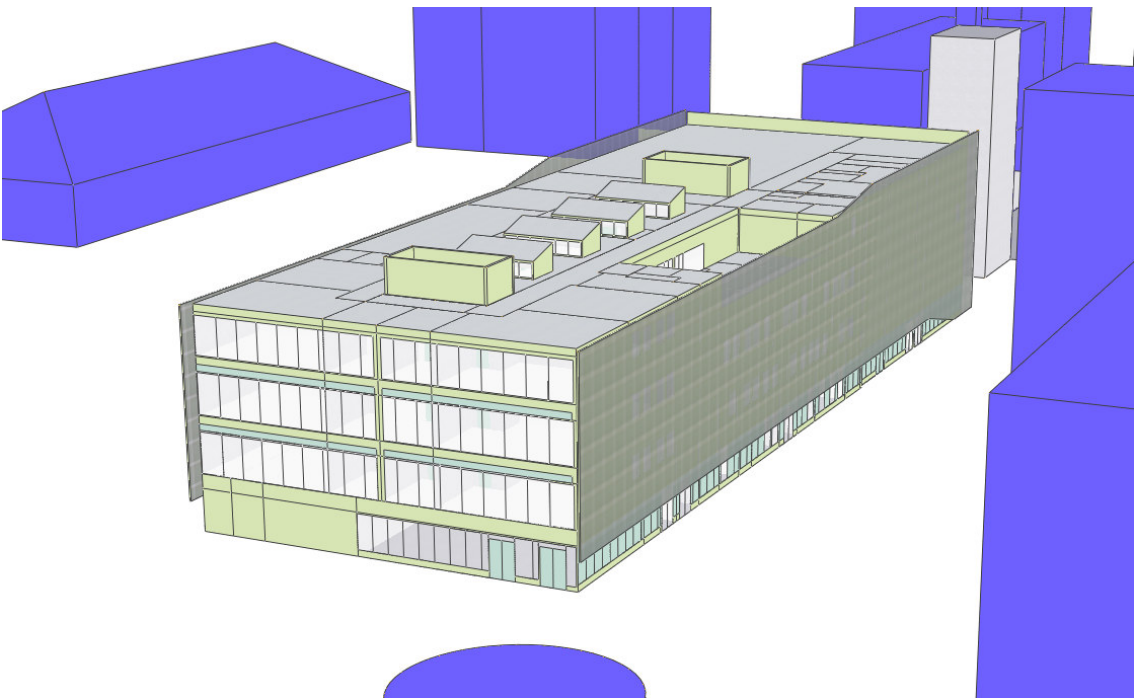
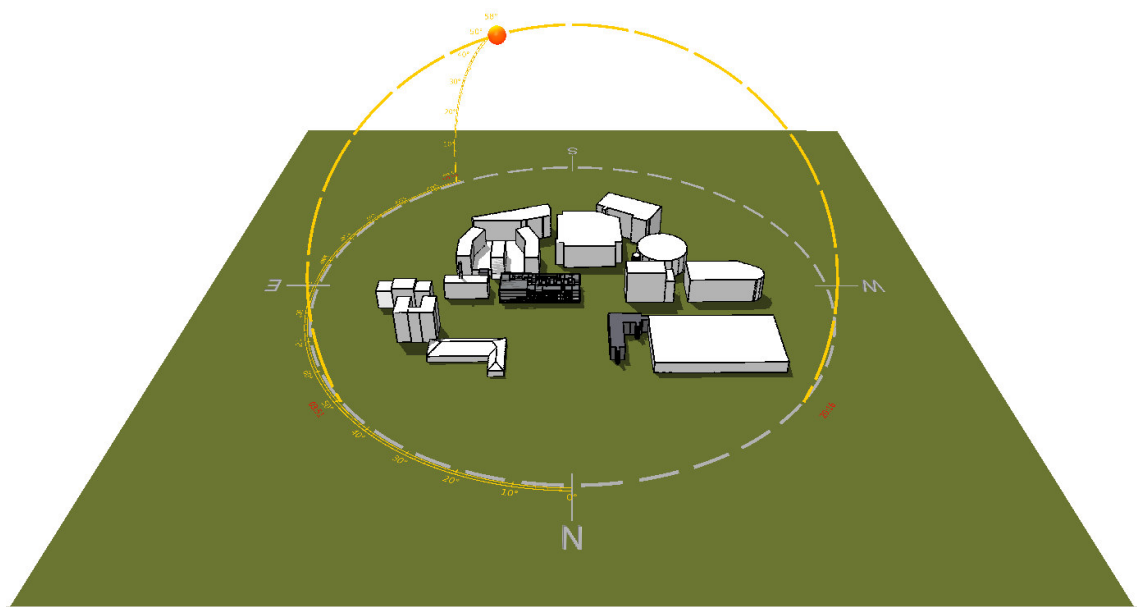


Figure 3.4: Model image



4.0 Construction data

The following U-values have been input into the analysis model for the purposes of this initial Part L analysis. The values modelled are better performing than the limiting values stipulated by Building Regulations to reduce the energy consumption and thus carbon emissions associated with heating use.

Table 4.1: Construction data

	ID	Description	U-value
			CIBSE
			(W/m ² .K)
Ceiling	YRKN0002	YORKON BUILDING SYSTEM Intermediate Ceiling/Floor	0.916
Ceiling	CCR10111	MODULAR Intermediate Floor	2.670
Internal Partition	MDLR0031	YORKON BUILDING SYSTEM Wall (Internal)	0.236
Door	MDLR0007	ULTIMA External Door	2.166
External Wall	MDLR0011	YORKON BUILDING SYSTEM Wall	0.240
Ground Floor	STD_FL13	YORKON BUILDING SYSTEM Ground Floor (Solid Concrete)	0.215
External Glazing	MDLR0012	MODULAR-Planitherm c/w Internal Room Blind - (1.6)	1.600
Door	MCLADW2	150408 Global metal-clad wall	0.202
External Glazing	MDLR0013	MODULAR SG Green c/w Internal Room Blind - (1.2)	1.200
Roof	FROOF216	YORKON BUILDING SYSTEM Roof + Suspended Ceiling	0.140
External Glazing	MDLR0034	MODULAR Platisol Double Doorset Glazed E- Series	1.948

Glazing has been modelled with the following photometric properties:

- Visible light transmittance: 68%
- g-value: 0.34 [EN 410]
- Blinds to General teaching spaces.
- External Screen Visible light transmittance: 60%

Part L results in Section 10.0 have analysed options with air permeability values of 5.0 m³/(hr.m²) @ 50 Pa.

5.0 Weather data and site orientation

CIBSE Test Reference Year (TRY) weather data for London has been applied to the model. This is the closest and most appropriate weather file for the project and comprises hourly data for 12-typical months, selected from around 20-year data sets. The TRY weather data file is used for all Part L and EPC calculations and has been verified by the CL2.1 SBEM weather locations lookup tool.

Figure 5.1: Extract-CL2.1 SBEM weather lookup tool

CL2.1 SBEM Weather Locations Lookup					
England & Wales Postcode Areas Lookup					
SBEM Weather Location					
Search:		UB	London		
Type the Post Area in the green field above, then press 'enter' to lookup the SBEM Location					
List	Post Area	Post Area	Main Post Town	SBEM code	SBEM Location

Figure 5.2: UK Building Regulations simulation weather data

ApacheSim

Simulation Weather File: LondonDSY05.fwt

Select

Nearest

Get more weather files from iesve.com

UK Building Regulations

City:

Select

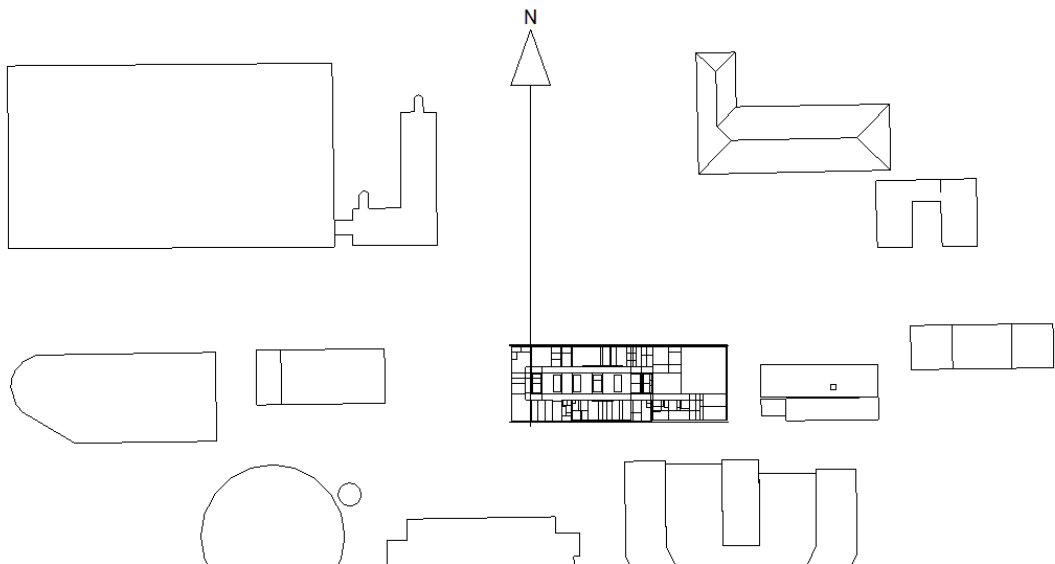
Simulation Weather File: LondonTRY05.fwt

For EPCs in England and Wales select the city closest to the subject address based on the Postcode Area (the initial 1 or 2 letters in the first part of the postcode).

Download EPC locations worksheet

[http://www.bre.co.uk/filelibrary/accreditation/scheme_standards/dec11/CL2_1_SBEM_Weather_Locations_Lookup\(v1\).xls](http://www.bre.co.uk/filelibrary/accreditation/scheme_standards/dec11/CL2_1_SBEM_Weather_Locations_Lookup(v1).xls)

Figure 5.3: Site orientation



6.0 Room templates and building definition

The building definition identifies the type of building it is and what design data will be used. This sets the basis for the calculation parameters prior to simulation.

Figure 6.1: Building settings

The screenshot displays the 'Building Settings' window with the following sections and values:

- General Tab:**
 - Location Description:** Empty text box.
 - Project Complexity:** Level 5 (dropdown).
 - Stage of analysis:** As designed (dropdown).
 - Shell and core building?** ☐
 - District heating:**
 - CO2 conversion factor: 0.18 kgCO2/kWh
 - Primary energy factor: 1.2 kWh/kWh
 - Portable or modular building?** ☒
 - Is the portable building a distress purchase? ☐
 - Planned time of use in given location < 2 years ☐
 - Is a TER/BER calculation not available for a module constructed prior to October 2010? ☐
 - Date of manufacture: October 2010 to March 2011 (dropdown)
 - Planned time of use in given location > 2 years ☒
 - Is more than 70% of the external envelope of the building to be created from sub-assemblies manufactured prior to the date the Approved Document comes into force? ☐
 - Date of manufacture: October 2010 to March 2011 (dropdown)
 - Has LENI lighting calculation been carried out? ☐
- Building Details Tab:**
 - Building air permeability at 50Pa:**
 - ☐ Default (applies Notional Building rules from 2013 NCM Modelling Guide)
 - Side-lit and unlit spaces: 5.0 m3/(h.m²)
 - Top-lit metal-clad spaces: 5.0 m3/(h.m²)
 - Infiltration method:** CIBSE Guide A (dropdown)
 - Building type:** Schools (dropdown, Choose closest match)
 - Building sub-type:** 3 storeys: 1000 m2/floor (40m x 25m x 4m) (dropdown, Choose closest match)
 - Exposure:** Partial (dropdown)
 - Infiltration Rates:**

	Side-lit / unlit	Top-lit / Metal clad	
☐ Override default values			
Actual Building	0.150	0.150	ach
Notional Building	0.150	0.200	ach
Reference Building	0.250	0.250	ach
 - Adjustment for management features (ADL2A Table 1):**
 - Electric power factor: >0.95 (dropdown)
 - Lighting systems have provision for metering? ☒
 - Lighting systems metering warns of 'out-of-range' values? ☒

Room template data is derived from the National Calculation Methodology (NCM) database collated by the Department of Communities and Local Government (DCLG) for Part L and EPC compliance assessment. Each type of space has been assigned an NCM template based upon the activity associated with it as per the table below.

Table 6.2: Summary of room template data

[illegible]

7.0 Lighting loads and control

Due to the project procurement stage, no detailed design lighting loads or control details have been defined. As such, empirical data has been input into the current modelling and is summarised below based on the Hierarchy 3 London Plan analysis undertaken

Table 7.1: Summary of modelled lighting data

Lighting	Lighting Metering	Yes
	Out of Range Values	Yes
	Lamp Type	LED
	Luminarie Efficacy	65 lm/cW
	Control	PIR and Daylight Control

Lighting Control Details

- ☐ Absence with Daylight Control to All Glazed areas
- ☐ Absence to internal areas
- ☐ Presence Control toilets, circulation and stores
- ☐ Absence with Manual Dimming to Performance Areas
- ☐ Parasitic Power <0.1 W/m²

8.0 HVAC systems

The following Building Services systems performance data has been used in the analysis

HVAC System Details	Hierarchy 2	
	HVAC system name	01 VRF Ducted Units
Heating	NCM System Type	Split or multi-split system
	Heat source	Heat pump [Electric]: air source
	Fuel	Grid supplied electricity
	Qualify for ECAs?	-
	Inst. On or after 1998?	Yes
	Does system use CHP?	No
Cooling	Heat Gen. SEER	4.00
	Pack chiller type	Heat pump [Electric]
	Pack chiller power	Upto 100kW
	Chiller fuel type	Grid supplied electricity
	Qualify for ECAs?	Yes
	SEER	5.00
	EER	3.13
	Mixed Mode	Mechanical Ventilation
System adjustment	Heat rejection [Pump and Fan Power %]	
	Ductwork Leakage tested	Class A
	AHU Leakage Tested	Class L3
	SFP (W/l/S)	1.6 and 0.3 terminal SFP [CO2 Speed Control]
Metering Provision	Variable speed pumps	-
	Met.	Yes
	Alarm for out of range	Yes
Ventilation	Cooling/vent Mechanism	Air Conditioning
	Air supply mechanism	Local ventilation units
	Heat recovery method	plate heat exchanger
	Variable Heat recovery efficiency	No
	Heat recovery efficiency	0.77
System Controls (EPC only)	Central Time Control	Yes
	Optimum start/stop control	Yes
	Local time control	Yes
	Local temp control	Yes
	Weather Comp control	No
Bivalent systems	Heat source	-
	Fuel	-
	Gen Seff	
	% load	

		Hierarchy 2
HVAC System Details	HVAC system name	02 VRF HRU Ducted Units
	NCM System Type	Split or multi-split system
Heating	Heat source	Heat pump [Electric]: air source
	Fuel	Grid supplied electricity
	Qualify for ECAs?	-
	Inst. On or after 1998?	Yes
	Does system use CHP?	No
	Heat Gen. SEER	4.00
Cooling	Pack chiller type	Heat pump [Electric]
	Pack chiller power	Upto 100kW
	Chiller fuel type	Grid supplied electricity
	Qualify for ECAs?	Yes
	SEER	5.00
	EER	3.13
	Mixed Mode	Mechanical Ventilation
System adjustment	Heat rejection [Pump and Fan Power %]	
	Ductwork Leakage tested	Class A
	AHU Leakage Tested	Class L3
	SFP (W/I/S)	1.6 and 0.3 terminal SFP {CO2 Speed Control}
Metering Provision	Variable speed pumps	-
	Met.	Yes
Ventilation	Alarm for out of range	Yes
	Cooling/vent Mechanism	Air Conditioning
	Air supply mechanism	Local ventilation units
	Heat recovery method	plate heat exchanger
	Variable Heat recovery efficiency	No
	Heat recovery efficiency	0.77
System Controls (EPC only)	Central Time Control	Yes
	Optimum start/stop control	Yes
	Local time control	Yes
	Local temp control	Yes
	Weather Comp control	No
Bivalent systems	Heat source	-
	Fuel	-
	Gen Seff	
	% load	

		Hierarchy 2
HVAC System Details	HVAC system name	03 LTHW Radiators Nat Vent
	NCMSystem Type	Central Heating using water : radiators
Heating	Heat source	District Heating
	Fuel	-
	Qualify for ECAs?	-
	Inst. On or after 1998?	No
	Does system use CHP?	No
	Heat Gen. SEER	1 [C/Factor 0.293 kgCO2/kWh]
Cooling	Pack chiller type	-
	Pack chiller power	-
	Chiller fuel type	-
	Qualify for ECAs?	-
	SEER	
	EER	
	Mixed Mode	-
	Heat rejection [Pump and Fan Power %]	
System adjustment	Ductwork Leakage tested	-
	AHU Leakage Tested	-
	SFP (W/I/S)	
	Variable speed pumps	variable speed differential sensor across pump
Metering Provision	Met.	Yes
	Alarm for out of range	Yes
Ventilation	Cooling/vent Mechanism	Natural Ventilation
	Air supply mechanism	-
	Heat recovery method	-
	Variable Heat recovery efficiency	-
	Heat recovery efficiency	
System Controls (EPC only)	Central Time Control	Yes
	Optimum start/stop control	Yes
	Local time control	No
	Local temp control	Yes
	Weather Comp control	Yes
Bivalent systems	Heat source	-
	Fuel	-
	Gen Seff	
	% load	

		Hierarchy 2
HVAC System Details	HVAC system name	04 LTHW Radiant Panels Nat Vent
	NCMSystem Type	Central Heating using water : radiators
Heating	Heat source	District Heating
	Fuel	-
	Qualify for ECAs?	-
	Inst. On or after 1998?	No
	Does system use CHP?	No
	Heat Gen. SEER	1 [C/Factor 0.293 kgCO2/kWh]
Cooling	Pack chiller type	-
	Pack chiller power	-
	Chiller fuel type	-
	Qualify for ECAs?	-
	SEER	
	EER	
	Mixed Mode	-
	Heat rejection [Pump and Fan Power %]	
System adjustment	Ductwork Leakage tested	-
	AHU Leakage Tested	-
	SFP (W/I/S)	
	Variable speed pumps	variable speed differential sensor across pump
Metering Provision	Met.	Yes
	Alarm for out of range	Yes
Ventilation	Cooling/vent Mechanism	Natural Ventilation
	Air supply mechanism	-
	Heat recovery method	-
	Variable Heat recovery efficiency	-
	Heat recovery efficiency	
System Controls (EPC only)	Central Time Control	Yes
	Optimum start/stop control	Yes
	Local time control	No
	Local temp control	Yes
	Weather Comp control	Yes
Bivalent systems	Heat source	-
	Fuel	-
	Gen Seff	
	% load	

		Hierarchy 2
HVAC System Details	HVAC system name	05 LTHW Radiant Panels Local Extract
	NCMSystem Type	Central Heating using water : radiators
Heating	Heat source	District Heating
	Fuel	-
	Qualify for ECAs?	-
	Inst. On or after 1998?	Yes
	Does system use CHP?	No
	Heat Gen. SEER	1 [C/Factor 0.293 kgCO2/kWh]
Cooling	Pack chiller type	-
	Pack chiller power	-
	Chiller fuel type	-
	Qualify for ECAs?	-
	SEER	
	EER	
	Mixed Mode	-
	Heat rejection [Pump and Fan Power %]	
System adjustment	Ductwork Leakage tested	-
	AHU Leakage Tested	-
	SFP (W/I/S)	0.4 [Enhanced Control]
	Variable speed pumps	variable speed differential sensor across pump
Metering Provision	Met.	Yes
	Alarm for out of range	Yes
Ventilation	Cooling/vent Mechanism	Mechanical Ventilation
	Air supply mechanism	Zonal extract with remote fan
	Heat recovery method	-
	Variable Heat recovery efficiency	-
	Heat recovery efficiency	
System Controls (EPC only)	Central Time Control	Yes
	Optimum start/stop control	Yes
	Local time control	No
	Local temp control	Yes
	Weather Comp control	Yes
Bivalent systems	Heat source	-
	Fuel	-
	Gen Seff	
	% load	

		Hierarchy 2
HVAC System Details	HVAC system name	06 LTHW UFH Natural vent
	NCMSystem Type	Central Heating using water : Floor Heating
Heating	Heat source	District Heating
	Fuel	-
	Qualify for ECAs?	-
	Inst. On or after 1998?	Yes
	Does system use CHP?	No
	Heat Gen. SEER	1 [C/Factor 0.293 kgCO2/kWh]
Cooling	Pack chiller type	
	Pack chiller power	
	Chiller fuel type	
	Qualify for ECAs?	
	SEER	
	EER	
	Mixed Mode	
	Heat rejection [Pump and Fan Power %]	
System adjustment	Ductwork Leakage tested	
	AHU Leakage Tested	
	SFP (W/I/S)	
	Variable speed pumps	variable speed differential sensor across pump
Metering Provision	Met.	Yes
	Alarm for out of range	Yes
Ventilation	Cooling/vent Mechanism	Natural Ventilation
	Air supply mechanism	-
	Heat recovery method	-
	Variable Heat recovery efficiency	-
	Heat recovery efficiency	
System Controls (EPC only)	Central Time Control	Yes
	Optimum start/stop control	Yes
	Local time control	No
	Local temp control	Yes
	Weather Comp control	Yes
Bivalent systems	Heat source	
	Fuel	
	Gen Seff	
	% load	

		Hierarchy 2
HVAC System Details	HVAC system name	07 Comms Room
	NCM System Type	Split or multi-split system
Heating	Heat source	Heat pump [Electric]: air source
	Fuel	Grid supplied electricity
	Qualify for ECAs?	
	Inst. On or after 1998?	Yes
	Does system use CHP?	No
	Heat Gen. SEER	4.00
Cooling	Pack chiller type	Heat pump [Electric]
	Pack chiller power	Upto 100kW
	Chiller fuel type	Grid supplied electricity
	Qualify for ECAs?	Yes
	SEER	3.50
	EER	3.13
	Mixed Mode	Not a CMM system
System adjustment	Heat rejection [Pump and Fan Power %]	
	Ductwork Leakage tested	-
	AHU Leakage Tested	-
	SFP (W/I/S)	
Metering Provision	Variable speed pumps	-
	Met.	Yes
	Alarm for out of range	Yes
Ventilation	Cooling/vent Mechanism	Air Conditioning
	Air supply mechanism	
	Heat recovery method	
	Variable Heat recovery efficiency	
	Heat recovery efficiency	
System Controls (EPC only)	Central Time Control	No
	Optimum start/stop control	No
	Local time control	Yes
	Local temp control	Yes
	Weather Comp control	No
Bivalent systems	Heat source	
	Fuel	
	Gen Seff	
	% load	

		Hierarchy 2
HVAC System Details	HVAC system name	08 Packaged AHU
	NCM System Type	Single-duct VAV
Heating	Heat source	Heat pump [Electric]: air source
	Fuel	Grid supplied electricity
	Qualify for ECAs?	No
	Inst. On or after 1998?	Yes
	Does system use CHP?	No
	Heat Gen. SEER	4.00
Cooling	Pack chiller type	Heat pump [Electric]
	Pack chiller power	Upto 100kW
	Chiller fuel type	Grid supplied electricity
	Qualify for ECAs?	Yes
	SEER	5.00
	EER	3.13
	Mixed Mode	Mechanical Ventilation
System adjustment	Heat rejection [Pump and Fan Power %]	
	Ductwork Leakage tested	Class A
	AHU Leakage Tested	Class L3
	SFP (W/I/S)	1.6
Metering Provision	Variable speed pumps	-
	Met.	Yes
	Alarm for out of range	Yes
Ventilation	Cooling/vent Mechanism	Air Conditioning
	Air supply mechanism	Central balanced A/C or mech vent system
	Heat recovery method	Thermal Wheel
	Variable Heat recovery efficiency	Yes
	Heat recovery efficiency	0.77
System Controls (EPC only)	Central Time Control	Yes
	Optimum start/stop control	Yes
	Local time control	Yes
	Local temp control	Yes
	Weather Comp control	No
Bivalent systems	Heat source	-
	Fuel	-
	Gen Seff	
	% load	

System Details	system name	System DHW03 Proposed
Domestic Hot Water	DHW Delivery Efficiency	1
	Generator Type	Same as Heating System
	Fuel Type	District heating
	Does the system have storage?	Yes
	Storage Volume (litres)	2000
	Storage Losses (kWh/l day)	0.0045
	Does the system have secondary circulation?	Yes
	Circulation Losses (W/m)	5
	Pump Power (kW)	0.1
	Loop Length (m)	400
	Time Switch?	Yes
	Does the system Use CHP	No
	Predicted CHP running Hours	0
Solar Water Heating		None
Solar Water Heating		None

9.0 Electrical systems

9.1 ADL2A management features

Part L results in Section 10.0 has been analysed with whole building power factor correction values of >0.95

The modelling has also included that lighting systems have a provision for metering and that the metering warns of 'out-of-range values.

9.2 Metering provision

In terms of metering provision, the modelling has assumed that HVAC systems have provision for metering and that the metering warns of out-of-range' values.

9.3 Carbon Factor

The team has not being able to validate the district heating carbon factor and the understanding, although not confirmed, that all the carbon credit has been claimed for the district heating CHP plant and as such the carbon factor of the exported heat has been set to the regulatory program default value of 0.293 kgCO₂/kWh as confirmed by CIBSE Certification

However, when an actual Carbon Factor is know an improvement is expected on the BER, BRUKL and EPC rating.

10.0 PART L2A RESULTS

Figure 10.1: BRUKL result

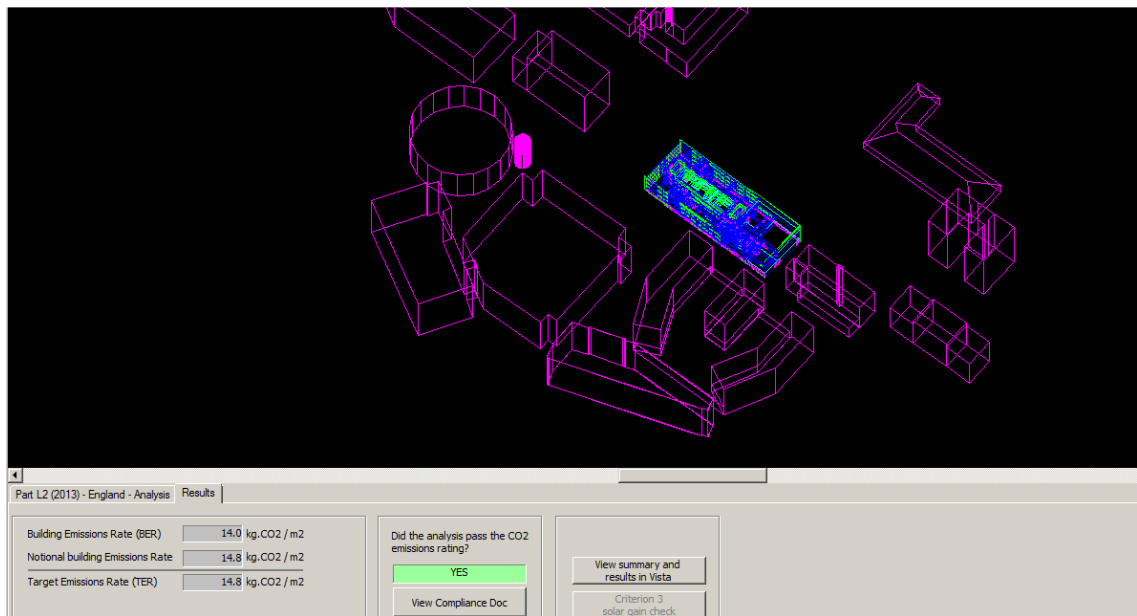
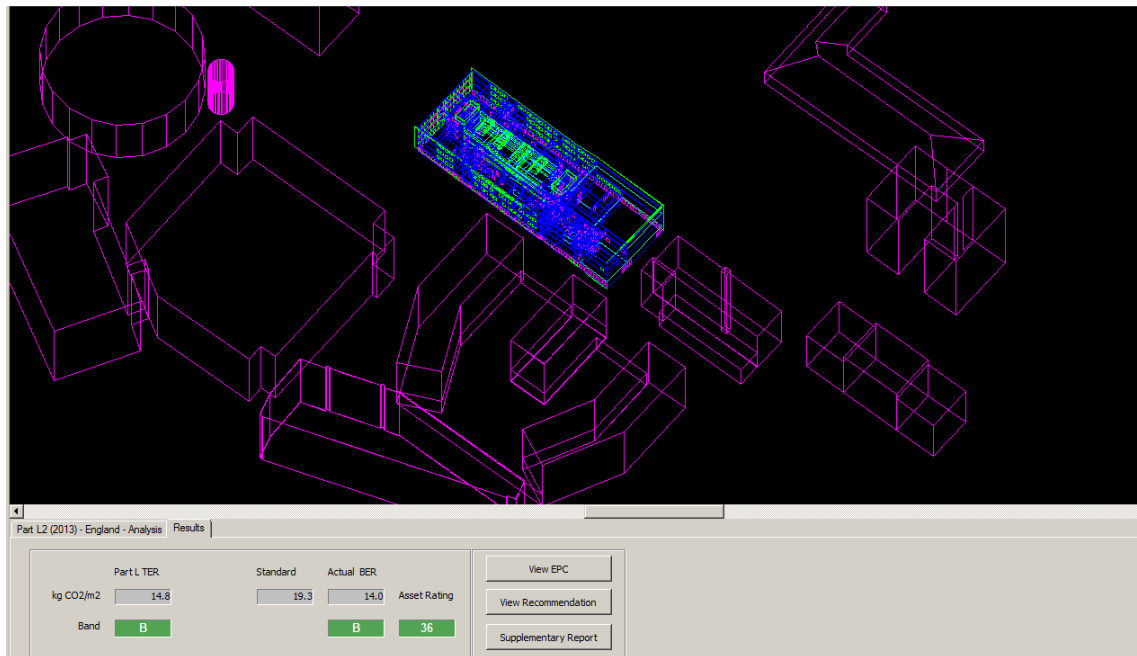


Figure 10.2: EPC result



APPENDICES

A. BRUKL Output H3 Analysis

[See attached PDF]

B. EPC Output H3 Analysis

[See attached PDF]

Appendix F

Estimated District heating Carbon Factor based on BRE SAP 2012 table 1.0

Community Heating and CHP	mains gas used to generate heat or heat and power (3 year average from year introduced) (1)		0.212
	mains gas used to generate heat or heat and power (5 year average from year introduced) (1)	0.198	0.214
	mains gas used to generate heat or heat and power (15 year average from year introduced) (1)		0.221
	coal used to generate heat or heat and power	0.350	0.385
	LPG used to generate heat or heat and power	0.245	0.242
	domestic heating oil used to generate heat or heat and power		0.292
	gas oil used to generate heat or heat and power		0.327
	fuel oil used to generate heat or heat and power	0.297	0.313
	electricity used to generate heat (3 year average projection) (1)		0.522
	electricity used to generate heat (5 year average projection) (1)	0.517	0.502
	electricity used to generate heat (15 year average projection) (1)		0.401
	waste used to generate heat or heat and power	0.040	0.047
	biomass used to generate heat or heat and power	0.013	0.069
	biogas used to generate heat or heat and power	0.018	0.098
	waste heat from power stations (3 year compliance period)		0.075
	waste heat from power stations (5 year compliance period)	0.058	0.072
	waste heat from power stations (15 year compliance period)		0.057
	geothermal heat sources (3 year compliance period)		0.037
	geothermal heat sources (5 year compliance period)	0.036	0.035