



building services consulting engineers

Energy and Sustainability Report

Queensmead
School

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design • consultancy • sustainability

Document History

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DESIGN SERVICES

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Mark founded Built Environment Consulting in 2005 after gaining extensive experience with both large and small building services consultancies.

Mark became a Chartered Engineer in 2003 and his knowledge gained on a wide variety of project types allows BEC to provide design services to most market sectors, from residential projects to large multi-million pound student accommodation projects, care homes, education, retail and industrial facilities alike.

Recognising the need to offer a tailored, flexible and cutting edge service to the market place, Mark has become a specialist in understanding the needs of an ever changing and developing construction industry and how M&E consultancy is now placed at the forefront of decision making with the advent of BREEAM, Passivhaus, SBEM, SAP and dynamic thermal modelling techniques.



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Matthew became a Chartered Engineer in 2017 and has gained considerable experience in a wide range of market sectors including education, commercial, residential, industrial and healthcare.

Having completed a master's degree in Sustainable Building Design, Matthew has a keen interest in energy efficiency, efficient building design and the introduction of renewable technologies to reduce both energy consumption and carbon footprint.

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1.0 ENERGY AND SUSTAINABILITY



1.1 Introduction

Built Environment Consulting Ltd has been contracted by Lungfish Architects to perform a Part L2A, BB101 and daylighting compliance analysis for the new classroom block at Queensmead School.

The thermal model has been produced in line with industry guidelines (CIBSE AM11) using approved software 'IES Virtual Environment', this software has been used to model the geometry of the building and simulate the buildings solar gains / shading, ventilation and CO2 emissions.

The use of IES modelling software in the analysis of the building design has informed a Pass of Part L2A of the building regulations, a regulation 25A feasibility study will still be required for compliance with building Regulations.

There is a project requirement for the new block to comply with the Greater London Authority (GLA) plan for carbon reduction. Section 2 of this report identifies the strategy for compliance.

1.2 Building Regulations Part L Compliance

A summary of assessed building elements and BER/TER is shown below. U-values have been taken as per the figures used within the 'My School' template and confirmed by the Architect.

Element	U value used in model [W/m²K]	Building Regulations Guidance	Percentage Betterment (%)	Pass
External Walls	0.18	0.35	51%	Yes
External Roofs	0.15	0.25	40%	Yes
Ground Floors	0.16	0.25	36%	Yes
Windows (inc. frame)	1.3	2.20	40%	Yes
Glazing G-Value of 0.35, LT Value of 0.69. Blinds have been used with a shading co-efficient of 0.61				
CO2 and Compliance summary				
Building	10.1 kgCO2/m²/yr	Notional	12.9 kgCO2/m²/yr	Yes

1.3 BB101 – Overheating and Carbon Dioxide Levels

All zones are passing the BB101 reporting, further information can be found within the BB101 section and recommendation sections of this report.

1.4 Daylighting (CBDM Analysis)

An increase in the reliance on electric lighting due to the restrictions created by existing buildings shading the proposed block, can be seen in the results. Further information can be found within the daylighting section and recommendations of this report.

1.5 Thermal Model & Design Data

1.5.1 Building Modelling

The building has been modelled within the IES:VE, in order to undertake the simulations, and building data provided to model the detailed specifications of the thermal envelope, window design, and surface reflectance's. The model has been built to standard industry guidance.

1.5.2 Glazing Specification

The external windows have been modelled based on the below target.

- U-Value – 1.3W/m²K
- G-Value – 0.35
- Light Transmittance Factor – 0.69

1.5.3 Air Permeability

The air permeability has been assigned a design value of 3m³(h.m²) at 50 Pa.

A certificate or declaration must be produced stating that an air leakage test has been carried out and the results show an air permeability of not greater than 3m³/h/m² at an applied pressure difference of 50 Pa has been achieved. The tests should be carried out by a suitably qualified person, e.g. an ATTMA member.

For TM52 the buildings infiltration has been set as 0.25 AC/H.

1.6 Heating, Cooling and DHW Systems

1.6.1 Heating and Cooling

The following table details an overview of the heating & DHW systems applied to the model:

Heating 1	
Plant	LTHW Boilers – (Fed from Central Boilers)
Fuel	Mains Gas
Controls	BEMS (Plant Separately Metered)
Efficiency	96%
Heating 2 Server + Graphics Cooling	
Plant	VRF
Fuel	Electricity
Controls	Standalone
Efficiency	COP 2.5 EER 3.5



1.6.2 DHW

DHW	
DHW Generation Fuel	Feed from Gas Fired Water Heater (2000L Central Storage)
Efficiency	98%
DHW Storage	200L
Storage Loss Factor	0.008 (kwh/(l/day))

Refer to the MEP services strategy report for full details on the heating and domestic water strategy for the project.

1.7 Ventilation Systems

1.7.1 System Overview

The mechanical ventilation systems for this project are:

- Local Extract Ventilation from Science Prep Room and specialist store.
- Natural Ventilation Heat Recovery (NVHR) units within first floor classrooms, resistant materials and Science Lab spaces.
- Mechanical Ventilation Heat Recovery (MVHR) units to serve WC’s, Offices and Graphics Labs
- Natural Ventilation to stair cores.

The following table details what parameters have been assigned to the model, where ‘assumed’ values have been taken from the “non-domestic building services compliance guide”.

Zone	Specific Fan Power
Local Extract Ventilation	0.5
MVHR	1.9 (65% Heat Recovery)

Local Extract Ventilation has been assigned as a zonal extract system where the fan is remote from the zone, this system is being used for foul extract.

Spaces with natural ventilation heat recovery ventilation (NVHR) are ventilated by the Breathing Buildings 900+ units.

The Hybrid Thermal Mixing (HTM) system from Breathing Buildings is designed to provide natural ventilation and hybrid ventilation incorporating mixed tempered air for winter periods, with the ability to provide secure night-time cooling and boosted levels of ventilation during summer. The system is designed to work in conjunction with other natural ventilation provided by manual windows.

The units are to be mounted below the ceiling line directly onto the louvres installed as part of the window package.

Mechanical ventilation heat recovery (MVHR) units are proposed to be ceiling void mounted and ducted to grilles within the space served.

1.7.2 Openable Windows

Windows that have been assigned to open follow the profile that has been set for windows to open when the internal temperature is over 21º C.

Windows have been set as Side Hung opening to 60°.

A restriction on the first floor windows only allows opening windows to be used for ventilation during the hottest 200 hours of the year. The windows have been modelled as fully opening during this time. The windows are to have restrictors with manual overrides to facilitate a larger opening area to combat overheating.

1.8 Lighting Systems

1.8.1 System Overview

As no current design data is available a figure of 80 Lumens/Circuit Watt using NCM Lux Levels to all occupied zones has been used to show compliance. Unoccupied zones are set as achieving 65 Lumens/Circuit Watt

The parasitic powers of the lighting controls have been set at 0.1 W/m² per control type.

External lighting has been excluded from the calculation as per NCM modelling guidelines.

Lighting gains for TM52 have been set at 5 w/m²

1.9 Renewable Energy Systems

There are currently no LZC technologies applied to the model. Please note that a regulation 25A feasibility study will still be required for compliance with building regulations.

1.10 Building Occupancy

The following table details occupancy levels as simulated.

The occupancy has been set to 100% between 8.00 and 12.00, 13.00 and 16.00 hrs unless stated below.

Zone	Occupancy (People)
Classrooms	32
Science Prep	3
Science Lab	32
Office	5
Resistant Materials	24
Staff Workroom	15
Graphics	25

1.11 Equipment Gains

Equipment gains are unknown and have been assigned as below

Zone	Equipment Gains (W)
Classrooms	450W



Science Prep	200W
Science Lab	600W
Office	320W
Resistant Materials	600W
Staff Work Room	320W
Graphics Lab	2050W

1.12 National Calculation Methodology Templates

The compliance methodology set by the Building Regulations give clear indication that compliance is independent of the occupied time and set point temperatures of the respective areas. These profiles are set by the NCM templates. The methodology compares two buildings operating over the same time period and conditioning the internal space to the same levels. For these simulations the most appropriate NCM building type is D1: Non-residential institutions: Education.

All other settings and efficiencies are as per the NCM templates unless stated otherwise within this report.

1.13 Part L2a Compliance

1.13.1 Overview

The Part L2A analysis covers five criteria, however only the first three are applicable at this stage and are detailed below. Please see appendix A for the full BRUKL compliance document.

1.13.2 Criterion 1: CO₂ Emissions

Criterion 1 relates to the overall Building Emission Rate (BER) relative to the Target Emission Rate (TER) calculated from the notional building (expressed in kgCO₂/m². annum.) The regulation requires the BER < TER.

As can be seen below the current design Passes criterion 1.

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

CO ₂ emission rate from the notional building, kgCO ₂ /m ² . annum	12.9
Target CO ₂ emission rate (TER), kgCO ₂ /m ² . annum	12.9
Building CO ₂ emission rate (BER), kgCO ₂ /m ² . annum	10.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

1.13.3 Criterion 2: Minimum Standards

Criterion 2 of Part L is a compliance check against the minimum standards set out by the Building Regulations and supplemented by the Non-Domestic Building Services Compliance guide.

The current design exceeds the minimum standards in all areas. Please note that some lighting efficacy figures will appear incorrect, this is due to lighting plots not being available for these areas, as such the total wattage has been assessed as per the lighting plans, however the software is calculating the efficacy from this wattage and the NCM Lux level, recording inaccurate figures (these figures do not affect the compliance calculation and is a reporting issue only).

1.13.4 Criterion 3: Limiting Solar Gains

Criterion 3 compares the solar gain through the buildings glazing with the notional building, primarily to ensure that the need for comfort cooling is kept to a minimum. This check is solely regarding the solar gains and is in no way indicative of room overheating, which is detailed later in the report.

As can be seen in the BRUKL output document, all applicable zones pass criterion 3.

1.13.5 Criterion 4: The Performance of the building 'As Built'

Criterion 4 is an ongoing due diligence throughout the Design and Construction Phase to ensure that the building is built as originally designed.

1.13.6 Criterion 5: provisions for enabling energy efficient operation of the building 'As Built'

Criterion 5 is production of User Manuals and Building Logbooks at completion of the project to ensure the end user is familiar with all energy usage within the building.

1.14 BB101 Adaptive Comfort Criteria

1.14.1 Overview

The overheating calculations completed for the project follow the guidance set out in CIBSE TM52. This is more onerous than the requirements for BB101.

The following three criteria, taken together, are used to assess the risk of overheating of buildings in the UK and Europe. A room or building that fails any two of the three criteria is classed as overheating.

1. The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1°K or more during the occupied hours of a typical non-heating season (1st May to 30th September).

2. The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperatures rise and its duration. This criterion sets a daily limit for acceptability.

3. The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

Further information on these criteria can be found in TM52 – 2013, section 6.1.2.

1.14.2 Hours of exceedance

The number of hours during which ΔT is greater than or equal to one degree (°K) during the period May to September inclusive shall not be more than 3% of occupied hours. ΔT is defined as operative temperature less the maximum acceptable temperature. ΔT is rounded to the nearest whole degree.

Please note:

1.14.3 Daily weighted exceedance

To allow for the severity of overheating, the weighted exceedance shall be less than or equal to 6 in any one day.

1.14.4 Upper limit temperature

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

1.14.5 Results

Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing	Result
GF - Graphics Lab 1	0	0	0	-	Pass
GF - Graphics Lab 2	0	0	0	-	Pass
GF - Science Lab 1	0.8	4	2	-	Pass
GF - Science Prep Room	0	0	0	-	Pass
GF - Staff work room	1.5	9	3	2	Pass
GF - Workshop	0.6	3	2	-	Pass
GF - Resistant Materials DAT47	0.6	3	2	-	Pass
GF - Resistant Mat	1.1	4	2	-	Pass
GF - Technical Prep	2.6	8	4	2	Pass
1F - General Classroom 1	2.8	10	4	2	Pass
1F - General Classroom 2	2.8	10	4	2	Pass
1F - General Classroom 3	2.9	10	4	2	Pass
1F - General Classroom 4	2.8	10	4	2	Pass
1F - General Classroom 6	2.8	10	4	2	Pass
1F - General Classroom 5	2.8	10	4	2	Pass
1F - General Classroom 12	1.8	8	3	2	Pass
1F - General Classroom 11	2.3	9	4	2	Pass
1F - General Classroom 10	2	9	4	2	Pass
1F - General Classroom 9	2.1	9	4	2	Pass
1F - General Office	0.7	7	2	-	Pass
1F - General Classroom 8	2	9	4	2	Pass
1F - General Classroom 7	2.4	9	4	2	Pass

1.15 BB101 Carbon Dioxide Levels

1.15.1 Overview

The ESFA requirements follow the methodology set out in the Building Bulletin 101 for assessing carbon dioxide levels within teaching spaces.

The requirements are set out below;

In general teaching spaces and learning resource areas where mechanical ventilation is used or when hybrid systems are operating in mechanical mode, sufficient outdoor air shall be provided to achieve a daily average concentration of carbon dioxide during the occupied period of less than 1000 ppm and so that the maximum concentration does not exceed 1500 ppm for more than 20 consecutive minutes each day, when the number of room occupants is equal to, or less than the design occupancy.

In general teaching spaces and learning resource areas where natural ventilation is used or when hybrid systems are operating in natural mode, sufficient outdoor air shall be provided to achieve a daily average concentration of carbon dioxide during the occupied period of less than 1500 ppm and so that the maximum concentration does not exceed 2000 ppm for more than 20 consecutive minutes each day, when the number of room occupants is equal to, or less than the design occupancy. In addition:

- in New Buildings, the system shall be designed to achieve a carbon dioxide level of less than 1200 ppm (800ppm above the outside carbon dioxide level, taken as 400ppm) for the majority of the occupied time during the year

1.15.2 Results

Room Name	Average CO2 (PPM)	Peak CO2 (PPM)	Result
1F - General Classroom 1	784	953	Pass
1F - General Classroom 2	785	955	Pass
1F - General Classroom 3	785	956	Pass
1F - General Classroom 4	785	955	Pass
1F - General Classroom 6	785	955	Pass
1F - General Classroom 5	785	955	Pass
1F - General Classroom 12	785	955	Pass
1F - General Classroom 11	786	957	Pass
1F - General Classroom 10	784	953	Pass
1F - General Classroom 9	785	955	Pass

1F - General Classroom 8	785	955	Pass
1F - General Classroom 7	785	956	Pass

1.16 Climate Based Daylight Modelling (CBDM)

1.16.1 Overview

Until recent times, the standardised measure of assessing daylighting performance was via the 'daylight factor' method. Which is simple to calculate and refers to the percentage of light inside a space, relative to outside. However, it is documented that daylight factors are not a reliable indicator of the usefulness of daylight within a space, as it does not take account of location, climate or orientation of a space. As such, the industry has moved toward dynamic daylighting metrics, known as Climate Based Daylight Modelling (CBDM), in order to ensure that daylight provision is assessed for both availability of daylight and daylight distribution within a space.

The EFSA requirements stipulate two CBDM factors in need of assessment, Useful Daylight Illuminance (UDI) and Spatial Daylight Autonomy (sDA). A further metric, Annual Sunlight Exposure (ASE), can be evaluated to assess over-lighting, however this is not a current performance requirement of the EFSA, and as such has not been assessed within this report.

1.16.2 Simulation Parameters

The calculation grid has been set at 500mm² intervals, at a working plane of 700mm. The daylighting performance was simulated using location and weather data obtained from the Chartered Institution of Building Services Engineers (CIBSE)

The whole of the room has been analysed for daylight performance. However, a perimeter of 0.5m from the room edge has been excluded from the final results.

Surface reflectance's are very influential for light levels at the back of the classroom. At this stage the reflectance's have been taken as;

- 85% for ceilings
- 75% for walls
- 35% for floors (Vinyl)

1.16.3 Useful Daylight Illuminance (UDI)

UDI is defined as the annual occurrence of illuminances across the working plane, that is within a range considered 'useful' by occupants. This is sub-divided into three 'ranges':

UDI-s – Where light is considered insufficient without electric lighting. (The ESFA guidance sets this lower limit at 100 Lux).

UDI-a – Where daylight is acceptable and electric lighting wouldn't be needed for the majority of the day (ESFA Guidance 100-3000 Lux).

UDI-e – Where the amount of light is considered excessive, leading to the use of blinds and electric lighting (The EFA guidance sets this upper limit at 3,000 Lux).

The requirements for schools represented below,

- Type L1 – Teaching Spaces – 80% of spaces to achieve an UDI-a of >80%.
- Type L2 – Halls, Libraries, Study areas – 65% of spaces to achieve an UDI-a of >80%.
- Type L3 – Group Rooms, Study areas – 50% of spaces to achieve an UDI-a of >80%.

It should be noted that the ESFA recognises that the primary performance criteria may not be able to be met and the spaces are expected to be as close as possible to full compliance as is feasible.

1.16.4 Spatial Daylight Autonomy (sDA)

sDA examines whether a space will receive enough daylight over the course of the occupied day and is designed to encourage design of energy efficient spaces, and not overly reliance on electric lighting during daylight hours. The calculation is run in two parts, with and without the operation of blinds, and the PASS or FAIL results presented in order to report whether a satisfactory level of daylight is achievable within the space. Blinds are included within the second set of calculations in order to account for times where the daylight provision will be above a certain threshold (set at 3,000 lux for the purposes of this calculation) at which point the blinds would be closed by occupants, and artificial lighting used.

The requirements for schools represented below,

- Type L1 – Teaching Spaces – 80% of spaces to achieve a sDA of >50%.
- Type L2 – Halls, Libraries, Study areas – No Requirement
- Type L3 – Group Rooms, Study areas – No Requirement

1.16.5 Results

The below table corresponds to the L1 type rooms;

Room Name	Orientation	UDIs 100-300Lux	UDIa 300-3000 Lux	Total Udi
GF Science Lab 1	North-East	40.7	29	69.7
GF Graphics Lab 1	North-East	29.9	25.9	55.8
GF Graphics Lab 2	North-East	31	26.4	57.4
GF Workshop (heat bay)	South-West	33.8	30.9	64.7
GF Resistant Material 47	South-West	35.9	29.8	65.7
GF Resistant Material 43	South-West	32.6	30	62.6
GF Technical Prep	South-West	30.4	30.2	60.6
FF Classroom 1	South-West	36.3	43	79.3
FF Classroom 2	South-West	35.7	44.3	80.0
FF Classroom 3	South-West	35.3	45.2	80.5
FF Classroom 4	South-West	34.7	46.5	81.2
FF Classroom 5	South-West	34.9	45.5	80.4
FF Classroom 6	South-West	34.6	45.9	80.5

FF Classroom 7	South-West	34.5	45.8	80.3
FF Classroom 8	North-East	44.8	35.4	80.2
FF Classroom 9	North-East	43.9	35.5	79.4
FF Classroom 10	North-East	41.5	35.9	77.4
FF Classroom 11	North-East	40.1	36.6	76.7
FF Classroom 12	North-East	42.1	36	78.1

The results above show that 100% of the first-floor rooms pass (within a percentage that we would deem acceptable). Currently all the ground floor rooms do not meet the CBDM requirements. This is due to shading from existing buildings that form part of the site constraints as the neighbouring buildings are within a proximity and are a minimum of two storeys.

Changing the window specification will have little impact on the ground floor rooms.

The below results refer to L2 Category Rooms.

Room Name	Orientation	UDIs 100-300Lux	UDIa 300-3000 Lux	Total Udi
GF Office	North-East	36.9	27.8	64.7
GF Staffroom	North-West	28.3	20.7	49

As above, the ground floor rooms are not achieving the minimum requirements due to shading from existing buildings.

The sDA results for the L1 classification rooms is given in the table below.

Room Name	Orientation	sDA
GF Science Lab 1	North-East	30.8
GF Graphics Lab 1	North-East	28.1
GF Graphics Lab 2	North-East	28.5
GF Workshop (heat bay)	South-West	34.2
GF Resistant Material 47	South-West	32.3
GF Resistant Material 43	South-West	32.3
GF Technical Prep	South-West	33.5
FF Classroom 1	South-West	49.3
FF Classroom 2	South-West	50.9
FF Classroom 3	South-West	51.3
FF Classroom 4	South-West	53.3
FF Classroom 5	South-West	53.5
FF Classroom 6	South-West	54.7
FF Classroom 7	South-West	54.5
FF Classroom 8	North-East	39
FF Classroom 9	North-East	38.5
FF Classroom 10	North-East	39.4
FF Classroom 11	North-East	39.9
FF Classroom 12	North-East	39.5

As described previously the sDA figures are effected by the site constraints and shading from existing buildings, largely affecting the ground floor with North-East classrooms on the first floor also being effected by shading from near buildings effecting morning and evening sun levels within the spaces.

This is represented in the diagram below.



1.1 Recommendations

1.1.1 BRUKL

There are currently no LZC technologies applied to the model. Please note that a regulation 25A feasibility study will still be required for compliance with building regulations.

Please refer to the London Plan Requirements for a strategy for betterment.

1.1.2 BB101

The Building is passing BB101 Reporting for both overheating and carbon dioxide levels and no further recommendations are required.

1.1.3 Daylighting

The limitations created through constructing on an existing site have meant that the orientation of the building and shading from existing buildings effects the theoretical modelling of the classroom block. With no option for change of orientation of the building or site location to avoid shading the ground floor spaces will rely more on artificial lighting than the first floor.

To increase energy efficiency, high efficiency lighting has been proposed to be used alongside automatic daylighting and presence controls within the space.

BRUKL Output Document

Compliance with England Building Regulations Part L 2013



Project name

**200228_20008_Queensmead School
SBEM**

As designed

Date: Fri Feb 28 15:34:55 2020

Administrative information

Building Details

Address: Queens Walk, Ruislip, HA4 0LS

Owner Details

Name: Queensmead School

Telephone number: Phone

Address: Queens Walk, Ruislip, HA4 0LS

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Certifier details

Name: Yaseen Waseem

Telephone number: Phone

Address: Street Address, City, Postcode

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

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	12.9
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	12.9
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	10.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	U _{a-limit}	U _{a-calc}	U _{i-calc}	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	GF000000:Surf[10]
Floor	0.25	0.16	0.16	GF000000:Surf[0]
Roof	0.25	0.15	0.15	1F000000:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	GF000000:Surf[2]
Personnel doors	2.2	1.6	1.6	GF000000: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/(m²K)]
 U_{a-calc} = Calculated area-weighted average U-values [W/(m²K)]
 U_{i-calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
 ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
 *** Display windows and similar glazing are excluded from the U-value check.
 N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

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

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Building services

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

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

1- VRF

	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					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.					

2- NVHR + Rads

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- LE + Rads

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

4- Rads + NV

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

5- MVHR + Rads

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	0.65
Standard value	0.91*	N/A	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

6- DX

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	3.5	-	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					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.					

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1- DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.98	0.008
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

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		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
GF - Acc W/C	-	-	0.5	-	-	-	-	-	-	-	-	N/A
GF - Girls W/C	-	-	0.5	-	-	-	-	-	-	-	-	N/A
GF - Boys W/C	-	-	0.5	-	-	-	-	-	-	-	-	N/A
GF - Circulation	-	-	-	1.9	-	-	-	-	-	-	-	N/A
1F - Acc W/C	-	-	0.5	-	-	-	-	-	-	-	-	N/A
1F - Girls W/C	-	-	0.5	-	-	-	-	-	-	-	-	N/A
1F - Boys W/C	-	-	0.5	-	-	-	-	-	-	-	-	N/A
1F - General Office	-	-	-	1.9	-	-	-	-	-	-	-	N/A
1F - Circulation	-	-	-	1.9	-	-	-	-	-	-	-	N/A
1F - Circulation	-	-	-	1.9	-	-	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
Standard value	Luminaire	Lamp	Display lamp	
GF - Graphics Lab 1	80	-	-	442
GF - Specialist Store	65	-	-	42
GF - Graphics Lab 2	80	-	-	438
GF - Science Lab 1	80	-	-	442
GF - Science Prep Room	65	-	-	47
GF - Acc W/C	-	65	-	60
GF - Girls W/C	-	65	-	71
GF - Boys W/C	-	65	-	69
GF - Stairs / Circulation	-	65	-	141
GF - Circulation	-	65	-	336
GF - Staff work room	80	-	-	193
GF - Engineer Store	65	-	-	19

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
Standard value	Luminaire	Lamp	Display lamp	
GF - Cleaner Store	65	-	-	12
GF - Workshop (heat bay)	80	-	-	545
GF - Resistant Materials DAT47	80	-	-	582
GF - Resistant Material DAT 43	80	-	-	509
GF - Stairs/Landing 1	-	65	-	133
GF - Technical Prep	80	-	-	302
1F - Acc W/C	-	65	-	60
1F - Girls W/C	-	65	-	71
1F - Boys W/C	-	65	-	69
1F - Circulation/stairs	-	65	-	141
1F - General Classroom 1	80	-	-	302
1F - Circulation/Stairs	-	65	-	98
1F - General Store	65	-	-	15
1F - General Classroom 2	80	-	-	294
1F - General Classroom 3	80	-	-	290
1F - General Classroom 4	80	-	-	292
1F - General Classroom 6	80	-	-	292
1F - General Classroom 5	80	-	-	292
1F - General Classroom 12	80	-	-	298
1F - General Classroom 11	80	-	-	285
1F - General Classroom 10	80	-	-	304
1F - General Classroom 9	80	-	-	295
1F - General Office	80	-	-	153
1F - General Classroom 8	80	-	-	293
1F - General Classroom 7	80	-	-	290
1F - IT Hub	65	-	-	88
1F - Teaching Store	65	-	-	29
1F - Dist. Boards	65	-	-	7
1F - Circulation	-	65	-	178
1F - Circulation	-	65	-	202
Plant Room	65	-	-	313

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?
GF - Graphics Lab 1	NO (-40.7%)	NO
GF - Graphics Lab 2	NO (-40.2%)	NO
GF - Science Lab 1	NO (-40.7%)	NO
GF - Staff work room	NO (-82.4%)	NO
GF - Workshop (heat bay)	NO (-43.1%)	NO
GF - Resistant Materials DAT47	NO (-46.6%)	NO
GF - Resistant Material DAT 43	NO (-39%)	NO
GF - Technical Prep	NO (-66.9%)	NO
1F - General Classroom 1	NO (-66.9%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1F - General Classroom 2	NO (-29.6%)	NO
1F - General Classroom 3	NO (-28.6%)	NO
1F - General Classroom 4	NO (-29.1%)	NO
1F - General Classroom 6	NO (-29.1%)	NO
1F - General Classroom 5	NO (-29.1%)	NO
1F - General Classroom 12	NO (-41.2%)	NO
1F - General Classroom 11	NO (-38.7%)	NO
1F - General Classroom 10	NO (-42.4%)	NO
1F - General Classroom 9	NO (-40.8%)	NO
1F - General Office	NO (-42.6%)	NO
1F - General Classroom 8	NO (-40.4%)	NO
1F - General Classroom 7	NO (-28.6%)	NO
1F - IT Hub	N/A	N/A

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Area [m ²]	2043.2	2043.2		A1/A2 Retail/Financial and Professional services
External area [m ²]	3350.5	3350.5		A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
Weather	LON	LON	1	B1 Offices and Workshop businesses
Infiltration [m ³ /hm ² @ 50Pa]	3	3		B2 to B7 General Industrial and Special Industrial Groups
Average conductance [W/K]	951.84	1309.1		B8 Storage or Distribution
Average U-value [W/m ² K]	0.28	0.39		C1 Hotels
Alpha value* [%]	10.02	10		C2 Residential Institutions: Hospitals and Care Homes
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging				
				C2 Residential Institutions: Residential schools
				C2 Residential Institutions: Universities and colleges
				C2A Secure Residential Institutions
				Residential spaces
				D1 Non-residential Institutions: Community/Day Centre
				D1 Non-residential Institutions: Libraries, Museums, and Galleries
			99	D1 Non-residential Institutions: Education
				D1 Non-residential Institutions: Primary Health Care Building
				D1 Non-residential Institutions: Crown and County Courts
				D2 General Assembly and Leisure, Night Clubs, and Theatres
				Others: Passenger terminals
				Others: Emergency services
				Others: Miscellaneous 24hr activities
				Others: Car Parks 24 hrs
				Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	15.1	17.2
Cooling	0.28	0.18
Auxiliary	3.23	1.79
Lighting	6.3	12.76
Hot water	7.48	6.64
Equipment*	21.78	21.78
TOTAL**	32.39	38.57

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

Energy Production by Technology [kWh/m²]

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

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	61.14	62.37
Primary energy* [kWh/m ²]	60.88	78.26
Total emissions [kg/m ²]	10.1	12.9

* 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	21.3	0	6.5	0	10	0.91	0	0.96	0
Notional	21.6	0	6.9	0	3.5	0.86	0	----	----
[ST] Central heating using water: convectors, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	69.4	0	21.2	0	1.6	0.91	0	0.96	0
Notional	69.7	0	22.5	0	0.7	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	14	0	4.3	0	23.2	0.91	0	0.96	0
Notional	37.8	0	12.2	0	26.7	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	30.2	0	9.2	0	2	0.91	0	0.96	0
Notional	54.1	0	17.4	0	1.2	0.86	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	120.6	42.2	8.4	3.3	0	4	3.55	4	5
Notional	113.8	29	12.4	2.1	0	2.56	3.79	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	0	0	0	0	0	4	3.55	4	5
Notional	0	0	0	0	0	2.56	3.79	----	----
[ST] No Heating or Cooling									
Actual	0	0	0	0	0	0	0	0	0
Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.18	GF000000:Surf[10]
Floor	0.2	0.16	GF000000:Surf[0]
Roof	0.15	0.15	1F000000:Surf[0]
Windows, roof windows, and rooflights	1.5	1.4	GF000000:Surf[2]
Personnel doors	1.5	1.6	GF000000: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	3



2.0 LONDON PLAN COMPLIANCE



2.1 Introduction

The proposed classroom block is required to comply to local planning restrictions as part of the Greater London Authority (GLA) London plan policy 5.2 which sets out to minimise carbon dioxide emissions in new developments.

In line with the release of Part L (2013) of the Building Regulations in April 2014, the GLA requires new non-residential developments to achieve a 35% carbon emissions reduction over Part L (2013).

The London Plan requires an assessment of energy demand that demonstrates the steps taken to apply the Mayor’s energy hierarchy. The London Plan includes planning policies both for reducing energy consumption within buildings and the use of renewable energy. These policies cover the role of the boroughs in supporting the Mayor’s energy strategy and the requirements of planning applications.

At the current stage of the project the design does not currently meet the GLA London plan requirements and measures will be introduced during the detailed design stage. The below sections outline the existing design alongside measures that will be incorporated/developed further to reduce the CO2 usage.

The current savings on carbon dioxide is listed below.

CO2 Savings			
Building	10.1 kgCO2/m²/yr	Notional	12.9 kgCO2/m²/yr

This achieves a baseline figure of 22% saving over the current unregulated notional building.

2.2 Energy Hierarchy

2.2.1 Be Lean – Reduce Energy Demand

The first step to achieving Building Regulations compliance and the targets outlined previously is to reduce energy demand. The measures associated with reducing demand can be termed as ‘Energy Efficiency Measures’. The Proposed Development will incorporate all relevant energy conservation measures; the benefits of which are discussed below. In summary the following measures will be included:

- Airtight construction.
- High performance building fabric.
- High performance glazing.
- 100% low energy lighting.
- Mechanical ventilation system with high heat recovery efficiency
- Local electric water storage reducing system heat loss.
- High efficiency heat generation.

The below table identifies the proposals currently and the enhancements to be investigated as part of the detailed design.

Building Fabric					
Element	Current Figure	Minimum Part L requirement	Percentage Betterment over Part L (%)	Proposed Figure	Percentage Betterment over Part L (%)
External Wall	0.18 [W/m²K]	0.35 [W/m²K]	51%	0.15 [W/m²K]	57%
External Roofs	0.15 [W/m²K]	0.25 [W/m²K]	40%	0.11 [W/m²K]	64%
Ground Floors	0.16 [W/m²K]	0.25 [W/m²K]	36%	0.15 [W/m²K]	40%
Windows (inc. frame)	1.3 [W/m²K]	2.20 [W/m²K]	40%	1.3 [W/m²K]	40%
Air Tightness	3m³(h.m²) at 50 Pa	5m³(h.m²) at 50 Pa.	40%	3m³(h.m²) at 50 Pa	40%

As seen above the proposal is to further better the fabric to reduce the carbon emission from a fabric first approach and will form the first part of the carbon emission savings strategy.

The second approach will be to review equipment efficiencies to reduce energy usage, the targets are listed below.

Equipment Efficiencies					
Element	Current Figure	Minimum Part L requirement	Percentage Betterment over Part L (%)	Proposed Figure	Percentage Betterment over Part L (%)
MVHR SFP’s	1.9 W/(l.s)	1.9 W/(l.s)	0%	1.3 W/(l.s)	32%
Extract Fan SFP’s	0.5 W/(l.s)	0.5 W/(l.s)	0%	0.3 W/(l.s)	40%
MVHR heat recovery efficiency	65%	50%	24%	85%	42%
Hot water storage loss	0.008 (kwh/(l/day) from central hot water	None	-	0 (change to local electric water heaters)	-

Internal Lighting Lumens/Circuit Watt	80	60	33%	120 average	200%
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As you can see above the plant efficiencies will be reviewed and offer significant improvement on minimum Part L figures and will contribute to the reduction in CO2 emissions.

Further to the above automatic lighting controls will incorporate presence/absence detection alongside daylight sensors to reduce the duration lighting is in use when not needed.

2.2.2 Be Clean – Supply Energy Efficiency

After consumption has been reduced through the application of energy efficiency measures, the next step is to consider low carbon technologies in order to provide further reduction in carbon dioxide emissions. The following low carbon technologies have been investigated for the Proposed Development.

- District heating network
- Combined Heat and Power (CHP)

2.2.2.1 District Heating

The London Heat Map identifies existing and potential opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study. The map shows the location of any existing and proposed district heating systems within the vicinity of the development.

There are no public existing district heating networks within 1 km of the site. The closest existing district heating network is Edgware Road which is located at approximately 13 miles from the site. The distance to the network is too far for a connection to be commercially viable, therefore this option has been considered unfeasible.

As part of the works at the school the existing energy centre and local district heating network is to be demolished and replaced. There are 3no. Remeha Gas 350 (152kW each) boilers within the basement plant room. The boiler provides heating and hot water to;

- Science Block.
- Dining and Food tech Block
- Existing DT Block (to be demolished and replaced)

The existing boilers are circa 15 years old and information received from the manufacturers state the existing efficiency to be around 81% and likely to be lower depending on servicing and maintenance.

The proposal is to replace the boiler plant within the new energy centre to boilers with a minimum efficiency of 95% to serve the existing school blocks at 82/71°C flow and return temperatures. This could increase to 97.5% efficiency if the new block system was based on 70/50°C flow and return temperatures.

Not only will this benefit the carbon savings of the new block but, by association, reduce the school's site carbon emissions greatly and should be a large factor to be included in association with the new block's standalone targets.

2.2.2.1 Combined Heat and Power (CHP)

The provision of a centralised CHP led LTHW heating system has been investigated. As a commercial development, domestic hot water consumption does not make up a significant proportion of the total heat demand. Also, as a relatively small network, the total heat demand does not provide a sufficient baseline heat load for the use of CHP. Therefore, the use of CHP engines is not considered to be appropriate for the development. Furthermore, because of the replacement of existing heating plant, the new alterations to the existing network would create unnecessary capital expenditure out of the main contract works.

2.2.3 Be Green – Renewable Energy Technologies

Renewable Energy Technologies are those listed below which can provide a source of energy on-site that is not primarily based on the consumption of fossil fuels or grid electricity and/or utilises a heat source that is renewable such as ground source and solar thermal systems. Examples of which are;

- Wind Power
- Biomass Heating
- Ground Source Heating and/or Cooling
- Solar Thermal Hot Water Heating
- Photovoltaic Panels

Due to the project being the replacement of an existing block fed from a central energy centre the options for renewable energy generation are limited without having a significant effect on the wider school site.

Photovoltaic panels would be a consideration but due to the proximity of RAF Northolt and the school being in a direct flight path, it is expected that PV is unsuitable for this project.

Therefore, the proposal is to target the first two steps, at which point a discussion will be had with the local sustainability officer as to the betterment achieved, at that point. The upgrade of boilers (by replacing the existing and increasing the efficiencies) in the energy centre that serve a number of other buildings will also be taken into account as an improvement to the overall school emission rate and reduction in energy use.