Meadow High School, London Borough of Hillingdon

Energy Strategy

Version 01

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JAWSustainability

Contents

1 Introduction

This energy strategy has been prepared for the proposed new 2 storey building of Meadow High School, in order to meet the sustainability requirements of the London Plan and the London Borough of Hillingdon.

The site is located in the London Borough of Hillingdon, Royal Lane, Uxbridge, UB8 3QU. The project consists of the construction of a new 2 storey building. The site location is shown in Figure 1-01.

Figure 1-01 – Site Location

2 Policy

2.1 Hillingdon Local Plan: Part 1 - Strategic Policies

Policy EM1: Climate Change Adaptation and Mitigation

The Council will ensure that climate change mitigation is addressed at every stage of the development process by:

1. Prioritising higher density development in urban and town centres that are well served by sustainable forms of transport.
2. Promoting a modal shift away from private car use and requiring new development to include innovative initiatives to reduce car dependency.
3. Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.
4. Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.
5. Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.
6. Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.
7. Encouraging sustainable techniques to land remediation to reduce the need to transport waste to landfill. In particular developers should consider bioremediation(39) as part of their proposals.
8. Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydroelectricty and a greater use of waste as a resource.
9. Promoting new development to contribute to the upgrading of existing housing stock where appropriate.

The Borough will ensure that climate change adaptation is addressed at every stage of the development process by:

10. Locating and designing development to minimise the probability and impacts of flooding.
11. Requiring major development proposals to consider the whole water cycle impact which includes flood risk management, foul and surface water drainage and water consumption.
12. Giving preference to development of previously developed land to avoid the loss of further green areas.
13. Promoting the use of living walls and roofs, alongside sustainable forms of drainage to manage surface water run-off and increase the amount of carbon sinks.
14. Promoting the inclusion of passive design measures to reduce the impacts of urban heat effects.

2.2 The London Plan

Policy SI 2 Minimising greenhouse gas emissions

A. Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

    1. be lean: use less energy and manage demand during operation
    2. be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
    3. be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
    4. be seen: monitor, verify and report on energy performance.

B. Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C. A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:
    a. through a cash in lieu contribution to the borough's carbon offset fund, or
    b. off-site provided that an alternative proposal is identified, and delivery is certain.

D. Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

E. Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

3 Energy Strategy

An energy strategy has been developed following the energy hierarchy 'Be Lean, Be Clean, Be Green, Be Seen'. Energy calculations using Building Regulations approved and accredited software have been undertaken at each stage to calculate the savings associated with the measures incorporated.

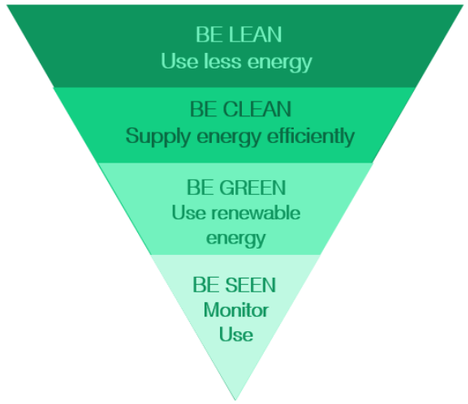


Figure 3-01 The Energy Hierarchy

Energy calculations have been carried out using IES VE Compliance tool, based on Part L 2021 building regulations. The development is a new building so it has been compared to the notional building.

The BRUKLs are used to assess the impact on energy demand and CO_2 emissions of improvements through the hierarchy and demonstrate the most appropriate solution for the development to meet the relevant planning requirements.

3.1 Energy Targets

Table 3-01 details the energy and carbon breakdown of the baseline emissions for the development. The baseline is based on the 2021 building regulations notional building.

Electricity (kWh/yr)						Electricity CO2 (kg/yr)	Total Energy (KWh/yr)	Total CO_2 (kg/yr)
Space Heating	HW	Cooling	Pumps & Fans	Lighting	Total			
21,822	16,036	0	6,110	13,163	57,130	8,142	57,130	8,142

Table 3-01 Baseline regulated energy demand and carbon emissions per energy source

3.2 Be Lean

As part of the Be Lean approach, passive design measures have been considered throughout the pre-planning stage to reduce initial energy demand.

Solar Gain Control and Daylight

Solar gains are a passive form of heating from the sun's radiation and are beneficial to a building during winter months as they provide an effective source of heat and reduce internal heating requirements. However, during summer months they must be controlled in order to mitigate the risk

of overheating. They can be controlled through glazing and shading design in order to allow low level winter sun to enter the building and to limit access to high level summer sun. Glazing will incorporate low emissivity coatings to limit overheating without compromising light transmittance.

In the BRUKL output document a couple of rooms fail Criterion 3 “The spaces in the building should have appropriate passive control measures to limit solar gains in summer”. This is because the glazing chosen by the designing team couldn’t have a very low g-value, due to the fact that would affect the LT value leading to a failure of the daylight assessment.

A separate overheating assessment shows that the development passes the overheating criteria, included in the “Building Bulletin 101: Guidelines on ventilation, thermal comfort and indoor air quality in schools”, so they excessive solar gains do not lead to the overheating of the rooms.

Building Fabric

Designing an efficient thermal envelope will greatly reduce the need for space heating and cooling as heat transmittance through the thermal elements is reduced.

Low air permeability rates will also reduce heating and cooling energy demand by reducing the volume of air that can penetrate the building.

As part of a ‘fabric first’ approach, the building fabric has been carefully considered and specified to meet or exceed current Building Regulations minimum requirements, as detailed in Table 3-02 below.

Fabric Component	U - Values
External Walls	0.14 W/m2*K
Roof	0.11 W/m2*K
Exposed/Ground Floor	0.11 W/m2*K
Windows (including glazed doors)	0.8 W/m2*K (g – value 0.53)
Rooflights	0.8 W/m2*K (g – value 0.53)
Air Tightness	3 $m^3/(h*m^2)$

Table 3-02 Proposed Be Lean passive design measures

Building Services

Initial systems have been identified to maximise efficiency therefore reducing energy used to deliver services. Table 3-03 shows the proposed services strategy and energy efficiency measures for the development. These are provisional system proposals and may change as the design evolves.

In line with the GLA guidance, a heat pump with SCOP 2.64 has been assumed to provide heating for the be lean stage, this does not represent the proposed strategy for the development. The proposed heating system is presented in section 3.4.

Services Component	Proposed Specification
Space Heating	*Assumed ASHP for Be Lean Stage, SCOP 2.64*
Domestic Hot Water	Instantaneous DHW
Ventilation	Natural ventilation in staff social, staff workroom, assistance head office, leader office, therapy, stores, circulation, stairs, breakout toom MVHR : Medical room, sensory and quiet study, heat recovery 80% NVHR : Common room, breakout room, music room, fitness room, classrooms, science classroom, food tech classroom, hygiene room
Lighting	LED lighting 145 lm/W in circulation, stairs, WC and food technology classroom 120 lm/W in store, group room, data, sensory room 95 lm/W in classrooms, fitness room, offices, hygiene room, medical room, plant room, staff workroom, staff social, common room, quiet study, therapy, breakout room
Lighting Controls	Occupancy and photoelectric sensors in circulations, hygiene rooms, stairs, breakout rooms Occupancy sensors in stores, data, lift, WC Local switch and occupancy in group rooms, offices, plant room, staff social, staff workroom, common, quiet study, sensory, therapy RIDI class control in classrooms, fitness room, science, music room, food technology classroom Photoelectric sensors in medical
Metering	Warning “out-of-range” values in HVAC and lighting services
Electric power factor	> 0.95

Table 3-03 Proposed energy efficient design measures

Energy Use

The breakdown of carbon and energy use has been identified for the site. Table 3-04 shows the breakdown of carbon and energy use once the strategies proposed at the be lean stage are incorporated.

Electricity (kWh/yr)						Electricity CO2 (kg/yr)	Total Energy (KWh/yr)	Total CO_2 (kg/yr)
Space Heating	HW	Cooling	Pumps & Fans	Lighting	Total			
17,205	16,879	0	4,151	9,396	47,630	6,818	47,630	6,818

Table 3-04 Be Lean regulated energy demand and carbon emissions per energy source

Carbon Savings

Table 3-05 and Figure 3-02 demonstrates the percentage improvement over the notional baseline levels for the be lean stage. The development demonstrates a 16% reduction in CO_2 emissions over the baseline at the Be Lean stage over the Part L 2021 notional baseline.

In collaboration with the design team, the passive design measures that have been introduced are the optimum from a practical and point of view, and the development reaches the 15% reduction in CO_2 in the Be Lean stage set by the London Plan.

	CO_2 Emissions (tonnes/annum)	CO_2 Savings (tonnes/annum)	% Saving
Baseline	8.1		
Be Lean	6.8	1.3	16%

Table 3-05 Be Lean improvements over the baseline

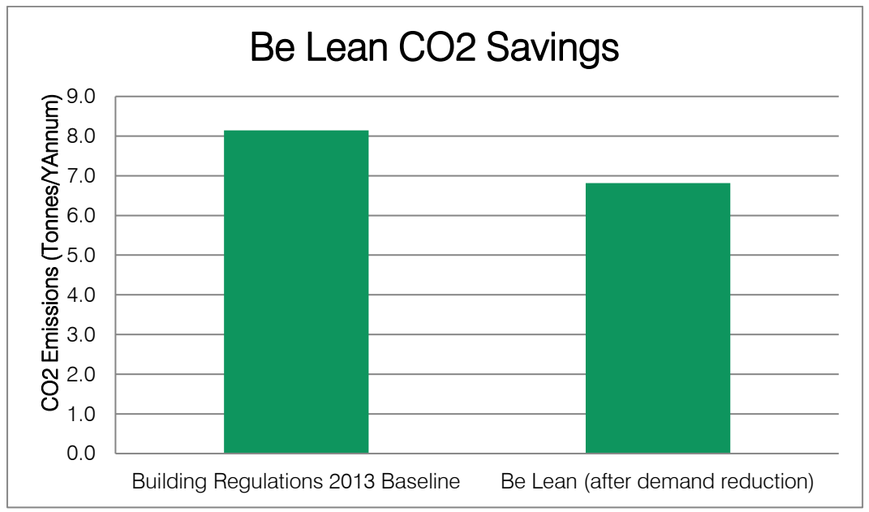


Figure 3-02 Be Lean improvement over the baseline

3.3 Be Clean

As part of the Be Clean approach, the use of energy efficient equipment, heat networks and community heating have been considered.

No existing or proposed heat networks are located within close proximity of the development, as shown in Figure 3-03.

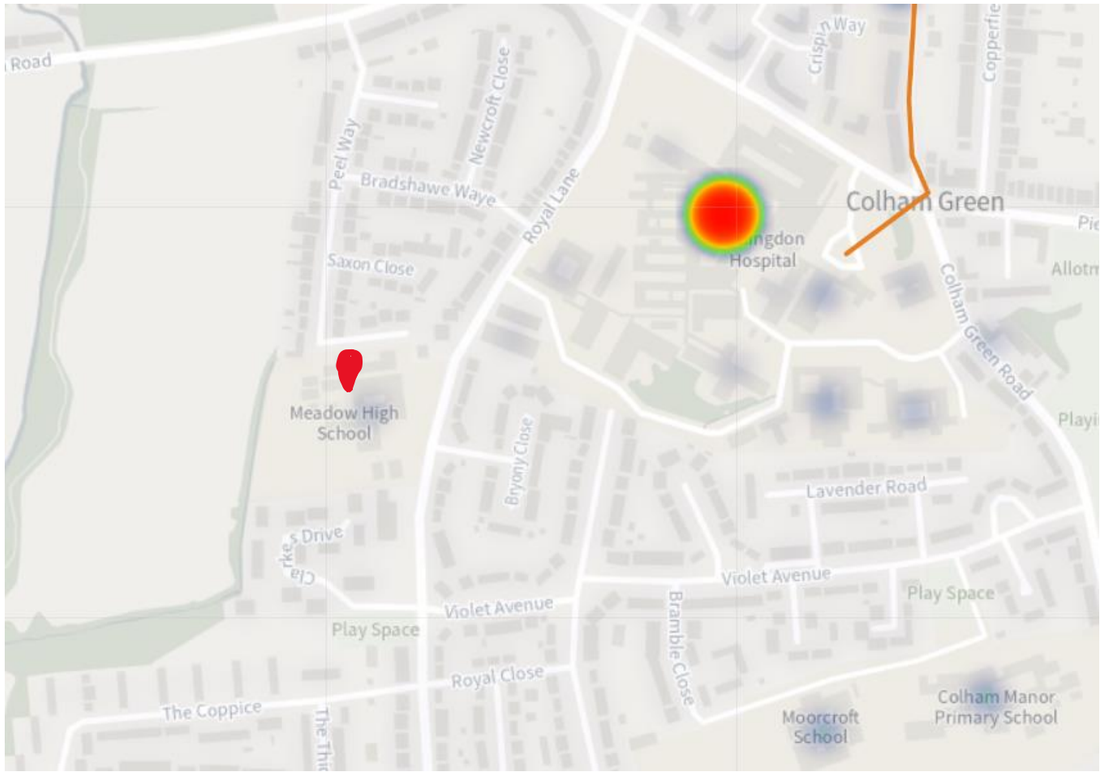
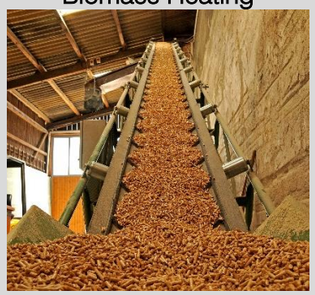


Figure 3-03 Harefield Acadamy Location, London Heat Map

3.4 Be Green

At the Be Green stage, renewable and low carbon technologies are investigated. Table 3-06 considers the feasibility of renewable energy technologies for the scheme.

LZC Technologies	Description	Noise	Visual impact	Internal Space	External Space	Capital Cost	Maintenance	Feasibility	
Solar Thermal Collectors 	Solar thermal collectors can be used to provide hot water using the irradiation from the sun. They can generally provide approx. 50% of the hot water demand	🟢	🟡	🟢	🟡	🔴	🟡	There are areas of flat roof that can incorporate solar technologies. However, carbon savings are quite low and it is quite a high cost technology. The development is proposing the use of heat pumps, which do not combine well with Solar thermal technology	✖
Solar Photovoltaic Panels 	Solar PV panels generate electricity from the sun's energy. They should be installed within 90° of due south ideally at a 30° angle. The electricity can be used to supply the landlords load.	🟢	🟡	🟢	🟡	🟡	🟡	There are areas of roof that can incorporate solar technologies. Solar PV is ideal for making carbon savings while being a simple technology.	✓
Biomass Heating 	Solid, liquid or gaseous fuels derived from plant material can provide boiler heat for space and water heating A biomass boiler would supplement a standard gas heating system so some of the cost may be offset through money saved on using smaller traditional boilers reliability of fuel access/supply can be a problem	🟡	🟢	🔴	🟡	🔴	🔴	Biomass is not considered feasible for this development due to issues with fuel storage, access for delivery vehicles and local NO_x emissions	✖

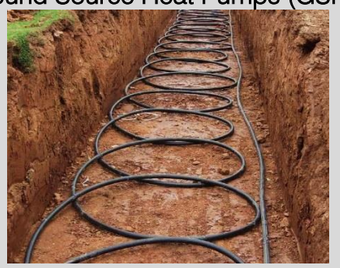
Wind Turbines 	Vertical and horizontal axis wind turbines enable electricity to be generated using the power within the wind Not suitable for urban environments due to low wind conditions and obstructions	🔴	🔴	🟢	🔴	🔴	🟡	This development is in an urban environment and so a wind turbine will not generate much energy	×
Ground Source Heat Pumps (GSHP) 	Utilising horizontal loops or vertical boreholes, GSHP make use of the grounds almost constant temperature to provide heating and/or cooling using a heat exchanger connected to a space/water heating delivery system Optimum efficiency with underfloor heating systems	🟡	🟢	🟡	🟡	🔴	🟡	GSHP are not a feasible technology for the site since there is a limited external space available for installation of boreholes	×
Air Source Heat Pumps (ASHP) 	Air Source Heat Pumps extract latent energy from the external air in a manner similar to ground source heat pumps. Optimum efficiency with underfloor heating systems	🟡	🟡	🟡	🟡	🟡	🟡	Air source heat pumps are proposed for providing heating to the development via underfloor heating	✓

Table 3-06 Feasibility of LZC technologies for the development

Renewable and low carbon systems

The feasibility study has identified ASHP and Solar PV as the most appropriate technologies for the development. The proposed systems for the development are outlined in Table 3-07. The total area of the PV panels have been divided into the two different parts of the development.

Services Component	Proposed Specification
Photovoltaic panels	61.62 kWp system Orientation – SW and NE Angle of elevation – 15˚ Estimates panel number 156 (395Wp panels)
ASHP	Wet underfloor heating system SCOP 3.19

Table 3-07 Proposed Be Green systems

Energy Use

The breakdown of carbon and energy use has been identified for the site. Table 3-08 demonstrates the breakdown of carbon and energy use once the be green strategies proposed in this report are incorporated.

Electricity (kWh/yr)							Electricity CO2 (kg/yr)	Total Energy (kWh/yr)	Total CO2 (kg/yr)
Space Heating	Hot Water	Cooling	Pumps & Fans	Lighting	PV	Total			
14,238	16,879	0	4,151	9,396	-49,356	44,663	6,364	-4,693	162

Table 3-08 Be Green regulated energy demand and carbon emissions per energy source

Carbon Savings

Table 3-09 and Figure 3-04 demonstrate the percentage improvement over the baseline for the refurbishment with Be Green measures incorporated. The development demonstrates a 82% reduction in CO_2 emissions over the baseline at the Be Green stage. The savings from this stage exceed by far the requirement set by the London Plan, balancing the fewer reductions in the Be Lean stage.

	CO_2 Emissions (tonnes/annum)	CO_2 Savings (tonnes/annum)	% Saving
Baseline	8.1		
Be Lean	6.8	1.3	16%
Be Clean	6.8	0.0	0.0%
Be Green	0.2	6.7	82%
Total		8.0	98.0%

Table 3-09 Be Green improvements over the baseline emissions

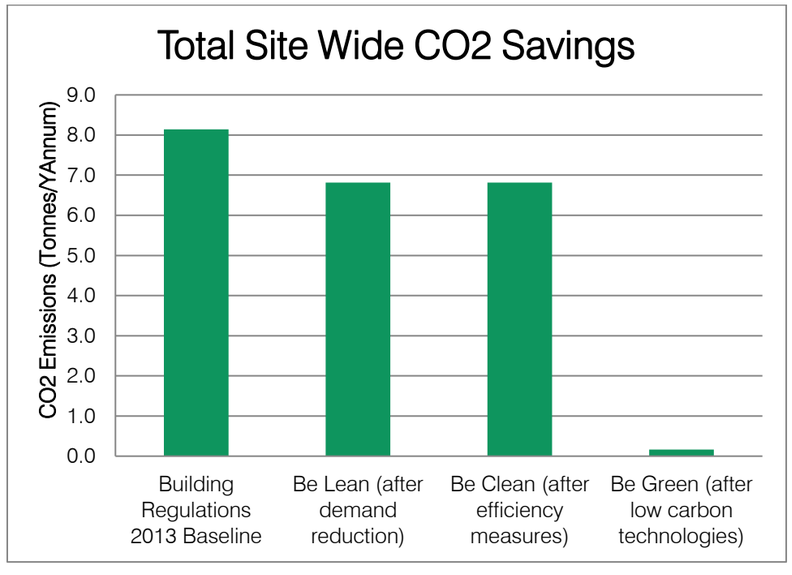


Figure 3-04 Be Green improvement over the baseline emissions

3.5 Be Seen

All major plant should be fitted with meters to allow remote monitoring of energy used by the communal heating systems and electrical distribution boards. A contract will be put in place to monitor the readings so that they can be compared with the predicted energy performance, and this information will be reported.

3.6 Carbon offset payment

The development has a target of net zero carbon. It has achieved a 98% improvement over the national baseline. In line with the London Plan carbon reduction requirements, there is a target of zero carbon, which can be achieved through an offset payment when there is a shortfall on site. This calculation is detailed below.

Shortfall on zero carbon		
Carbon emissions (tonnes / annum)	30 year carbon emissions	Offset payment (£95/tonne)
0.16	5	£462

4 Conclusion

This energy strategy has been prepared for the proposed new 2 storey building of Meadow High School, in order to meet the sustainability requirements of the London Plan and the London Borough of Hillingdon. The site is located in the London Borough of Hillingdon, Royal Lane, Uxbridge, UB8 3QU. The project consists of the construction of a new 2 storey building.

As required by the London Plan, the development follows the energy hierarchy, incorporating passive design measures, energy efficient equipment and renewable energy. Carbon emissions have been calculated over a baseline scenario. The baseline is based on the 2021 building regulations notional building.

The development employs an efficient building fabric, including well insulated walls and highly efficient glazing and efficient systems. It achieves a 16% reduction in CO_2 emissions over the baseline at the Be Lean stage, which is higher than the 15% set by the London Plan. The fabric performance is exceptionally high and glazing specifications balance the energy, daylight and overheating requirements.

The development demonstrates a 82% reduction in CO_2 emissions over the baseline at the Be Green stage. The savings from this stage exceed by far the requirement set by the London Plan, balancing the fewer reductions in the Be Lean stage.

The figures within this report are based on preliminary analysis only and further detailed studies will be required at the detailed design stage before specifying any of the proposed systems.

4.1 BRUKL Output Documents

The BRUKL output documents are shown below

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

230110 Meadow High School_be lean

As designed

Date: Tue Jan 10 13:56:36 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

BRUKL compliance module version: v6.1.d.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m^2]: 809.55

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	4.81	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	4.03	
Target primary energy rate (TPER), $kWh/m^2.annum$	50.67	
Building primary energy rate (BPER), $kWh/m^2.annum$	42.31	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	FL000004:Surf[3]
Floors	0.18	0.11	0.11	FL000004:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.11	0.11	FL000016:Surf[6]
Windows** and roof windows	1.6	0.77	0.77	FL000004:Surf[1]
Rooflights***	2.2	0.79	0.79	FL00005F:Surf[0]
Personnel doors^	1.6	1.55	1.55	FL000004:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

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

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

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	3

Building services

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

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

1- Be lean, wet undrerfloor, NVHR, heating

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.64	-	0	-	-
Standard value	2.5*	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 all types >12 kW output, except absorption and gas engine heat pumps.					

2- Be lean, wet undrerfloor, Natural, heating

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.64	-	0	-	-
Standard value	2.5*	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 all types >12 kW output, except absorption and gas engine heat pumps.					

3- Be lean, wet undrerfloor, MVHR, heating

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.64	-	0	-	0.8
Standard value	2.5*	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 all types >12 kW output, except absorption and gas engine heat pumps.					

1- DHW, Direct electric heating

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
Floor 00_breakout room	0.1	-	-	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
Floor 00_classroom 01	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 00_common room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 00_fitness room	0.2	-	-	-	-	-	-	-	-	-	N/A
Floor 00_food tech	0.2	-	-	-	-	-	-	-	-	-	N/A
Floor 00_group room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 00_medical room	-	-	-	1.2	-	-	-	-	-	-	N/A
Floor 00_music	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 00_science	0.2	-	-	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 01_classroom 02	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_classroom 03	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_classroom 04	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_classroom 05 ICT rich	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_classroom 06	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_group room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_hygiene room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_large group room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_quiet study	-	-	-	1.2	-	-	-	-	-	-	N/A
Floor 01_sensory room	-	-	-	1.2	-	-	-	-	-	-	N/A
Floor 01_small group room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 01_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 01_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 01_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 01_wc	-	-	0.3	-	-	-	-	-	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
Floor 00_breakout room	95	-	-
Floor 00_circ	145	-	-
Floor 00_circ	145	-	-
Floor 00_circ	145	-	-
Floor 00_circ	145	-	-
Floor 00_classroom 01	95	-	-
Floor 00_common room	95	-	-
Floor 00_data	120	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
Floor 00_fitness room	95	-	-
Floor 00_fitness store	120	-	-
Floor 00_food tech	145	-	-
Floor 00_food tech store	120	-	-
Floor 00_group room	120	-	-
Floor 00_medical room	95	-	-
Floor 00_music	95	-	-
Floor 00_music store	120	-	-
Floor 00_plant	95	-	-
Floor 00_science	95	-	-
Floor 00_stairs	145	-	-
Floor 00_stairs	145	-	-
Floor 00_store	120	-	-
Floor 00_store	120	-	-
Floor 00_store	120	-	-
Floor 00_store	120	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wheel chair store	120	-	-
Floor 01_ass head office	95	-	-
Floor 01_ass head office	95	-	-
Floor 01_breakout	95	-	-
Floor 01_breakout	95	-	-
Floor 01_circ	145	-	-
Floor 01_circ	145	-	-
Floor 01_classroom 02	95	-	-
Floor 01_classroom 02 store	120	-	-
Floor 01_classroom 03	95	-	-
Floor 01_classroom 03 store	120	-	-
Floor 01_classroom 04	95	-	-
Floor 01_classroom 04 store	120	-	-
Floor 01_classroom 05 ICT rich	95	-	-
Floor 01_classroom 05 ICT rich store	120	-	-
Floor 01_classroom 06	95	-	-
Floor 01_classroom 06 store	120	-	-
Floor 01_faculty leader office	95	-	-
Floor 01_group room	100	-	-
Floor 01_hygiene room	95	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
Floor 01_large group room	120	-	-
Floor 01_quiet study	95	-	-
Floor 01_sensory room	120	-	-
Floor 01_small group room	100	-	-
Floor 01_staff social	95	-	-
Floor 01_staff social store	120	-	-
Floor 01_staff workroom	95	-	-
Floor 01_stairs	145	-	-
Floor 01_stairs	145	-	-
Floor 01_stairs	145	-	-
Floor 01_store	120	-	-
Floor 01_team leader office	95	-	-
Floor 01_therapy	95	-	-
Floor 01_wc	145	-	-
Floor 01_wc	145	-	-
Floor 01_wc	145	-	-
Floor 01_wc	145	-	-
Floor 01_wc	145	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Floor 00_breakout room	NO (-58.2%)	NO
Floor 00_classroom 01	YES (+54.8%)	NO
Floor 00_common room	NO (-29.9%)	NO
Floor 00_fitness room	NO (-18.5%)	NO
Floor 00_food tech	NO (-3.6%)	NO
Floor 00_group room	NO (-40.5%)	NO
Floor 00_medical room	N/A	N/A
Floor 00_music	NO (-34.1%)	NO
Floor 00_science	YES (+7.5%)	NO
Floor 01_ass head office	YES (+45%)	NO
Floor 01_ass head office	YES (+45%)	NO
Floor 01_breakout	YES (+21.4%)	NO
Floor 01_breakout	YES (+168.6%)	NO
Floor 01_classroom 02	YES (+55%)	NO
Floor 01_classroom 03	YES (+19.7%)	NO
Floor 01_classroom 04	NO (-24.9%)	NO
Floor 01_classroom 05 ICT rich	NO (-20.4%)	NO
Floor 01_classroom 06	NO (-15.9%)	NO
Floor 01_faculty leader office	NO (-9.4%)	NO
Floor 01_group room	YES (+18.7%)	NO
Floor 01_hygiene room	YES (+8%)	NO
Floor 01_large group room	YES (+10.5%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Floor 01_quiet study	NO (-18%)	NO
Floor 01_sensory room	YES (+44.6%)	NO
Floor 01_small group room	YES (+21.2%)	NO
Floor 01_staff social	NO (-25%)	NO
Floor 01_staff workroom	NO (-9.4%)	NO
Floor 01_team leader office	NO (-14.6%)	NO
Floor 01_therapy	YES (+7.6%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	1693.8	1693.8
External area [m^2]	3381.7	3381.7
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	646.65	1092.34
Average U-value [W/m^2K]	0.19	0.32
Alpha value* [%]	22.93	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
5	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
95	**Non-residential Institutions: Education**
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	10.16	12.88
Cooling	0	0
Auxiliary	2.45	3.61
Lighting	5.55	7.77
Hot water	9.97	9.47
Equipment*	18.72	18.72
TOTAL**	**28.12**	**33.73**

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

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	90.68	128.89
Primary energy [kWh/m^2]	42.31	50.67
Total emissions [kg/m^2]	4.03	4.81

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: floor heating, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	44.6	0	5	0	2.7	2.48	0	2.64	0
	Notional	65.9	0	6.6	0	1.5	2.78	0	----	----
[ST] Central heating using water: floor heating, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	52.6	0	5.9	0	2.9	2.48	0	2.64	0
	Notional	95.3	0	9.5	0	2.1	2.78	0	----	----
[ST] Central heating using water: floor heating, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	132.1	0	14.8	0	2.3	2.48	0	2.64	0
	Notional	171.1	0	17.1	0	5.3	2.78	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

230110 Meadow High School_be green

As designed

Date: Tue Jan 10 14:15:07 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

BRUKL compliance module version: v6.1.d.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m^2]: 809.55

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	4.81	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	0.1	
Target primary energy rate (TPER), $kWh/m^2.annum$	50.67	
Building primary energy rate (BPER), $kWh/m^2.annum$	-2.97	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	FL000004:Surf[3]
Floors	0.18	0.11	0.11	FL000004:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.11	0.11	FL000016:Surf[6]
Windows** and roof windows	1.6	0.77	0.77	FL000004:Surf[1]
Rooflights***	2.2	0.79	0.79	FL00005F:Surf[0]
Personnel doors^	1.6	1.55	1.55	FL000004:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

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

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

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

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

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	3

Building services

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

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

1- Be green, wet undrerfloor, NVHR, heating

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.19	-	0	-	-
Standard value	2.5*	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 all types >12 kW output, except absorption and gas engine heat pumps.					

2- Be green, wet undrerfloor, Natural, heating

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.19	-	0	-	-
Standard value	2.5*	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 all types >12 kW output, except absorption and gas engine heat pumps.					

3- Be green, wet undrerfloor, MVHR, heating

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	3.19	-	0	-	0.8
Standard value	2.5*	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 all types >12 kW output, except absorption and gas engine heat pumps.					

1- DHW, Direct electric heating

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

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

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
Floor 00_breakout room	0.1	-	-	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
Floor 00_classroom 01	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 00_common room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 00_fitness room	0.2	-	-	-	-	-	-	-	-	-	N/A
Floor 00_food tech	0.2	-	-	-	-	-	-	-	-	-	N/A
Floor 00_group room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 00_medical room	-	-	-	1.2	-	-	-	-	-	-	N/A
Floor 00_music	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 00_science	0.2	-	-	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 00_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 01_classroom 02	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_classroom 03	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_classroom 04	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_classroom 05 ICT rich	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_classroom 06	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_group room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_hygiene room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_large group room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_quiet study	-	-	-	1.2	-	-	-	-	-	-	N/A
Floor 01_sensory room	-	-	-	1.2	-	-	-	-	-	-	N/A
Floor 01_small group room	0.1	-	-	-	-	-	-	-	-	-	N/A
Floor 01_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 01_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 01_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 01_wc	-	-	0.3	-	-	-	-	-	-	-	N/A
Floor 01_wc	-	-	0.3	-	-	-	-	-	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
Floor 00_breakout room	95	-	-
Floor 00_circ	145	-	-
Floor 00_circ	145	-	-
Floor 00_circ	145	-	-
Floor 00_circ	145	-	-
Floor 00_classroom 01	95	-	-
Floor 00_common room	95	-	-
Floor 00_data	120	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
Floor 00_fitness room	95	-	-
Floor 00_fitness store	120	-	-
Floor 00_food tech	145	-	-
Floor 00_food tech store	120	-	-
Floor 00_group room	120	-	-
Floor 00_medical room	95	-	-
Floor 00_music	95	-	-
Floor 00_music store	120	-	-
Floor 00_plant	95	-	-
Floor 00_science	95	-	-
Floor 00_stairs	145	-	-
Floor 00_stairs	145	-	-
Floor 00_store	120	-	-
Floor 00_store	120	-	-
Floor 00_store	120	-	-
Floor 00_store	120	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wc	145	-	-
Floor 00_wheel chair store	120	-	-
Floor 01_ass head office	95	-	-
Floor 01_ass head office	95	-	-
Floor 01_breakout	95	-	-
Floor 01_breakout	95	-	-
Floor 01_circ	145	-	-
Floor 01_circ	145	-	-
Floor 01_classroom 02	95	-	-
Floor 01_classroom 02 store	120	-	-
Floor 01_classroom 03	95	-	-
Floor 01_classroom 03 store	120	-	-
Floor 01_classroom 04	95	-	-
Floor 01_classroom 04 store	120	-	-
Floor 01_classroom 05 ICT rich	95	-	-
Floor 01_classroom 05 ICT rich store	120	-	-
Floor 01_classroom 06	95	-	-
Floor 01_classroom 06 store	120	-	-
Floor 01_faculty leader office	95	-	-
Floor 01_group room	100	-	-
Floor 01_hygiene room	95	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
Floor 01_large group room	120	-	-
Floor 01_quiet study	95	-	-
Floor 01_sensory room	120	-	-
Floor 01_small group room	100	-	-
Floor 01_staff social	95	-	-
Floor 01_staff social store	120	-	-
Floor 01_staff workroom	95	-	-
Floor 01_stairs	145	-	-
Floor 01_stairs	145	-	-
Floor 01_stairs	145	-	-
Floor 01_store	120	-	-
Floor 01_team leader office	95	-	-
Floor 01_therapy	95	-	-
Floor 01_wc	145	-	-
Floor 01_wc	145	-	-
Floor 01_wc	145	-	-
Floor 01_wc	145	-	-
Floor 01_wc	145	-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Floor 00_breakout room	NO (-58.2%)	NO
Floor 00_classroom 01	YES (+54.8%)	NO
Floor 00_common room	NO (-29.9%)	NO
Floor 00_fitness room	NO (-18.5%)	NO
Floor 00_food tech	NO (-3.6%)	NO
Floor 00_group room	NO (-40.5%)	NO
Floor 00_medical room	N/A	N/A
Floor 00_music	NO (-34.1%)	NO
Floor 00_science	YES (+7.5%)	NO
Floor 01_ass head office	YES (+45%)	NO
Floor 01_ass head office	YES (+45%)	NO
Floor 01_breakout	YES (+21.4%)	NO
Floor 01_breakout	YES (+168.6%)	NO
Floor 01_classroom 02	YES (+55%)	NO
Floor 01_classroom 03	YES (+19.7%)	NO
Floor 01_classroom 04	NO (-24.9%)	NO
Floor 01_classroom 05 ICT rich	NO (-20.4%)	NO
Floor 01_classroom 06	NO (-15.9%)	NO
Floor 01_faculty leader office	NO (-9.4%)	NO
Floor 01_group room	YES (+18.7%)	NO
Floor 01_hygiene room	YES (+8%)	NO
Floor 01_large group room	YES (+10.5%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Floor 01_quiet study	NO (-18%)	NO
Floor 01_sensory room	YES (+44.6%)	NO
Floor 01_small group room	YES (+21.2%)	NO
Floor 01_staff social	NO (-25%)	NO
Floor 01_staff workroom	NO (-9.4%)	NO
Floor 01_team leader office	NO (-14.6%)	NO
Floor 01_therapy	YES (+7.6%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
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External area [m^2]	3381.7	3381.7
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Average conductance [W/K]	646.65	1092.34
Average U-value [W/m^2K]	0.19	0.32
Alpha value* [%]	22.93	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
5	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
95	**Non-residential Institutions: Education**
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	8.41	12.88
Cooling	0	0
Auxiliary	2.45	3.61
Lighting	5.55	7.77
Hot water	9.97	9.47
Equipment*	18.72	18.72
TOTAL**	**26.37**	**33.73**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	29.14	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*29.14*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	90.68	128.89
Primary energy [kWh/m^2]	-2.97	50.67
Total emissions [kg/m^2]	0.1	4.81

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: floor heating, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	44.6	0	4.1	0	2.7	3	0	3.19	0
	Notional	65.9	0	6.6	0	1.5	2.78	0	----	----
[ST] Central heating using water: floor heating, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	132.1	0	12.2	0	2.3	3	0	3.19	0
	Notional	171.1	0	17.1	0	5.3	2.78	0	----	----
[ST] Central heating using water: floor heating, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	52.6	0	4.9	0	2.9	3	0	3.19	0
	Notional	95.3	0	9.5	0	2.1	2.78	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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