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River Academy, Reading Energy Strategy

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Document Revision History			Ref	FS0949-CPW-ZZ-XX-RP-N-0027	
Rev	Author	Verification By	Date	Suitability	Comments / Status
P01	A.HOWARD	M.WRATE	10/12/2021	S3	Planning Issue
P02	A.HOWARD	M.WRATE	14/12/2021	S3	Final Planning Issue

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BRUKL Output Document HM Government Compliance with England Building Regulations Part L 2013

Project name

River Academy

As designed

Date: Thu Sep 30 12:30:45 2021

Administrative information

Building Details

Address: Richfield Avenue, Reading.

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

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	13.8
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	13.8
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	12.3
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 _{s-limit}	U _{s-calc}	U _{i-calc}	Surface where the maximum value occurs*
Wall**	0.35	0.21	0.21	L0000000:Surf[13]
Floor	0.25	0.21	0.21	L0000000:Surf[0]
Roof	0.25	0.16	0.16	L000004B:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.34	1.35	L0000000:Surf[7]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building
U _{s-limit} = Limiting area-weighted average U-values [W/(m ² K)] U _{s-calc} = Calculated area-weighted average U-values [W/(m ² K)] U _{i-calc} = Calculated maximum individual element U-values [W/(m ² K)] * There might be more than one surface where the maximum U-value occurs. ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. *** Display windows and similar glazing are excluded from the U-value check. N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

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

River Academy - Energy Statement



Executive Summary

This Energy statement is intended to support the planning application for the proposed River Academy development in Reading. The energy statement and approach to the design follows the energy hierarchy of 'Be Lean', 'Be Clean', and 'Be Green' as described herewith.

The project has been designed to meet exemplar design standards for education buildings based upon the Department for Education (DfE) briefing document, known as the Output Specification (OS). The OS enhances the design in a number of areas including the internal environment beyond educational buildings designed to meet the traditional Building Bulletins where these benefits are not captured by the Part L compliance calculations (BRUKL). This energy statement demonstrates where the enhanced design further reduces the operational Carbon Dioxide (CO₂) emissions not reflected within the Part L BRUKL calculation.

In addition to the passive design techniques adopted, the building has been designed with a 'Fabric First' approach whereby the construction budget is invested in the building fabric and energy efficiency measures, reducing reliance on renewable energy technologies. As can be seen in the table below, the fabric first energy strategy demonstrates that the overall CO₂ emissions reduction equates to over 16.9 tonnes per annum, a reduction of 10.87 % over the notional building in accordance with and beyond current Approved Document Part L2A of the Building Regulations. The initial Part L analysis BRUKL is included in Appendix A1.

It is important to highlight that this does not include the full extent of the savings of which avoiding active cooling and reducing domestic hot water provides additional as discussed and shown in Appendix B.

	Carbon Dioxide Emissions for Non-Domestic Buildings (Tonnes CO ₂ per annum)
Baseline: Part L 2013 of the Building Regulations Compliant Development	155.502
'Be Lean' - After Energy Demand Reduction	138.689
'Be Clean' - After Heat Network / CHP	138.689
'Be Green' - After Renewable Energy	138.689

The below table also indicates the reduction in carbon.

	Regulated Domestic Carbon Dioxide Savings	
	TonnesCO ₂ /year	% CO ₂ reduction for building
Savings from Energy Demand Reduction	16.913	10.87 %
Savings from Heat Network / CHP	0	0 %
Savings from Renewable Energy	0	0 %
Cumulative on-Site Savings	16.913	10.87 %

The carbon emission savings outlined in the table above is presented on the graph below to demonstrate the CO₂ savings against each level of the hierarchy.

River Academy - Energy Statement

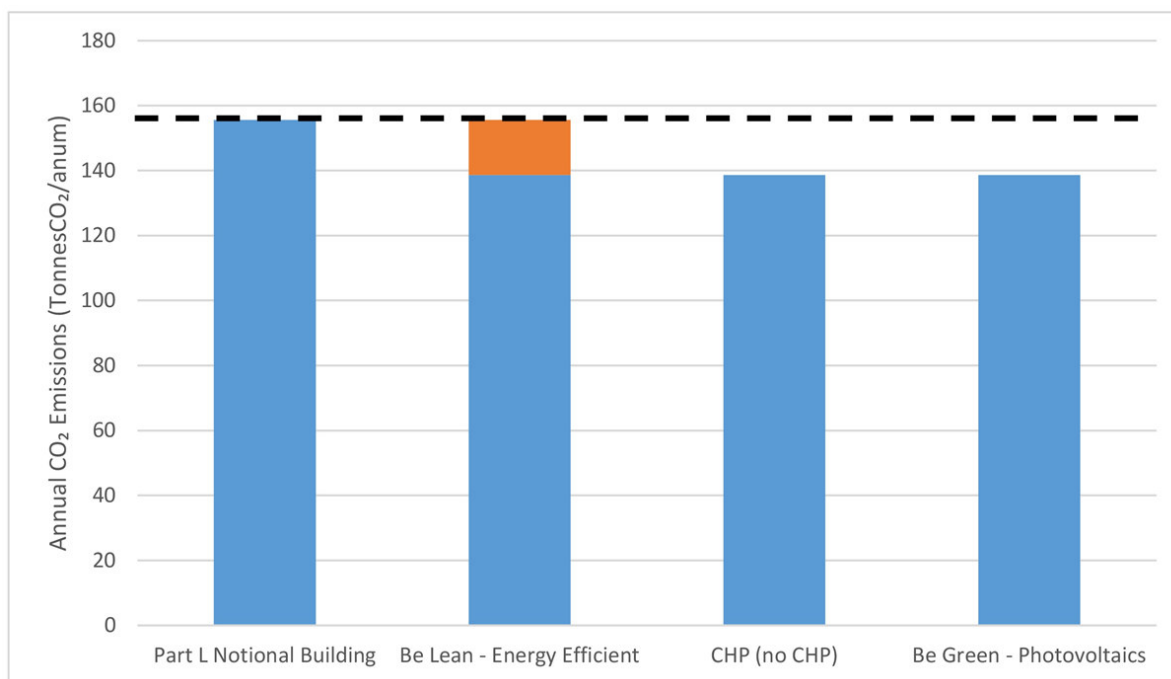


Figure 0.2 - Resultant Carbon Reduction.

As can be seen in the table above, the proposed strategy reduces the quantity of carbon beyond that required by Approved Document Part L2A. **The further carbon savings described in Appendix B shows that it is expected that the building would further surpass the Part L2A TER when considering further carbon emission savings.**

The building is designed to allow future improvement to the carbon emissions by including connection points to the centralised heating plant for introduction of Low and Zero Carbon (LZC) technology and the designed heating flow temperatures have been reduced to work at operating temperatures to suit LZC technology such as heat pumps.

River Academy - Energy Statement



1.0 Introduction

Couch Perry Wilkes are appointed by Bowmer & Kirkland as the Mechanical and Electrical design consultants for the River Academy development. This Energy Statement is intended to support the planning application for the proposed Secondary Academy in Reading.

The proposed development consists of approximately 11,060m² of new build education facility. The proposed new facility shall provide education facilities to approximately 1500 pupils of ages 11 to 18. The development is a U-shaped three story building as shown in the image below.



Figure 1.1 - Architects' Vision of Constructed Proposed Building
Image courtesy of Jestico + Whiles Architects

River Academy - Energy Statement



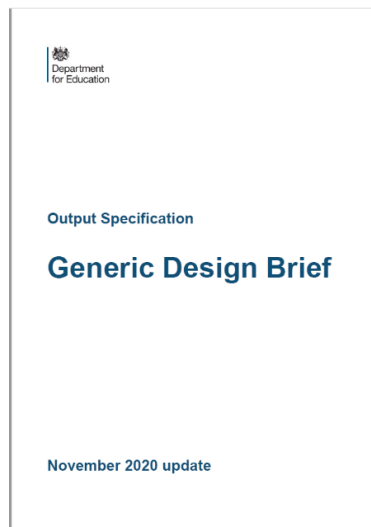
2.0 Exemplar Design Standards

The Department for Education (DfE) introduced a new briefing document in June 2013. This briefing document, called the Output Specification (OS), has recently been updated and has been included in the briefing documents for this project. The OS includes several significant design standards that were not included in the previous version of the Building Bulletins for School designs.

The resultant outcome of a design that is compliant with the DfE's OS briefing document, such as River Academy is a building with an internal environment that is significantly better and a reduced energy consumption, than an education facility designed to meet the Building Bulletins. Four key enhancements of the internal environment are as follows: -

- a) Climate Based Daylight Modelling (CBDM)
- b) Encouragement to eliminate active cooling from the building in favour of passive cooling measures
- c) Overheating Assessment to meet BB101
- d) Reduction in water consumption, most notably hot water consumption

The following sub sections describe each of these performance criteria and the benefits that they bring to the River Academy design.



2.1 Climate Based Daylight Modelling

Previously schools were designed by using daylight factor (DF). The provision of natural daylight for River Academy has been designed utilising Climate Based Daylight Modelling (CBDM) as analysed by Arup. CBDM improves on DF by analysing natural light levels across the course of the year and considering site orientation and local weather conditions.

There are a few extra considerations taken into account that is not included in DF:

- Site orientation.
- Local weather conditions (using weather file).
- Direct sunlight.
- Building occupancy times.
- Analysis of a whole year of data.

CBDM calculations have a number of possible metrics that measure the available daylight over the course of the year. The OS has stipulated that daylight autonomy and useful daylight indicator are both simulated, and pass set threshold values. The results for the spaces on ground, first and second floor of the School are shown in the figure below for illustrative purposes.

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Figure 2.1 – Excerpts of Category 1 and 2 Analysis Results from Daylight Analysis Report
Images courtesy of Arup

River Academy - Energy Statement



Figure 2.2 – Excerpts of Category 3 (left) and 4, 5 & 6 (right) Analysis Results from Daylight Analysis Report
Images courtesy of Arup

This approach to the optimisation of natural light entering the building ensures that the space is not over-lit, as was the case when using the minimum DF approach. By avoiding having too much natural light this avoids the scenario of blinds down and lights on that results in excessive energy consumption for artificial lighting. In addition, by limiting the amount of natural light to only what is 'useful' helps to limit solar gains that would otherwise lead to overheating problems.

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2.2 Eliminating Active Cooling in Favour of Passive Cooling Measures

As discussed in section 2.1, the proportion of glazing has been optimised to provide a 'useful' daylight provision that will not result in excessive daylight. In addition, the type of glazing selected is orientation specifically to ensure where direct sunlight would reach the façade, a solar performance glazing (g-value = 0.38) is utilised to reduce solar gain that may otherwise lead to overheating.

The project proposes to utilise a mixed-mode ventilation strategy to maximise energy efficiency. During winter months, heat is recovered but when outdoor conditions permit, windows are opened to reduce the reliance upon the heat recovery unit thus saving energy. The mixed-mode ventilation strategy operates on a room-by-room basis, ensuring that each room can provide the ideal conditions and ensure it is operating in the most energy efficient manner possible. The ventilation unit is controlled by a wall mounted touch screen LCD controller providing live data feedback on the environmental conditions and allowing the occupants direct control over their environment.

In addition to the mixed mode ventilation strategy, the majority of occupied spaces utilise an exposed concrete soffit and night purge strategy to achieve excellent passive cooling performance. By providing a room-by-room approach to the ventilation controls, every room has the optimum night purge for that space based upon that room's particular requirement (i.e. orientation, internal heat gains, usage pattern etc.). The control arrangement for the night-purge strategy is as per the BSRIA recommendations based upon research to ensure the solution works correctly. This overall approach ensures that each individual room is not over-cooled or under-cooled giving an optimised passive cooling design solution for the building. Figure 2.2 below shows the typical classroom environmental strategy.

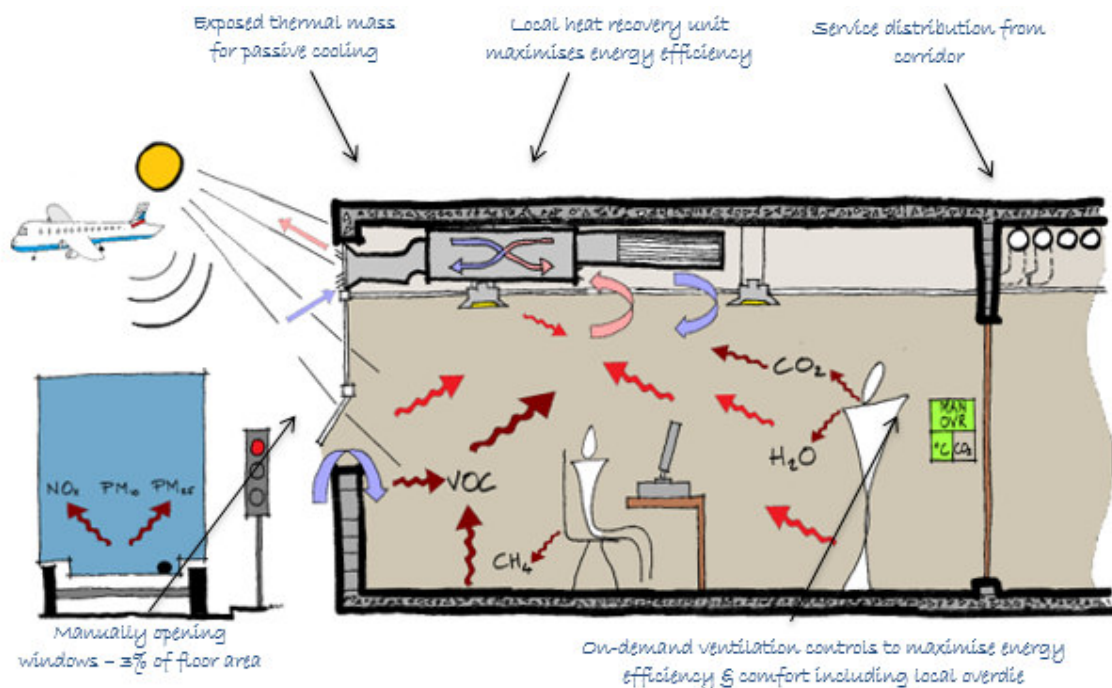


Figure 2.3 – Proposed environmental strategy for typical classroom

The building utilises several passive solutions to comply with overheating risk criteria without the requirement for active cooling systems in the occupied areas of the building. **As there are no active cooling systems providing comfort cooling throughout the building, there is no comfort cooling energy demand to report other than that associated with server rooms, hub rooms and control rooms.**

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The requirement for cooling has been minimised in accordance with the cooling hierarchy as described below:

1. Internal heat generation – Efficient lighting has been utilised throughout to minimise lighting heat gains.
2. Reduce the amount of heat entering a building in summer – Has been limited by use of blinds that allow the occupants to balance useful daylight and heat gains. Window sizes have been optimised throughout to keep solar gains to a minimum, whilst providing useful daylight as analysed using CBDM (as described in section 2.1).
3. Manage the heat within the building – Use of exposed thermal mass and night cooling in occupied spaces allows the heat to be absorbed during hot spells and released and removed during unoccupied times.
4. Passive ventilation – Has been provided by window openings throughout in occupied spaces to allow occupants control of their environment. Traffic light style feedback in ventilation controllers indicate when the room is warm to help the occupants determine when windows should be opened.
5. Mechanical ventilation – Is included in addition to passive ventilation which automatically operates in accordance with the room temperature and carbon dioxide to continuously maintain operative temperature.
6. Active cooling systems – Have been excluded from the current design, other than to maintain server room temperature. This shall only be introduced as a measure should the building suffer in a prolonged period of sustained warmth which would be deemed as a rare occurrence.

2.3 Overheating Assessment against BB101

The outcome of the adopted design strategy is a building that exceeds the requirements of BB101 whilst **eliminating the need for active cooling throughout the building** (except for the server, hub and control rooms). The results from some of the key spaces within the building are shown below. To pass the test to comply with the requirements of the OS, is that Criterion 1 is not exceeded by more than 40 hours (equates to 6.17%).

The weather file/scenario used to simulate the summer to the area of the proposed school was Swindon_Brize_Norton_DSY1_2020High50. This is a predicted design summer year file which represents a hotter than 'usual' climate and therefore provides a worst-case scenario for testing overheating of occupied rooms.

Room Analysed	Criterion 1 hours of exceedance (He), < 6.17%	Criterion 2 daily weighted exceedance (We), <6	Criterion 3 upper limit temperature (Tupp), <4K
Main Hall	1.4	5	3K
Pass/Fail	Pass	Pass	Pass
Room Analysed	Criterion 1 hours of exceedance (He), < 6.17%	Criterion 2 daily weighted exceedance (We), <6	Criterion 3 upper limit temperature (Tupp), <4K
Dining Hall 2004	0.8	1	1K
Pass/Fail	Pass	Pass	Pass
Dining Hall 2006	0.1	1	1K
Pass/Fail	Pass	Pass	Pass

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Room Analysed	Criterion 1 hours of exceedance (He), < 6.17%	Criterion 2 daily weighted exceedance (We), <6	Criterion 3 upper limit temperature (Tupp), <4K
General Office	2	5	3
Pass/Fail	Pass	Pass	Pass
Room Analysed	Criterion 1 hours of exceedance (He), < 6.17%	Criterion 2 daily weighted exceedance (We), <6	Criterion 3 upper limit temperature (Tupp), <4K
Activity Studio	1.4	3	2
Pass/Fail	Pass	Pass	Pass
Room Analysed	Criterion 1 hours of exceedance (He), < 6.17%	Criterion 2 daily weighted exceedance (We), <6	Criterion 3 upper limit temperature (Tupp), <4K
Typical Classroom – PE 1129	1.7	5	3
Pass/Fail	Pass	Pass	Pass
Room Analysed	Criterion 1 hours of exceedance (He), < 6.17%	Criterion 2 daily weighted exceedance (We), <6	Criterion 3 upper limit temperature (Tupp), <4K
Typical Science Lab – Science 1 1109	1.7	5	3
Pass/Fail	Pass	Pass	Pass
Room Analysed	Criterion 1 hours of exceedance (He), < 6.17%	Criterion 2 daily weighted exceedance (We), <6	Criterion 3 upper limit temperature (Tupp), <4K
Typical IT Classroom – ICT 2 1102	2	4	2
Pass/Fail	Pass	Pass	Pass

From the table above, it can be seen that all of the rooms are PASSING. To clarify, any 'fail' results shown in the criterion 2 or 3 columns does not indicate that the room is failing the OS BB101 criteria as criterion 1 is passing, so therefore is of acceptable risk. The full results can be found in Appendix C1.

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3.0 Energy Strategy

This section of the report describes how the project has been designed in line with the Reading Borough Council Local Plan and to reduce CO₂ emissions.

3.1 Local Planning Policies

The local planning policies that relate to energy and sustainability are listed below along with a description of how these policies are being adhered to. Some elements of the planning policies are not directly relatable to the context of this report and so are not discussed in this report but elsewhere within the planning submission documents.

CC2: SUSTAINABLE DESIGN AND CONSTRUCTION

Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change.

To meet these requirements:

- All major non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Excellent' standards, where possible;
- All minor non-residential developments or conversions to residential are required to meet the most up-to-date BREEAM 'Very Good' standard as a minimum;
- All non-residential development or conversions to residential should incorporate water conservation measures so that predicted per capita consumption does not exceed the appropriate levels set out in the applicable BREEAM standard. Both residential and non-residential development should include recycling greywater and rainwater harvesting where systems are energy and cost effective.

The Reading Borough Local Plan goes on to state that 'some types of development, such as industrial uses, warehouses and schools might find it more difficult to meet these standards. In these cases, developments must demonstrate that the standard to be achieved is the highest possible for the development, and at a minimum meets the BREEAM 'Very Good' standard.' Therefore, the proposal for this development is to meet BREEAM 'Very Good' standards. Please refer to the BREEAM pre-assessment for confirmation of the targeted BREEAM score and applicable credits. To achieve a 'very good' BREEAM score, there is no mandatory requirement to achieve specified carbon or energy reduction beyond the minimum requirements of Approved Document Part L2A of the building regulations.

Please also refer to the BREEAM pre-assessment in relation to water consumption credits. The proposal does not include greywater or rainwater harvesting. Greywater and rainwater harvesting have been determined to not be cost effective. Low water use fittings are proposed to reduce water consumption and hot water energy consumption. As described in Appendix B1, reduced flow taps and showers makes a significant reduction in domestic hot water energy consumption and associated carbon emissions.

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CC3: ADAPTATION TO CLIMATE CHANGE

All developments will demonstrate how they have been designed to incorporate measures to adapt to climate change. The following measures shall be incorporated into development:

- Wherever possible, new buildings shall be orientated to maximise the opportunities for both natural heating and ventilation and reducing exposure to wind and other elements;
- Proposals involving both new and existing buildings shall demonstrate how they have been designed to maximise resistance and resilience to climate change for example by including measures such as solar shading, thermal mass, heating and ventilation of the building and appropriately coloured materials in areas exposed to direct sunlight, green and brown roofs, green walls, etc;
- Use of trees and other planting, where appropriate as part of a landscape scheme, to provide shading of amenity areas, buildings and streets and to help to connect habitat, designed with native plants that are carefully selected, managed and adaptable to meet the predicted changed climatic conditions; and
- All development shall minimise the impact of surface water runoff from the development in the design of the drainage system, and where possible incorporate mitigation and resilience measures for any increases in river flooding levels as a result of climate change

A passive design feasibility report has been undertaken to achieve the associated BREEAM credit for Ene04 which shall address the building design in line with measures to maximise opportunity for natural ventilation and cooling and also describe inclusion of passive measures utilised to reduce need for cooling, such as thermal mass, optimizing sunlight etc. Achieving this credit shall demonstrate compliance with this policy.

CC4: DECENTRALISED ENERGY

In meeting the sustainability requirements of this plan, developments of the sizes set out below shall demonstrate how consideration has been given to securing energy for the development from a decentralised energy source.

Any development of more than 20 dwellings and/ or non-residential development of over 1,000 sq m shall consider the inclusion of decentralised energy provision, within the site, unless it can be demonstrated that the scheme is not suitable, feasible or viable for this form of energy provision.

Where there is existing decentralised energy provision present within the vicinity of an application site, further developments of 10 dwellings or more or non-residential development of 1,000 sq m or more will be expected to link into the existing decentralised energy network or demonstrate why this is not feasible.

Section 3.4 of this report addresses the feasibility of decentralised energy systems. In addition a low and zero carbon energy feasibility report has been produced to achieve the associated BREEAM credit with Ene04. The outcome of the report shows that decentralised systems are not suitable. However, futureproofing of the heating systems shall allow for future connections from decentralised systems should they become viable.

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3.2 Energy Hierarchy

Couch Perry Wilkes' design philosophy for reducing energy consumption, implemented on the River Academy school is demonstrated in the image below and is aligned with the, OS and CIBSE guidelines:

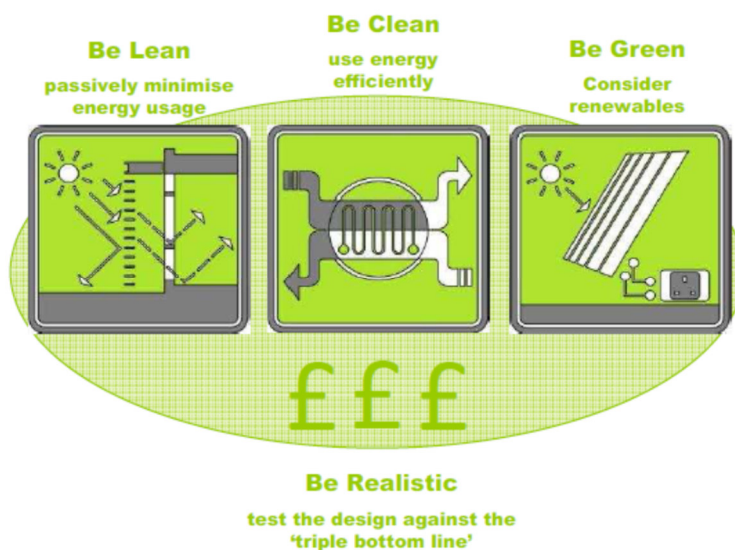


Figure 3.1 – Proposed environmental strategy

The subsequent sections describe how the proposed design aligns with the Energy Hierarchy.

3.3 ‘Be Lean’ - Energy Demand Reductions

The project energy strategy is to maximise a fabric first energy strategy whereby the construction budget is focussed on reducing energy consumption and using it efficiently and not in expensive renewable energy technologies.

The proposed Thermal Efficiency of each construction element on average is approximately 30% better than the Part L minimum: -

Construction	Part L 2013 Minimum	River Academy [W/(m²K)]
External Wall	0.35	0.21
Floor	0.25	0.21
Roof	0.25	0.16
Glazing	2.2	1.35 (G-value: 0.38)
Air Tightness	10m³/m²/hr @ 50Pa	5m³/m²/hr @ 50Pa

The glazing G-value is as shown in the above table for windows facing South, East and West. The G value for North facing glazing is higher at 0.58 as direct solar gains are minimal from the North.

The weather file/scenario used to simulate the climate in all Part L compliance simulations in the Dynamic Simulation Modelling software was SwindonTRY05.

The table below shows some of the other ‘Be Lean’ measures incorporated within the design: -

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Design Measure	'Be Lean' Benefits
Building Geometry	Multi storey building reduces exposed surface area to internal volume, reducing heat loss and improving efficiency.
Reduce cold and hot water consumption	By utilising water efficient fittings, the amount of energy consumed for water consumption is much reduced.
Maximise Useful Daylight	As described in the lighting section (2.1) Climate Based Daylight Modelling has been utilised to ensure the building has optimum useful daylight levels that in combination with daylight-dimming lighting controls, helps eliminate the need for artificial lighting energy consumption.
Heat recovery ventilation	As discussed, the ventilation system utilises heat recovery ventilation as part of a mixed-mode ventilation strategy that is deployed to maximise energy efficiency
On-demand control	The room-by-room ventilation controls ensure that energy efficiency is maximised in every space where the amount of air delivered is variable to suit the space
Zoned building services	The Building shall incorporate zones to ensure energy is not wasted elsewhere in the facility when certain zones are used out-of-hours for community use.
Automatic monitoring of all energy sub-metering	Out of range alarms shall be triggered when the energy consumption of the building exceeds the typical consumption levels to highlight to the facilities staff that excessive energy use has occurred
Efficient gas condensing boilers	The boiler plant is highly efficient ensuring that energy is not wasted in the heat generation process
Variable speed pumping	Variable speed pumping on all secondary circuits (see heating schematic) reduces energy consumption associated with distribution significantly
Weather compensation on LTHW	As the external temperature rises and conditions become mild, the boiler flow temperature will reduce to ensure heat is not wasted

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3.3.1 Resultant CO₂ Reductions from 'Be Lean' Measures

The proposed Fabric First strategy described in section 3.3 reduces the space conditioning associated CO₂ emissions. The image below shows the BRUKL output of the design stage Part L compliance model for the River Academy development. The Full 'Be Lean' BRUKL can be found in Appendix A1.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

River Academy

As designed

Date: Thu Sep 30 12:30:45 2021

Administrative information

Building Details

Address: Richfield Avenue, Reading,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

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

Figure 3.2 - BRUKL Report for Building Excluding PV and other Carbon Reductions

As can be seen above, the 'Be Lean' BRUKL shows compliance with Approved Document Part L2A of the Building Regulations and therefore does not need inclusion of additional renewables to achieve compliance.

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3.4 'Be Clean' - Heating Infrastructure

3.4.1 Existing District Heating Infrastructure

There is not currently a district heating network in proximity to the site and therefore no connection proposals are included within the design.

3.4.2 Provisions for Future Connection to District Heating Network

In accordance with the OS, the building's heating systems are centralised within the building and shall include connection points for any future potential decentralised heating systems should they become available and feasible. The heating flow temperatures shall also be set to accommodate future connection of LZC systems.

The indicative heating schematic is shown below identifying connection points for future systems: -

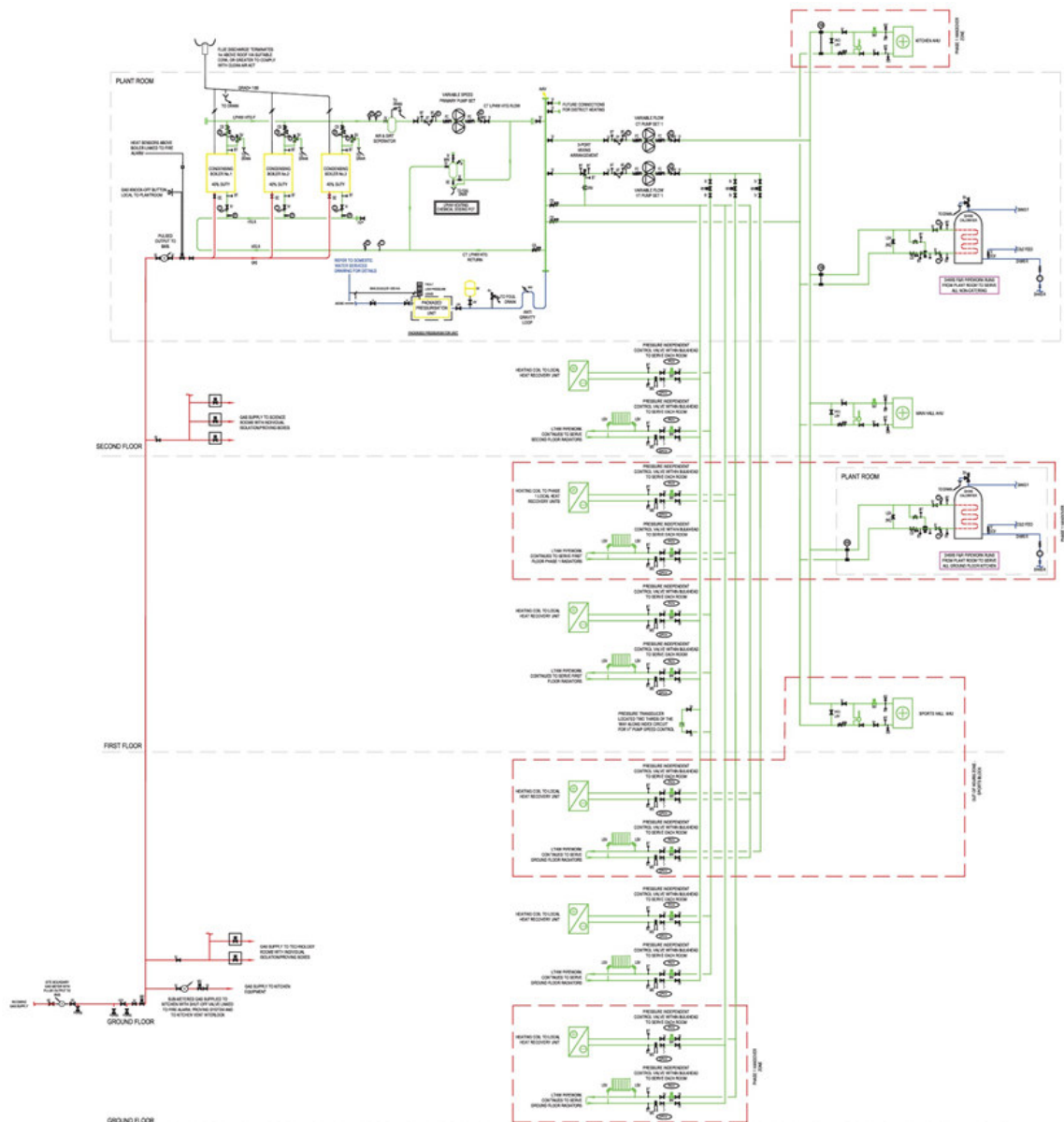


Figure 3.3 - Proposed Heating Schematic Excerpt

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3.4.3 Onsite Combined Heat and Power (CHP) Feasibility

The proposed non-domestic River Academic development will have a heat profile that will be significantly less than 5,000 hours per annum and therefore, onsite CHP is not considered viable in this case.

Expected changes to emission factors for grid electricity also further reduces feasibility of CHP systems with respect to carbon emissions. The emission factor for grid electricity is expected to be reduced below that for the emission factor for gas and therefore, gas fired CHP would result in increased carbon emissions

3.5 'Be Green' – Renewable Technology

As described in section 3.1, there is no policy requirement for reducing carbon emissions to achieve a BREEAM score of 'very good'. Therefore, no renewable technology is included within the design proposals.

Renewable technology such as photovoltaic (PV) panels would be suitable to reduce CO₂ emissions for this building to achieve future carbon reduction policies and commitments. There is significant available roof space available for a PV array which at this time would be considered the most appropriate technology to further reduce carbon emissions for this project.

In addition to a PV array, Air Source Heat Pumps (ASHP) and Ground Source Heat Pumps (GSHP) could be considered to replace gas heating systems to further reduce carbon emissions. These would be considered as a less cost-effective means to reduce emissions.

As described in section 3.3, the project budget has been focused on the building fabric in a 'fabric first' approach. Whilst PV panels are feasible, ensuring the building consumes as little energy as possible is a higher priority. Whilst PV panels as a bolt on renewable can be added in the future, improving the construction performance at a later time is significantly more difficult and would involve greater costs. Therefore, our approach is the most appropriate given the available funding.

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4.0 Conclusions

The project has been designed in line with the Energy Hierarchy with a focus on a fabric-first energy strategy. The fabric first energy strategy has ensured that the construction budget has been invested in reducing the energy consumption for the building to reduce space conditioning energy, rather than focusing on reliance on renewable energy technologies. This ensures that the building is inherently energy efficient and is robust to increases in energy costs in the future.

The project has also been designed to meet the DfE's new OS that provides a significantly better internal environment than previous education projects. It is widely accepted and proven through Government studies that the internal environment has a large influence on the performance of its occupants. Subsequently the design solution increases occupant comfort and provides a facility that will enable the staff and pupils of River Academy to perform above the minimum standards expected from a building that complies with the traditional Building Bulletins alone.

The fabric first design philosophy adopted provides a 10.87 % reduction in comparison to the baseline Part L 2013 TER.

The below summarises the building performance measures in comparison to the baseline Part L 2013 TER.

Energy Efficiency Measure	CO ₂ Emission Savings	% CO ₂ reduction for building
'Be Lean' - Fabric First Approach (BRUKL)	16.913 TonnesCO ₂ /year	10.87%
'Be Clean' – Heating Infrastructure	0.000 TonnesCO ₂ /year	0.00%
'Be Green' - Photovoltaic Panels	0.000 TonnesCO ₂ /year	0.00%
Initial Total CO₂ Emission Reduction	16.913 TonnesCO₂/year	10.87%

There is no existing district heating network in the vicinity of the site; however, the provision has been made to allow for future connection to a district heating network. A single site wide heating system has been incorporated to serve the proposed building. This has the additional benefit of creating a single point of connection for the site should a district heating network or LZC technologies be introduced. The heating flow temperatures will be low enough to also facilitate change to LZC technology in the future.

The project avoids the need for active cooling systems favoring passive design solutions as described within section 2 of this report and Appendix B that meet the overheating requirements of BB101. By avoiding active cooling systems, an estimated 59.42 % increase in CO₂ emissions is avoided that would be emitted from traditional educational buildings with active cooling. The domestic hot water consumption for the project is reduced in several ways including water efficient showers and flow restrictors on wash hand basin taps; this reduction in hot water demand further reduces the projects CO₂ emissions by 27.56 %. Including the further carbon saving measures, the proposed design features reduce the overall CO₂ emissions by approximately 38.43 % and avoiding an increase of 59.42 % when compared with the notional building from the Part L calculation, totaling a saving in excess of 152.255 TonnesCO₂/annum. Please refer to Appendix B for summarised tables and graphs showing the full extent of carbon savings for the building.

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Appendix A1 - 'Be Lean' BRUKL Calculation

The image below shows the output from the design stage Part L assessment before applying photovoltaic panels and further carbon saving measures: -

BRUKL Output Document HM Government
Compliance with England Building Regulations Part L 2013

Project name

River Academy
As designed

Date: Thu Sep 30 12:30:45 2021

Administrative information

Building Details
Address: Richfield Avenue, Reading.

Certification tool
Calculation engine: Apache
Calculation engine version: 7.0.13
Interface to calculation engine: IES Virtual Environment
Interface to calculation engine version: 7.0.13
BRUKL compliance check version: v5.6.b.0

Certifier details
Name:
Telephone number:
Address: . .

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	13.8
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	13.8
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	12.3
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	0.21	0.21	L0000000:Surf[13]
Floor	0.25	0.21	0.21	L0000000:Surf[0]
Roof	0.25	0.18	0.18	L000004B:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.34	1.35	L0000000:Surf[7]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

U_{a-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	5

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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	>0.95

1- MVHR Heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	1.2	0.8
Standard value	0.91	N/A	N/A	1.1 [*]	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[*] Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

2- Radiator Heating Hybrid Vent Vent (local units)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	0	0.8
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.					

3- Server Room Cooling

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

4- Kitchen Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	1.6	-
Standard value	0.91	N/A	N/A	1.1 [*]	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
[*] Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

5- Radiator Heating Natural Vent

	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.					

6- Radiator Heating Dirty Extract

	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.					

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7- Electric Panel Nat Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

8- AHU Heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	0.2	1.6	0.8
Standard value	0.91	N/A	N/A	1.1 ^A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
^A Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

1- DHW (gas domestic)

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.96	-
Standard value	0.8	N/A

2- DHW (gas catering)

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.96	-
Standard value	0.8	N/A

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]										HR efficiency	
	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			
L00 : LRG GROUP (3017)	-	-	-	1.4	-	-	-	-	-	-	-	N/A
L00 : HUB (6211)	-	-	0.5	-	-	-	-	-	-	-	-	N/A
L00 : 1P OFF. (4022)	-	-	-	1.4	-	-	-	-	-	-	-	N/A
L00 : EXT PRACT. (3006)	-	-	-	1.4	-	-	-	-	-	-	-	N/A
L00 : PRACT. (3005)	-	-	-	1.4	-	-	-	-	-	-	-	N/A
L00 : P WC CIRC (6029)	0.5	-	-	-	-	-	-	-	-	-	-	N/A
L00 : P WC (6029)	0.5	-	-	-	-	-	-	-	-	-	-	N/A
L00 : AWC (6028)	0.5	-	-	-	-	-	-	-	-	-	-	N/A
L00 : P WC CIRC (6012)	0.5	-	-	-	-	-	-	-	-	-	-	N/A
L00 : P WC (6012)	0.5	-	-	-	-	-	-	-	-	-	-	N/A

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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		
L00 : WC (6020)	0.5	-	-	-	-	-	-	-	-	-	N/A
L00 : CL ST. (5123)	0.5	-	-	-	-	-	-	-	-	-	N/A
L00 : REPRO (4014)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : SICK (4019)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : MUS & D WRM (4007)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : GEN/FIN/SS OFF (4015)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : SENCO	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : INC/W RM (3021)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : INC/W RM (3020)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : SM GRP (3012)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : MED GRP (3016)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : SM GRP(3011)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : SEN SEM RM (1002)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : EXAM OFF. (4039)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : HD OFF (4012)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : AWC (6024)	0.5	-	-	-	-	-	-	-	-	-	N/A
L00 : INTR (4018)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : HEAD PA (4013)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : BM (4020)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : DP.H (4021)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : CONF RM (4010)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : OFF/MTG (4038)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : CL ST. (5122)	0.5	-	-	-	-	-	-	-	-	-	N/A
L00 : PREM OFF (4042)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : HYG RM (6011)	0.5	-	-	-	-	-	-	-	-	-	N/A
L00 : SRVR (6201)	-	-	0.5	-	-	-	-	-	-	-	N/A
L00 : ICT TECH (4041)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : OFF/MTG (4037)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : AWC (6035)	0.5	-	-	-	-	-	-	-	-	-	N/A
L00 : P WC (6013)	0.5	-	-	-	-	-	-	-	-	-	N/A
L00 : 1P OFF. (4031)	-	-	-	1.4	-	-	-	-	-	-	N/A
L00 : P WC (6031)	0.5	-	-	-	-	-	-	-	-	-	N/A
L00 : P WC CIRC (6013)	0.5	-	-	-	-	-	-	-	-	-	N/A
L00 : P WC CIRC (6031)	0.5	-	-	-	-	-	-	-	-	-	N/A
L00 : PE WRM (4008)	-	-	-	1.4	-	-	-	-	-	-	N/A
L01 : CONTROL (3007)	-	1.4	0	-	-	-	-	-	-	-	N/A
L01 : PUPIL TOILETS 10 CIRC	0.5	-	-	-	-	-	-	-	-	-	N/A
L01 : PUPIL TOILETS 10	0.5	-	-	-	-	-	-	-	-	-	N/A
L01 : AWC (6026)	0.5	-	-	-	-	-	-	-	-	-	N/A
L01 : PUPIL TOILETS 11 CIRC	0.5	-	-	-	-	-	-	-	-	-	N/A
L01 : PUPIL TOILETS 11	0.5	-	-	-	-	-	-	-	-	-	N/A
L01 : CL ST. (5123)	0.5	-	-	-	-	-	-	-	-	-	N/A
L01 : LRG GROUP (3019)	-	-	-	1.4	-	-	-	-	-	-	N/A

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Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I			
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard	
L01 : ENGLISH WRM (4002)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L01 : FOOD ST/PR (5021)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L01 : MM ST/PR (5020)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L01 : AWC 1	0.5	-	-	-	-	-	-	-	-	-	N/A	
L01 : PUPIL TOILETS 5	0.5	-	-	-	-	-	-	-	-	-	N/A	
L01 : PUPIL TOILETS CIRC 5	0.5	-	-	-	-	-	-	-	-	-	N/A	
L01 : PUPIL TOILETS CIRC 6	0.5	-	-	-	-	-	-	-	-	-	N/A	
L01 : PUPIL TOILETS 6	0.5	-	-	-	-	-	-	-	-	-	N/A	
L01 : MFL & HUMS WRM (4003)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L01 : STAFF WC (6022)	0.5	-	-	-	-	-	-	-	-	-	N/A	
L01 : STAFF WC (6021)	0.5	-	-	-	-	-	-	-	-	-	N/A	
L01 : STAFF ROOM (SOCIAL)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L01 : OFF/MTG (4035)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L01 : CL ST (5125)	0.5	-	-	-	-	-	-	-	-	-	N/A	
L01 : SM GROUP (3013)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L01 : DT WRM (4005)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L01 : 1P OFF (4023)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L01 : ENTERPRISE WRM (4006)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L02 : PUPIL TOILETS 8 CIRC	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : PUPIL TOILETS 8	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : AWC 6	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : PUPIL TOILETS 12 CIRC	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : PUPIL TOILETS 12	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : AWC 3	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : PUPIL TOILETS 3	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : PUPIL TOILETS CIRC 3	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : PUPIL TOILETS CIRC 4	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : PUPIL TOILETS 4	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : SM GROUP (3014)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L02 : ART WRM (4043)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L02 : OFF/MTG (4036)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L02 : SCI WRM (4004)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L02 : 1P OFF (4032)	-	-	-	1.4	-	-	-	-	-	-	N/A	
L02 : CHEM. ST. (5013)	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : CL. ST. (5120)	0.5	-	-	-	-	-	-	-	-	-	N/A	
L02 : MATHS WRM (4001)	-	-	-	1.4	-	-	-	-	-	-	N/A	

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
L00 : SIXTH FORM STUDY (3002)	42	-	-	-	304
L00 : LRG GROUP (3017)	57	-	-	-	76
L00 : HUB (6211)	60	-	-	-	59

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General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	80	80	22	
L00 : SIXTH FORM SEM RM (1001)		45	-	-	153
L00 : 1P OFF. (4022)		74	-	-	40
L00 : KITCHEN & SERVERY (8001)		-	59	-	1196
L00 : DINING (2006)		-	80	-	298
L00 : STAIR 12		-	72	-	148
L00 : SIXTH FORM SOCIAL (2005)		-	80	-	711
L00 : CIRCULATION-1 (8320)		-	58	-	385
L00 : DINING (2004)		-	57	-	1330
L00 : STAIR 11		-	64	-	252
L00 : ICT 3 (1103)		43	-	-	235
L00 : MUSIC RECITAL (1123)		42	-	-	469
L00 : EXT PRACT. (3006)		55	-	-	86
L00 : PRACT. (3003)		70	-	-	50
L00 : PRACT. (3004)		71	-	-	49
L00 : PRACT. (3005)		70	-	-	45
L00 : MUSIC ST. (5022)		81	-	-	58
L00 : PERFORMING ARTS (1041)		43	-	-	207
L00 : LOBBY-2		-	108	-	38
L00 : CIRCULATION-3 (8320)		-	84	-	211
L00 : CIRCULATION-4 (8320)		-	83	-	393
L00 : CIRCULATION-5 (8320)		-	86	-	214
L00 : T ST (5011)		83	-	-	35
L00 : P WC CIRC (8029)		-	92	-	85
L00 : P WC (8029)		-	108	-	83
L00 : AWC (8028)		-	119	-	59
L00 : P WC CIRC (8012)		-	92	-	85
L00 : P WC (8012)		-	108	-	83
L00 : CIRCULATION-6 (8320)		-	71	-	179
L00 : CIRCULATION-7 (8320)		-	88	-	348
L00 : WC (8020)		-	157	-	42
L00 : AL ST. (5128)		109	-	-	23
L00 : CL ST. (5123)		120	-	-	5
L00 : REPRO (4014)		50	-	-	137
L00 : SICK (4019)		87	-	-	50
L00 : MUS & D WRM (4007)		49	-	-	142
L00 : GEN/FIN/SS OFF (4015)		44	-	-	373
L00 : SENCO		82	-	-	60
L00 : INC/W RM (3021)		55	-	-	85
L00 : SEN TH (3009)		81	-	-	67
L00 : OPEN GRP (3022)		80	-	-	68
L00 : MED GRP (3015)		80	-	-	68
L00 : INC/W RM (3020)		56	-	-	82
L00 : SM GRP (3012)		69	-	-	47

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General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	80	80	22	
L00 : MED GRP (3016)		80	-	-	88
L00 : SM GRP(3011)		64	-	-	54
L00 : SEN SEM RM (1002)		45	-	-	222
L00 : GEN. STOCK (5103)		78	-	-	33
L00 : SWTCH RM (8012)		70	-	-	45
L00 : ARCHIVE (5104)		72	-	-	40
L00 : EXAM OFF. (4039)		68	-	-	53
L00 : TANK RM (8103)		53	-	-	88
L00 : EXAM ST. (5105)		68	-	-	43
L00 : HD OFF (4012)		58	-	-	85
L00 : AWC (8024)		-	134	-	42
L00 : INTR (4018)		78	-	-	35
L00 : CIRCULATION-8 (8320)		-	83	-	68
L00 : HEAD PA (4013)		75	-	-	41
L00 : BM (4020)		75	-	-	41
L00 : DP.H (4021)		75	-	-	41
L00 : CONF RM (4010)		51	-	-	134
L00 : SEN REC (3010)		-	71	-	62
L00 : CIRC (8320)		-	81	-	182
L00 : SPORTS HALL (2002)		-	58	-	3873
L00 : ACTIVITY STUDIO (2003)		41	-	-	1025
L00 : PE (1128)		43	-	-	208
L00 : OFF/MTG (4038)		61	-	-	69
L00 : CL ST. (5122)		60	-	-	66
L00 : PE (1130)		44	-	-	204
L00 : COM REPT (4011)		-	95	-	49
L00 : PREM OFF (4042)		64	-	-	59
L00 : MAIN ST. (5130)		72	-	-	37
L00 : AL. ST. (5122)		120	-	-	17
L00 : HYG RM (8011)		-	85	-	114
L00 : ST CHG (8009)		67	-	-	47
L00 : COM. ST. (5028)		102	-	-	21
L00 : ACT ST (5029)		58	-	-	76
L00 : ST CHG (8010)		68	-	-	48
L00 : LOBBY (8320)		-	91	-	51
L00 : STAIR 9		-	73	-	142
L00 : SRVR (8201)		58	-	-	72
L00 : GEN. STOCK (5102)		84	-	-	34
L00 : ICT TECH (4041)		65	-	-	61
L00 : ICT LRC (3001)		41	-	-	893
L00 : STAIR 10		-	72	-	147
L00 : CIRCULATION-11 (8320)		-	67	-	203
L00 : CIRCULATION-10 (8320)		-	67	-	160

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General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
L00 : OFF/MTG (4037)		55	-	-	114
L00 : ICT 2 (1102)		43	-	-	230
L00 : ENTERPRISE 1 (1023)		43	-	-	206
L00 : ENTERPRISE 2 (1023)		43	-	-	206
L00 : ENTERPRISE 3 (1023)		43	-	-	207
L00 : AWC (6035)		-	133	-	42
L00 : P WC (6013)		-	101	-	100
L00 : 1P OFF. (4031)		75	-	-	40
L00 : P WC (6031)		-	104	-	84
L00 : P WC CIRC (6013)		-	83	-	137
L00 : P WC CIRC (6031)		-	85	-	133
L00 : T ST (5007)		97	-	-	21
L00 : PE WRM (4008)		51	-	-	151
L00 : CIRCULATION-12 (6320)		-	62	-	381
L00 : PE (1129)		43	-	-	207
L00 : P CHG-1 (6008)		-	131	-	46
L00 : P CHG-2 (6008)		-	119	-	53
L00 : P CHG-3 (6008)		-	170	-	28
L00 : P CHG CIRC-1 (6008)		-	129	-	25
L00 : P CHG CIRC-1 (6007)		-	116	-	31
L00 : CIRCULATION-13 (6320)		-	68	-	89
L00 : P CHG-4 (6008)		-	125	-	49
L00 : P CHG CIRC-2 (6008)		-	66	-	380
L00 : P CHG-4 (6007)		-	127	-	47
L00 : P CHG-3 (6007)		-	128	-	47
L00 : EXT. ST. (5030)		70	-	-	41
L00 : P CHG-2 (6007)		-	120	-	52
L00 : P CHG-1 (6007)		-	154	-	33
L00 : CH ST (5101)		59	-	-	81
L00 : P CHG CIRC-2 (6007)		-	69	-	371
L00 : PE STORE (5027)		44	-	-	282
L01 : ENGLISH 1 (1013)		43	-	-	207
L01 : STAIR 4		-	72	-	148
L01 : CONTROL (3007)		83	-	-	39
L01 : PUPIL TOILETS 10 CIRC		-	92	-	85
L01 : PUPIL TOILETS 10		-	106	-	83
L01 : AWC (6026)		-	119	-	59
L01 : PUPIL TOILETS 11 CIRC		-	92	-	85
L01 : PUPIL TOILETS 11		-	106	-	83
L01 : CIRCULATION-6 (6320)		-	71	-	179
L01 : CL ST. (5123)		120	-	-	5
L01 : MFL 1 (1035)		44	-	-	204
L01 : STAIR 2		-	73	-	142

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General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	80	80	22	
L01 : STAIR 3		-	72	-	147
L01 : ENGLISH 3 (1015)		44	-	-	200
L01 : ENGLISH 5 (1017)		44	-	-	201
L01 : T ST (5004)		74	-	-	37
L01 : KITC HWS (6131)		71	-	-	43
L01 : LRG GROUP (3019)		46	-	-	195
L01 : ENGLISH 8 (1020)		43	-	-	206
L01 : ENGLISH 9 (1021)		44	-	-	203
L01 : ICT 6 ENGLISH (1106)		43	-	-	224
L01 : ENGLISH WRM (4002)		50	-	-	148
L01 : ENGLISH 2 (1014)		43	-	-	207
L01 : ENGLISH 4 (1016)		43	-	-	206
L01 : ENGLISH 6 (1018)		43	-	-	207
L01 : ENGLISH 7 (1019)		43	-	-	206
L01 : CIRCULATION-3 (6320)		-	59	-	197
L01 : CIRCULATION-1 (6320)		-	67	-	171
L01 : CIRCULATION-2 (6320)		-	67	-	214
L01 : STAIR 1		-	73	-	142
L01 : FOOD TECHNOLOGY (1126)		42	-	-	552
L01 : CIRCULATION-4 (6320)		-	64	-	220
L01 : FOOD ST/PR (5021)		56	-	-	82
L01 : T ST (5005)		59	-	-	60
L01 : FOOD TECHNOLOGY (1125)		42	-	-	546
L01 : MM ST/PR (5020)		47	-	-	185
L01 : AWC 1		-	119	-	58
L01 : PUPIL TOILETS 5		-	105	-	84
L01 : PUPIL TOILETS CIRC 5		-	94	-	81
L01 : PUPIL TOILETS CIRC 6		-	94	-	82
L01 : PUPIL TOILETS 6		-	105	-	84
L01 : ELECTRONICS (RM) (1127)		41	-	-	387
L01 : MFL & HUMS WRM (4003)		50	-	-	149
L01 : STAFF WC (6022)		-	166	-	30
L01 : STAFF WC (6021)		-	166	-	30
L01 : STAFF ROOM (SOCIAL)		43	-	-	329
L01 : ICT (MFL/HUMS) (1101)		43	-	-	231
L01 : HUMANITIES 4 (1034)		44	-	-	205
L01 : HUMANITIES 3 (1033)		44	-	-	205
L01 : CIRCULATION-7 (6320)		-	66	-	243
L01 : OFF/MTG (4035)		58	-	-	88
L01 : HUMANITIES 2 (1032)		44	-	-	205
L01 : HUMANITIES 1 (1031)		44	-	-	205
L01 : ENGLISH 10 (1022)		44	-	-	204
L01 : CL ST (5125)		112	-	-	17

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General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
L01 : CIRCULATION-5 (6320)	-		63	-	947
L01 : ENTERPRISE 4 (1026)	43	-	-	-	206
L01 : ENTERPRISE 5 (1027)	43	-	-	-	206
L01 : ENTERPRISE 7 (1029)	43	-	-	-	206
L01 : MFL 6 (1040)	44	-	-	-	202
L01 : SM GROUP (3013)	70	-	-	-	49
L01 : DT WRM (4005)	50	-	-	-	126
L01 : 1P OFF (4023)	60	-	-	-	78
L01 : MFL 2 (1036)	43	-	-	-	232
L01 : MFL 3 (1037)	43	-	-	-	207
L01 : MFL 4 (1038)	43	-	-	-	207
L01 : CIRCULATION-7 (6320)	-		62	-	127
L01 : MFL 5 (1039)	43	-	-	-	207
L01 : CIRCULATION-8 (6320)	-		68	-	152
L01 : ENTERPRISE 8 (1030)	43	-	-	-	207
L01 : ENTERPRISE 6 (1028)	43	-	-	-	207
L01 : CIRCULATION-9 (6320)	-		67	-	203
L01 : ICT/BUSINESS (1107)	43	-	-	-	231
L01 : ENTERPRISE WRM (4006)	55	-	-	-	114
L01 : CIRCULATION-6 (6320)	-		63	-	169
L02 : STAIR 4	-		69	-	148
L02 :	77	-	-	-	35
L02 : PUPIL TOILETS 8 CIRC	-		87	-	85
L02 : PUPIL TOILETS 8	-		98	-	83
L02 : AWC 6	-		109	-	59
L02 : PUPIL TOILETS 12 CIRC	-		87	-	85
L02 : PUPIL TOILETS 12	-		98	-	83
L02 : MATHS 10 (1012)	43	-	-	-	204
L02 : STAIR 2	-		70	-	142
L02 : STAIR 3	-		69	-	147
L02 : CIRCULATION-3 (6320)	-		61	-	197
L02 : CIRCULATION-1 (6320)	-		73	-	171
L02 : CIRCULATION-2 (6320)	-		72	-	214
L02 : STAIR 1	-		70	-	142
L02 : AWC 3	-		110	-	58
L02 : PUPIL TOILETS 3	-		98	-	84
L02 : PUPIL TOILETS CIRC 3	-		89	-	81
L02 : PUPIL TOILETS CIRC 4	-		89	-	82
L02 : PUPIL TOILETS 4	-		98	-	84
L02 : MATHS 1 (1103)	43	-	-	-	206
L02 : MATHS 3 (1105)	43	-	-	-	206
L02 : MATHS 5 (1107)	43	-	-	-	206
L02 : MATHS 7 (1109)	43	-	-	-	202

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General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
L02 : SM GROUP (3014)		65	-	-	49
L02 : ART WRM (4043)		48	-	-	125
L02 : OFF/MTG (4036)		57	-	-	78
L02 : CIRCULATION-8 (6320)		-	65	-	127
L02 : MATHS 8 (1010)		43	-	-	207
L02 : MATHS 6 (1108)		43	-	-	207
L02 : MATHS 4 (1106)		43	-	-	207
L02 : CIRCULATION-7 (6320)		-	67	-	169
L02 : SCI WRM (4004)		48	-	-	148
L02 : SPECIALIST LAB 1 (1118)		41	-	-	509
L02 : SCIENCE 3 (1111)		41	-	-	469
L02 : SPECIALIST LAB 2 (1119)		41	-	-	516
L02 : SCIENCE PREP (5012)		41	-	-	632
L02 : 1P OFF (4032)		61	-	-	54
L02 : CHEM. ST. (5013)		60	-	-	52
L02 : SCIENCE 5 (1113)		41	-	-	473
L02 : SCIENCE 6 (1114)		41	-	-	474
L02 : SCIENCE 7 (1115)		41	-	-	474
L02 : SCIENCE 8 (1116)		41	-	-	473
L02 : SCIENCE 9 (1117)		41	-	-	474
L02 : CIRCULATION-6 (6320)		-	72	-	352
L01 : ICT 4 (1104)		42	-	-	237
L01 : ICT 5 (1105)		42	-	-	237
L02 : CIRCULATION-5 (6320)		-	67	-	811
L02 : CIRCULATION-4 (6320)		-	66	-	380
L02 : CL. ST. (5120)		120	-	-	13
L02 : MAIN PLANT ROOM (6101)		43	-	-	241
L02 : ART & DESIGN RSC (3008)		44	-	-	243
L02 : GENERAL ART (1120)		41	-	-	309
L02 : ART ST (5018)		84	-	-	24
L02 : ART ST (5014)		66	-	-	48
L02 : GENERAL ART (1121)		41	-	-	310
L02 : ICT LEARNING AREA (1108)		42	-	-	233
L02 : 3D ART ROOM (1122)		41	-	-	575
L02 : ART ST (5015)		84	-	-	23
L02 : ART ST (5019)		66	-	-	48
L02 : SCIENCE 2 (1110)		41	-	-	470
L02 : SCIENCE 4 (1112)		41	-	-	475
L02 : SCIENCE 1 (1109)		42	-	-	466
L02 : CIRCULATION-10 (6320)		-	73	-	185
L02 : CIRCULATION-9 (6320)		-	73	-	170
L02 : MATHS WRM (4001)		48	-	-	148
L02 : MATHS 2 (1104)		43	-	-	207

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General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
L02 : MATHS 9 (1011)		43	-	-	205
L02 : MATHS DOUBLE (1042)		41	-	-	394
L02 : T ST (5001)		70	-	-	59
L00 : MAIN HALL (2001)		43	-	-	1601
L00 : DRAMA STUDIO (1124)		51	-	-	595
L00 : LOBBY-1 (6320)		-	174	-	46
L00 : MAIN REPT (4017)		-	117	-	100
L00 : DRAMA ST. (5024)		114	-	-	71
L00 : T ST (5009/5010)		120	-	-	74
L00 : CIRCULATION-9 (6320)		-	68	-	426
L00 : CIRCULATION-2 (6320)		-	69	-	368
L01 : ENGLISH DOUBLE (1043)		41	-	-	392

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?
L00 : SIXTH FORM STUDY (3002)	NO (-60.5%)	NO
L00 : LRG GROUP (3017)	NO (-43.5%)	NO
L00 : HUB (6211)	N/A	N/A
L00 : SIXTH FORM SEM RM (1001)	NO (-48.5%)	NO
L00 : 1P OFF. (4022)	NO (-41.6%)	NO
L00 : DINING (2006)	NO (-40.2%)	NO
L00 : SIXTH FORM SOCIAL (2005)	NO (-63.9%)	NO
L00 : DINING (2004)	NO (-31.7%)	NO
L00 : ICT 3 (1103)	NO (-48.1%)	NO
L00 : MUSIC RECITAL (1123)	NO (-60.3%)	NO
L00 : EXT PRACT. (3006)	NO (-73.6%)	NO
L00 : PRACT. (3003)	N/A	N/A
L00 : PRACT. (3004)	N/A	N/A
L00 : PRACT. (3005)	NO (-43.6%)	NO
L00 : PERFORMING ARTS (1041)	NO (-76.5%)	NO
L00 : REPRO (4014)	N/A	N/A
L00 : SICK (4019)	N/A	N/A
L00 : MUS & D WRM (4007)	NO (-44.9%)	NO
L00 : GEN/FIN/SS OFF (4015)	NO (-60.8%)	NO
L00 : SENCO	N/A	N/A
L00 : INC/W RM (3021)	NO (-57.7%)	NO
L00 : SEN TH (3009)	N/A	N/A
L00 : OPEN GRP (3022)	N/A	N/A
L00 : MED GRP (3015)	N/A	N/A
L00 : INC/W RM (3020)	NO (-35.3%)	NO
L00 : SM GRP (3012)	NO (-56.1%)	NO
L00 : MED GRP (3016)	NO (-59.2%)	NO
L00 : SM GRP(3011)	NO (-61.9%)	NO

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Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L00 : SEN SEM RM (1002)	NO (-44.8%)	NO
L00 : EXAM OFF. (4039)	N/A	N/A
L00 : HD OFF (4012)	NO (-64.5%)	NO
L00 : INTR (4018)	N/A	N/A
L00 : HEAD PA (4013)	NO (-48.4%)	NO
L00 : BM (4020)	NO (-47.9%)	NO
L00 : DP.H (4021)	NO (-46.1%)	NO
L00 : CONF RM (4010)	NO (-52.1%)	NO
L00 : SPORTS HALL (2002)	N/A	N/A
L00 : ACTIVITY STUDIO (2003)	NO (-71.8%)	NO
L00 : PE (1128)	NO (-48.6%)	NO
L00 : OFF/MTG (4038)	NO (-12.1%)	NO
L00 : PE (1130)	NO (-66.4%)	NO
L00 : PREM OFF (4042)	N/A	N/A
L00 : SRVR (6201)	N/A	N/A
L00 : ICT TECH (4041)	N/A	N/A
L00 : ICT LRC (3001)	NO (-46.4%)	NO
L00 : OFF/MTG (4037)	NO (-71%)	NO
L00 : ICT 2 (1102)	NO (-44.1%)	NO
L00 : ENTERPRISE 1 (1023)	NO (-37.6%)	NO
L00 : ENTERPRISE 2 (1023)	NO (-37.6%)	NO
L00 : ENTERPRISE 3 (1023)	NO (-37.7%)	NO
L00 : 1P OFF. (4031)	N/A	N/A
L00 : PE WRM (4008)	NO (-36.2%)	NO
L00 : PE (1129)	NO (-36.4%)	NO
L01 : ENGLISH 1 (1013)	NO (-39.8%)	NO
L01 : CONTROL (3007)	N/A	N/A
L01 : MFL 1 (1035)	NO (-61.8%)	NO
L01 : ENGLISH 3 (1015)	NO (-39.7%)	NO
L01 : ENGLISH 5 (1017)	NO (-39.8%)	NO
L01 : LRG GROUP (3019)	NO (-33.9%)	NO
L01 : ENGLISH 8 (1020)	NO (-39.8%)	NO
L01 : ENGLISH 9 (1021)	NO (-39.7%)	NO
L01 : ICT 6 ENGLISH (1106)	NO (-63.4%)	NO
L01 : ENGLISH WRM (4002)	NO (-68.4%)	NO
L01 : ENGLISH 2 (1014)	NO (-37.7%)	NO
L01 : ENGLISH 4 (1016)	NO (-37.6%)	NO
L01 : ENGLISH 6 (1018)	NO (-37.7%)	NO
L01 : ENGLISH 7 (1019)	NO (-37.6%)	NO
L01 : FOOD TECHNOLOGY (1126)	NO (-42.3%)	NO
L01 : FOOD ST/PR (5021)	NO (-67.4%)	NO
L01 : FOOD TECHNOLOGY (1125)	NO (-41.7%)	NO
L01 : MM ST/PR (5020)	NO (-73.5%)	NO
L01 : ELECTRONICS (RM) (1127)	NO (-45.9%)	NO
L01 : MFL & HUMS WRM (4003)	NO (-55.3%)	NO
L01 : STAFF ROOM (SOCIAL)	NO (-49.6%)	NO
L01 : ICT (MFL/HUMS) (1101)	NO (-69.5%)	NO
L01 : HUMANITIES 4 (1034)	NO (-42.2%)	NO
L01 : HUMANITIES 3 (1033)	NO (-42.2%)	NO

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Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L01 : OFF/MTG (4035)	NO (-44.3%)	NO
L01 : HUMANITIES 2 (1032)	NO (-42.2%)	NO
L01 : HUMANITIES 1 (1031)	NO (-42.3%)	NO
L01 : ENGLISH 10 (1022)	NO (-42.1%)	NO
L01 : ENTERPRISE 4 (1026)	NO (-39.8%)	NO
L01 : ENTERPRISE 5 (1027)	NO (-39.7%)	NO
L01 : ENTERPRISE 7 (1029)	NO (-39.7%)	NO
L01 : MFL 6 (1040)	NO (-39.8%)	NO
L01 : SM GROUP (3013)	N/A	N/A
L01 : DT WRM (4005)	NO (-62.9%)	NO
L01 : 1P OFF (4023)	NO (-11.5%)	NO
L01 : MFL 2 (1036)	NO (-74.2%)	NO
L01 : MFL 3 (1037)	NO (-54.8%)	NO
L01 : MFL 4 (1038)	NO (-37.6%)	NO
L01 : MFL 5 (1039)	NO (-37.7%)	NO
L01 : ENTERPRISE 8 (1030)	NO (-37.6%)	NO
L01 : ENTERPRISE 6 (1028)	NO (-37.6%)	NO
L01 : ICT/BUISNESS (1107)	NO (-44.1%)	NO
L01 : ENTERPRISE WRM (4006)	NO (-66.2%)	NO
L02 : MATHS 10 (1012)	NO (-59.5%)	NO
L02 : MATHS 1 (1103)	NO (-39.9%)	NO
L02 : MATHS 3 (1105)	NO (-39.7%)	NO
L02 : MATHS 5 (1107)	NO (-39.7%)	NO
L02 : MATHS 7 (1109)	NO (-39.8%)	NO
L02 : SM GROUP (3014)	N/A	N/A
L02 : ART WRM (4043)	NO (-62.9%)	NO
L02 : OFF/MTG (4036)	NO (-11.6%)	NO
L02 : MATHS 8 (1010)	NO (-37.7%)	NO
L02 : MATHS 6 (1108)	NO (-37.6%)	NO
L02 : MATHS 4 (1106)	NO (-37.6%)	NO
L02 : SCI WRM (4004)	NO (-56.3%)	NO
L02 : SPECIALIST LAB 1 (1118)	NO (-51%)	NO
L02 : SCIENCE 3 (1111)	NO (-45.2%)	NO
L02 : SPECIALIST LAB 2 (1119)	NO (-50%)	NO
L02 : SCIENCE PREP (5012)	NO (-51.8%)	NO
L02 : 1P OFF (4032)	N/A	N/A
L02 : SCIENCE 5 (1113)	NO (-59.8%)	NO
L02 : SCIENCE 6 (1114)	NO (-48.4%)	NO
L02 : SCIENCE 7 (1115)	NO (-48.4%)	NO
L02 : SCIENCE 8 (1116)	NO (-48.3%)	NO
L02 : SCIENCE 9 (1117)	NO (-66.4%)	NO
L01 : ICT 4 (1104)	NO (-45.9%)	NO
L01 : ICT 5 (1105)	NO (-45.9%)	NO
L02 : ART & DESIGN RSC (3008)	N/A	N/A
L02 : GENERAL ART (1120)	NO (-46.4%)	NO
L02 : GENERAL ART (1121)	NO (-47.2%)	NO
L02 : ICT LEARNING AREA (1108)	NO (-47.6%)	NO
L02 : 3D ART ROOM (1122)	NO (-44.6%)	NO
L02 : SCIENCE 2 (1110)	NO (-43.4%)	NO

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Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L02 : SCIENCE 4 (1112)	NO (-44%)	NO
L02 : SCIENCE 1 (1109)	NO (-56.7%)	NO
L02 : MATHS WRM (4001)	NO (-68.5%)	NO
L02 : MATHS 2 (1104)	NO (-37.6%)	NO
L02 : MATHS 9 (1011)	NO (-72.6%)	NO
L02 : MATHS DOUBLE (1042)	NO (-34.7%)	NO
L00 : MAIN HALL (2001)	NO (-33%)	NO
L00 : DRAMA STUDIO (1124)	N/A	N/A
L01 : ENGLISH DOUBLE (1043)	NO (-48%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Area [m ²]	11275.5	11275.5		A1/A2 Retail/Financial and Professional services
External area [m ²]	14855.2	14855.2		A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
Weather	SWI	SWI		B1 Offices and Workshop businesses
Infiltration [m ³ /hm ² @ 50Pa]	5	3		B2 to B7 General Industrial and Special Industrial Groups
Average conductance [W/K]	4421.07	5708.4		B8 Storage or Distribution
Average U-value [W/m ² K]	0.3	0.38		C1 Hotels
Alpha value* [%]	10.01	10		C2 Residential Institutions: Hospitals and Care Homes
				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
			100	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

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	7.47	7.97
Cooling	0.01	0
Auxiliary	4.48	5.24
Lighting	7.87	12.42
Hot water	19.31	14.22
Equipment*	24.34	24.34
TOTAL**	39.14	39.85

* 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]	23.8	24.81
Primary energy* [kWh/m ²]	71.14	79.91
Total emissions [kg/m ²]	12.3	13.8

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

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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 air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	23.6	0	7.5	0	4.8	0.87	0	0.96	0
Notional	23.5	0	7.6	0	7.1	0.86	0	---	---
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	14.7	0	4.5	0	12.9	0.9	0	0.96	0
Notional	18.4	0	5.9	0	14.3	0.86	0	---	---
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	54	0	16.6	0	4	0.9	0	0.96	0
Notional	56.7	0	18.3	0	2.5	0.86	0	---	---
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	8.9	0	2.7	0	2	0.9	0	0.96	0
Notional	9.9	0	3.2	0	1.2	0.86	0	---	---
[ST] Single room cooling system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity									
Actual	26.2	25	2.1	2.8	0.9	3.43	2.47	3.5	3.5
Notional	14.8	12.1	1.6	0.9	0.6	2.56	3.79	---	---
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	30.4	0	8.6	0	10.4	0.99	0	0.96	0
Notional	4.3	0	1.4	0	7.3	0.86	0	---	---
[ST] Central heating using air distribution, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	32.3	0	10.3	0	7.1	0.87	0	0.96	0
Notional	46.2	0	14.9	0	4.7	0.86	0	---	---
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	81.8	0	27	0	0	0.84	0	1	0
Notional	78.1	0	25.2	0	0	0.86	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

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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	0.21	L0000000:Surf[13]
Floor	0.2	0.21	L0000000:Surf[0]
Roof	0.15	0.16	L000004D:Surf[1]
Windows, roof windows, and rooflights	1.5	1.05	L00000E1:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building
U _{i-Typ} = Typical Individual element U-values [W/(m²K)]			U _{i-Min} = Minimum Individual element U-values [W/(m²K)]
* There might be more than one surface where the minimum U-value occurs.			

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

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Appendix B1 - Further Carbon Reduction Measures

Avoiding Active Cooling

The Part L assessment for the project does not recognise that exemplar levels of passive design in the CO₂ emission reduction where a traditional school would require significant amounts of comfort cooling. As discussed in the main body of the report under section 2.2, the building eliminates the need for active cooling in favour of passive design solutions. The resultant compliance with BB101 in all occupied spaces is testament to the passive design strategy that has been adopted.

To measure the benefit of the passive design that is not included in the Part L compliance calculation, the project model has been re-simulated as an air-conditioned building, where the occupied rooms have been simulated with a generic cooling system. The TER generated in the BRUKL report for this cooled building represents the emission rate that would otherwise be designed against and shows the actual benefit. When modelled with active cooling in all occupied spaces, the resultant increase in CO₂ emissions of the TER is 92,459 TonnesCO₂/yr. When measured per unit of floor area, this equates to 8.2 kgCO₂/m²/yr, the equivalent of a further 59.42 % reduction in the buildings CO₂ emissions when compared with the non-air-conditioned notional building. Please refer to Appendix B2 for the modelling outputs.

Reduction in Hot Water Demand

The design proposals include water efficient fittings throughout such as low volumes WCs. Consequently, to meet the OS requirement, the domestic hot water consumption is reduced significantly. The amount of water consumption is fixed within a Part L BRUKL calculation and therefore the associated CO₂ saving would not be rewarded. In order to appraise the additional CO₂ emission reduction measure for the domestic hot water reduction, a comparison of the proposed shower and wash hand basin fittings with industry norms has been made in the table below, in this case taken from 'BS 8542:2011 – Calculating Domestic Water Consumption in Non-Domestic Buildings – Code of Practice' using the 'fair' standard of water efficiency which is defined as "improvement on current practice".

Sanitary Fitting	BS 8542 Flowrate	River Proposed Flowrate	Annual CO ₂ Saving	Annual CO ₂ Saving by floor area
Showers	10 litres/min	6 litres/min	9,663.8 kgCO ₂ /yr	0.9kgCO ₂ /m ² /yr
Wash Hand Basin Taps	9 litres/min	2 litres/min	33,219.2 kgCO ₂ /yr	2.9 kgCO ₂ /m ² /yr
Total Savings			42,883.0 kgCO₂/yr	3.8 kgCO₂/m²/yr

It should be noted that the following usage pattern has been assumed which is as the project Water Consumption calculations/assumptions: -

- Each building occupant shall have on average a 5-minute shower once every two weeks
- Shower temperature is limited to 38°C
- Each building occupant shall on average use a wash hand basin 2.5 time per day for 20 seconds per use
- Wash hand basin temperature is limited to 43°C

The overall CO₂ reduction for reducing domestic hot water consumption represents a further 27.56 % reduction when compared with the notional building.

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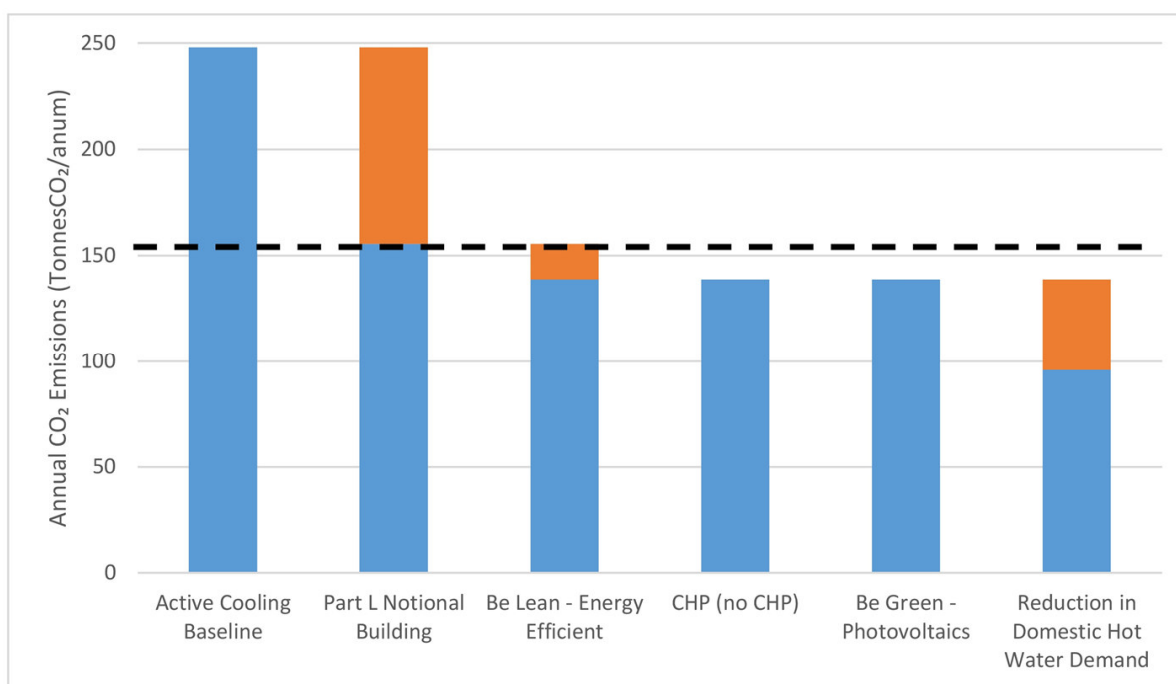


Building Performance with Further Carbon Savings Creating a Leaner and Cleaner Building

Taking the calculated savings from avoiding active cooling and reducing domestic hot water usage results in a building that requires less energy to function. These savings are shown in the below extended table, comparable to the table in the Executive Summary in the Main Report which shows the full carbon reduction to be achieved. The below savings are in relation to comparison to the baseline TER.

Energy Efficiency Measure	CO ₂ Emission Savings	% CO ₂ reduction for building
Avoiding Active Cooling	92.457 TonnesCO ₂ /year	59.42 %
'Be Lean' - Fabric First Approach (BRUKL)	16.913 TonnesCO ₂ /year	10.87 %
'Be Clean' - Heating Infrastructure	0.000 TonnesCO ₂ /year	0.00 %
'Be Green' - Photovoltaic Panels	0.000 TonnesCO ₂ /year	0.00 %
Reduction in Hot Water Demand	42.883 TonnesCO ₂ /year	27.56 %
Total CO₂ Emission Reduction	152.255 TonnesCO₂/year	97.85 %

The carbon emission savings outlined in the table above is presented on the graph below to demonstrate CO₂ savings against each item.



The calculated further savings equate to an estimated annual carbon emission reduction of 135.342 TonnesCO₂/annum on top of the 'Be Lean' measures as discussed in the Main Report to produce a total carbon saving of 152.255 TonnesCO₂/annum which results in a 97.85 % reduction against the Notional Building.

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Appendix B2 – Active Cooling Energy Consumption

The image below shows the BRUKL report from the building should it have been designed with mechanical cooling in the occupied rooms. The TER has been taken from this to show the savings in energy consumption from designing avoiding active cooling with hybrid ventilation.

BRUKL Output Document HM Government
Compliance with England Building Regulations Part L 2013

Project name

River Academy

As designed

Date: Fri Dec 10 10:14:56 2021

Administrative information

Building Details
 Address: Richfield Avenue, Reading.

Certification tool
 Calculation engine: Apache
 Calculation engine version: 7.0.13
 Interface to calculation engine: IES Virtual Environment
 Interface to calculation engine version: 7.0.13
 BRUKL compliance check version: v5.6.b.0

Certifier details
 Name:
 Telephone number:
 Address: , ,

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

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

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	17.8
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	17.8
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	22
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 _o -Limit	U _o -Calc	U _i -Calc	Surface where the maximum value occurs*
Wall**	0.35	0.21	0.21	L0000000:Surf[13]
Floor	0.25	0.21	0.21	L0000000:Surf[0]
Roof	0.25	0.16	0.16	L000004B:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.34	1.35	L0000000:Surf[7]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

U_o-Limit = Limiting area-weighted average U-values [W/(m²K)]
 U_o-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	5

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Appendix C1 – Overheating Risk Assessment

Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)
L00 : SIXTH FORM STUDY (3002)	1.1	3	2
L00 : LRG GROUP (3017)	2.3	5	3
L00 : SIXTH FORM SEM RM (1001)	2.1	5	3
L00 : 1P OFF. (4022)	0	0	0
L00 : KITCHEN & SERVERY (6001)	0.1	1	1
L00 : DINING (2006)	0.1	1	1
L00 : SIXTH FORM SOCIAL (2005)	0	0	0
L00 : DINING (2004)	0.8	1	1
L00 : ICT 3 (1103)	2.3	8	4
L00 : MUSIC RECITAL (1123)	2.8	5	3
L00 : EXT PRACT. (3006)	1.1	3	2
L00 : PRACT. (3003)	0.9	3	2
L00 : PRACT. (3004)	0.6	2	2
L00 : PRACT. (3005)	0.6	3	2
L00 : PERFORMING ARTS (1041)	0.2	1	1
L00 : REPRO (4014)	0.5	2	2
L00 : SICK (4019)	0.3	1	1
L00 : MUS & D WRM (4007)	1.8	4	2
L00 : GEN/FIN/SS OFF (4015)	2	5	3
L00 : SENCO	1.5	4	3
L00 : INCW RM (3021)	2.4	6	3
L00 : SEN TH (3009)	1.1	3	2
L00 : OPEN GRP (3022)	1.1	3	2
L00 : MED GRP (3015)	1.5	5	3
L00 : SM GRP (3012)	2.9	7	3
L00 : MED GRP (3016)	2.4	6	3
L00 : INCW RM (3020)	5	10	4
L00 : SEN SEM RM (1002)	3.4	8	4
L00 : SM GRP(3011)	2.3	6	3
L00 : EXAM OFF. (4039)	0.2	1	1
L00 : HD OFF (4012)	0.5	2	1
L00 : INTR (4018)	0.3	3	2
L00 : HEAD PA (4013)	3.7	8	3
L00 : BM (4020)	4.7	9	4
L00 : DP.H (4021)	4.3	10	4
L00 : CONF RM (4010)	2.3	5	2
L00 : SPORTS HALL (2002)	0	0	0
L00 : ACTIVITY STUDIO (2003)	1.4	3	2
L00 : PE (1128)	1.2	3	2
L00 : OFF/MTG (4038)	3.1	7	3
L00 : PE (1130)	0.2	1	1
L00 : PREM OFF (4042)	0.8	1	1
L00 : ICT TECH (4041)	0.2	1	1
L00 : ICT LRC (3001)	2.3	3	2
L00 : OFF/MTG (4037)	0.2	1	1
L00 : ICT 2 (1102)	2	4	2
L00 : ENTERPRISE 1 (1023)	1.2	3	2
L00 : ENTERPRISE 2 (1023)	0.8	3	2
L00 : ENTERPRISE 3 (1023)	0.5	3	2
L00 : 1P OFF. (4031)	0	0	0
L00 : PE WRM (4008)	2	4	2
L00 : PE (1129)	1.7	5	3
L01 : ENGLISH 1 (1013)	0.2	1	1
L01 : CONTROL (3007)	0	0	0
L01 : MFL 1 (1035)	0.5	1	1
L01 : ENGLISH 3 (1015)	0.3	2	1
L01 : ENGLISH 5 (1017)	0.3	2	1
L01 : LRG GROUP (3019)	0.3	1	1
L01 : ENGLISH 8 (1020)	0.2	1	1
L01 : ENGLISH 9 (1021)	0.3	2	1
L01 : ICT 6 ENGLISH (1106)	1.5	3	2
L01 : ENGLISH WRM (4002)	0.5	2	1
L01 : ENGLISH 2 (1014)	0.5	2	1
L01 : ENGLISH 4 (1016)	0.3	2	1
L01 : ENGLISH 6 (1018)	0.3	2	1
L01 : ENGLISH 7 (1019)	0.2	1	1
L01 : FOOD TECHNOLOGY (1126)	0	0	0

Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)
L01 : FOOD ST/PR (5021)	0	0	0
L01 : FOOD TECHNOLOGY (1125)	0	0	0
L01 : MM ST/PR (5020)	0	0	0
L01 : ELECTRONICS (RM) (1127)	0.5	2	1
L01 : MFL & HUMS WRM (4003)	1.8	4	2
L01 : STAFF ROOM (SOCIAL)	0.1	1	1
L01 : ICT (MFL/HUMS) (1101)	1.5	3	2
L01 : HUMANITIES 4 (1034)	1.1	3	2
L01 : HUMANITIES 3 (1033)	0.9	3	2
L01 : OFF/MTG (4035)	0.6	2	1
L01 : HUMANITIES 2 (1032)	0.9	2	1
L01 : HUMANITIES 1 (1031)	0.9	2	1
L01 : ENGLISH 10 (1022)	0.9	2	1
L01 : ENTERPRISE 4 (1026)	0.3	2	1
L01 : ENTERPRISE 5 (1027)	0.3	2	1
L01 : ENTERPRISE 7 (1029)	0.3	2	1
L01 : MFL 6 (1040)	0.2	1	1
L01 : SM GROUP (3013)	0.3	1	1
L01 : DT WRM (4005)	0.3	2	1
L01 : 1P OFF (4023)	2.8	6	3
L01 : MFL 2 (1036)	0.2	1	1
L01 : MFL 3 (1037)	0.2	1	1
L01 : MFL 4 (1038)	0.3	2	1
L01 : MFL 5 (1039)	0.3	2	1
L01 : ENTERPRISE 8 (1030)	0.3	2	1
L01 : ENTERPRISE 6 (1028)	0.5	2	1
L01 : ICT/BUSINESS (1107)	1.8	3	2
L01 : ENTERPRISE WRM (4006)	0.6	2	1
L02 : MATHS 10 (1012)	0.5	3	2
L02 : MATHS 1 (1103)	0.9	3	2
L02 : MATHS 3 (1105)	0.9	3	2
L02 : MATHS 5 (1107)	0.9	3	2
L02 : MATHS 7 (1109)	0.9	3	2
L02 : SM GROUP (3014)	0.6	3	2
L02 : ART WRM (4043)	0.6	3	2
L02 : OFF/MTG (4036)	1.7	5	3
L02 : MATHS 8 (1010)	0.9	3	2
L02 : MATHS 6 (1108)	0.9	3	2
L02 : MATHS 4 (1106)	1.1	4	2
L02 : SCI WRM (4004)	0.9	3	2
L02 : SPECIALIST LAB 1 (1118)	1.4	5	3
L02 : SCIENCE 3 (1111)	1.4	5	3
L02 : SPECIALIST LAB 2 (1119)	1.4	4	3
L02 : SCIENCE PREP (5012)	0.2	1	1
L02 : 1P OFF (4032)	0	0	0
L02 : SCIENCE 5 (1113)	0.5	3	2
L02 : SCIENCE 6 (1114)	1.4	5	3
L02 : SCIENCE 7 (1115)	1.4	5	3
L02 : SCIENCE 8 (1116)	1.4	5	3
L02 : SCIENCE 9 (1117)	0.8	3	2
L01 : ICT 4 (1104)	1.4	5	3
L01 : ICT 5 (1105)	1.4	5	3
L02 : ART & DESIGN RSC (3008)	0	0	0
L02 : GENERAL ART (1120)	0.3	2	1
L02 : GENERAL ART (1121)	0.3	2	1
L02 : ICT LEARNING AREA (1108)	1.5	5	3
L02 : 3D ART ROOM (1122)	0.9	3	2
L02 : SCIENCE 2 (1110)	1.5	5	3
L02 : SCIENCE 4 (1112)	1.2	5	3
L02 : SCIENCE 1 (1109)	1.7	5	3
L02 : MATHS WRM (4001)	0.8	3	2
L02 : MATHS 2 (1104)	1.1	4	2
L02 : MATHS 9 (1011)	0.3	3	2
L02 : MATHS DOUBLE (1042)	1.1	4	2
L00 : MAIN HALL (2001)	1.4	5	3
L00 : DRAMA STUDIO (1124)	0.8	3	2
L01 : ENGLISH DOUBLE (1043)	0.2	1	1



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