couchperrywilkes

engineering change

Turing House School
Energy Strategy
FS0316-CPW-00-XX-RP-N-0007

DOCUMENT REVISION HISTORY			Ref:	FS0316-CPW-00-XX-RP-N-0007
Rev	Author	Verification	Date	Comments / Status
P01	A.Howard	M.Wrate	12/10/18	Planning Issue for Comment
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P03	A.Howard	M.Wrate	11/03/19	Revised in Accordance with Stage I Consultation Comments
P04	A.Howard	M.Wrate	05/05/20	Carbon Offset Calculation Added (Section 3.5)

Contents

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Turing House School — As designed

Date: Tue Mar 05 10:35:52 2019

Administrative information

Building Details

Address: Hospital Bridge Road, Twickenham, TW2 6LH

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.10

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.10

BRUKL compliance check version: v5.4.b.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	13
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	13
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	8.5
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.21	0.26	FF000009:Surf[0]
Floor	0.25	0.21	0.21	GF000000:Surf[0]
Roof	0.25	0.16	0.16	FF000032:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.33	1.35	GF000006:Surf[1]
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

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

* 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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Figure 0.1 - BRUKL Report for Building Including PV before adding further Carbon Reductions

Executive Summary

This Energy statement is intended to support the planning application for the proposed Turing House School development in Twickenham, South-West London. The energy statement and approach to the design follows the London Plan 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 Education and Skills Funding Authority (ESFA) 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 (CO_2) 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, rather than relying on renewable energy technologies. This approach has led to 7.69 % betterment over Part L 2013 as described in the report. As can be seen in the table below, the fabric first energy strategy, in addition to the 'Be Green' measures demonstrate that the overall CO_2 emission reduction for the project equates to over 38 tonnes per annum, a reduction of 35% over the notional building in accordance with London Plan policy. The initial Part L analysis BRUKL report before applying photovoltaic panels is included in Appendix A1. The BRUKL in Appendix A1 shows the Fabric First Approach savings as shown in the below table. **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 savings to meet the target of 35% 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	108.828
'Be Lean' - After Energy Demand Reduction	100.457
'Be Clean' - After Heat Network / CHP	100.457
'Be Green' - After Renewable Energy	70.738

The below table also indicates that the development achieves around 27% CO_2 reduction from onsite renewables.

	Regulated Domestic Carbon Dioxide Savings	
	TonnesCO2/year	% CO_2 reduction for building
Savings from Energy Demand Reduction	8.371	7.69%
Savings from Heat Network / CHP	0	0%
Savings from Renewable Energy	29.718	27.31%
Cumulative on-Site Savings	38.090	**35%**

The carbon emission savings outlined in the table above is presented on the graph below in the GLA format to demonstrate the CO_2 savings against each item relative to the GLA target.

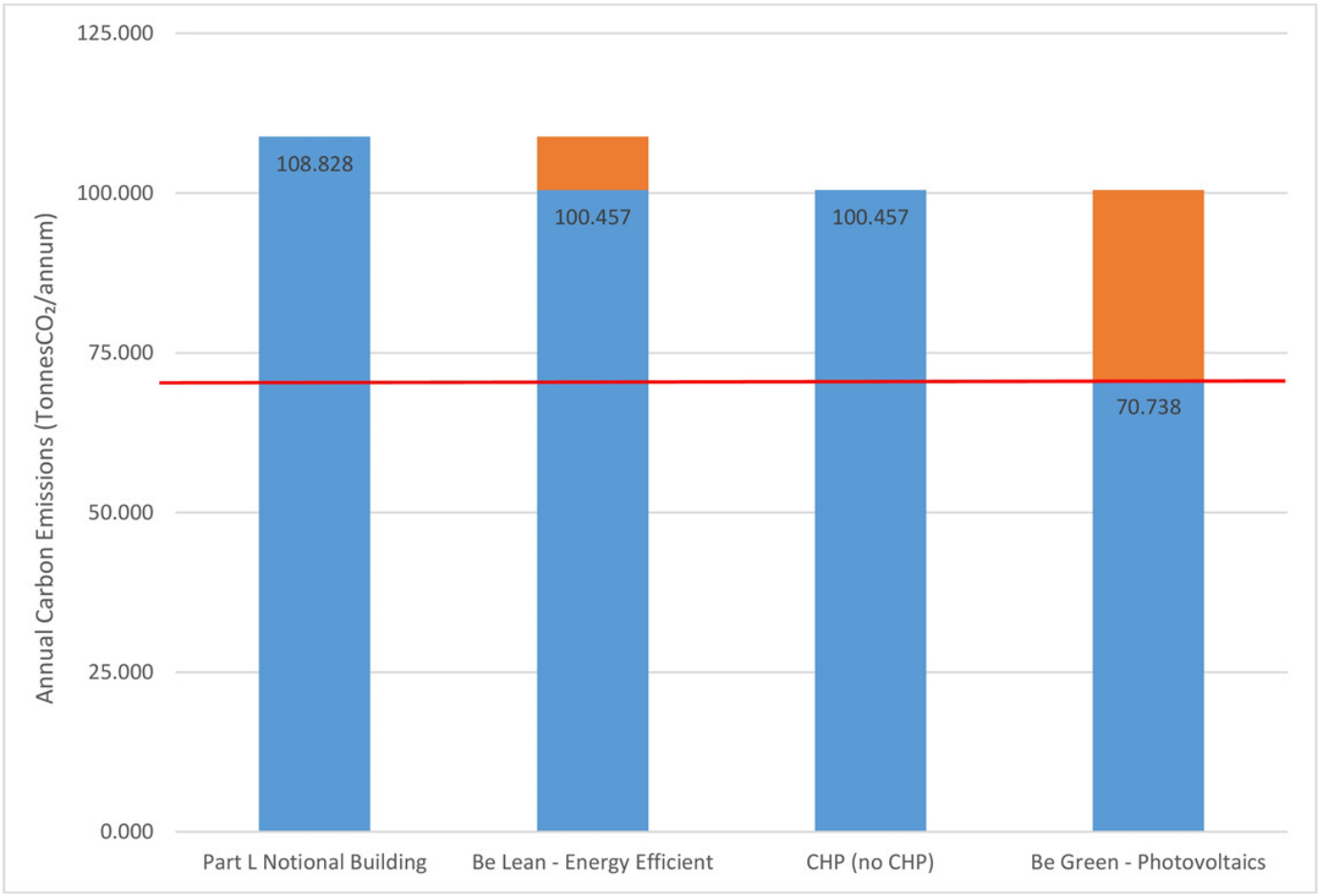


Figure 0.2 - Resultant Carbon Reduction to meet GLA Target of 35% Reduction below Part L 2013

As can be seen in the table above, the GLA 35% CO_2 emission reduction target is shown by the red line. **The further carbon savings shown in Appendix B shows that it is expected that the building will surpass the GLA 35% target when considering further carbon emission savings.**

The site is not situated close to an existing district heating network and subsequently the building is not proposed for connection to such a system. However, the building services design incorporates the provision to connect to a future district heating network should one become available. The building is to be provided with heat via a single energy centre to provide heat via a single system. This single heating network will also enable future connections or change in heating technology plant for both zones.

The above indicates compliance with the requirement to reduce carbon emission by 35% in comparison to the baseline TER. In addition to this, it is proposed that a cash in-lieu payment shall be made to the carbon offset fund to achieve a resultant net-zero carbon emitting building. A payment of £105,828.21 has been proposed based on resultant carbon emissions, corrected using SAP10 carbon factors, based on a 30-year period at £60/tonneCO_2. Please refer to section 3.5 for further information on this calculation.

1.0 Introduction

Couch Perry Wilkes are appointed by Bowmer & Kirkland as the Mechanical and Electrical design consultants for the Turing House School Development. This Energy Statement is intended to support the planning application for the proposed secondary school educational facility in Twickenham, South-West London. The project Energy Statement has been written to meet the Greater London Authority's guidance on preparing energy statements.

The proposed development consists of approximately 8,372m^2 of new build education facility. The proposed new facility shall provide education facilities to approximately 1,050 pupils of ages 11 to 18 (Sixth Form). The development is a superblock design with a sports block attached to the end as shown in the image below.

Figure 1.1 - Architects' Vision of Constructed Proposed Building

Image courtesy of Stride Treglown Architects

2.0 Exemplar Design Standards


Education Funding Agency

CONTRACTORS FRAMEWORK

INVITATION TO TENDER
VOLUME 5

FACILITIES OUTPUT SPECIFICATION

Part B – Generic Design Brief

December 2013

The Education and Skills Funding Agency (ESFA) 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 complaint with the ESFA's OS briefing document, such as Turing House School 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 TM52

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 Turing House School design.

2.1 Climate Based Daylight Modelling

Previously schools were designed by using daylight factor (DF). The provision of natural daylight for Turing House School 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.

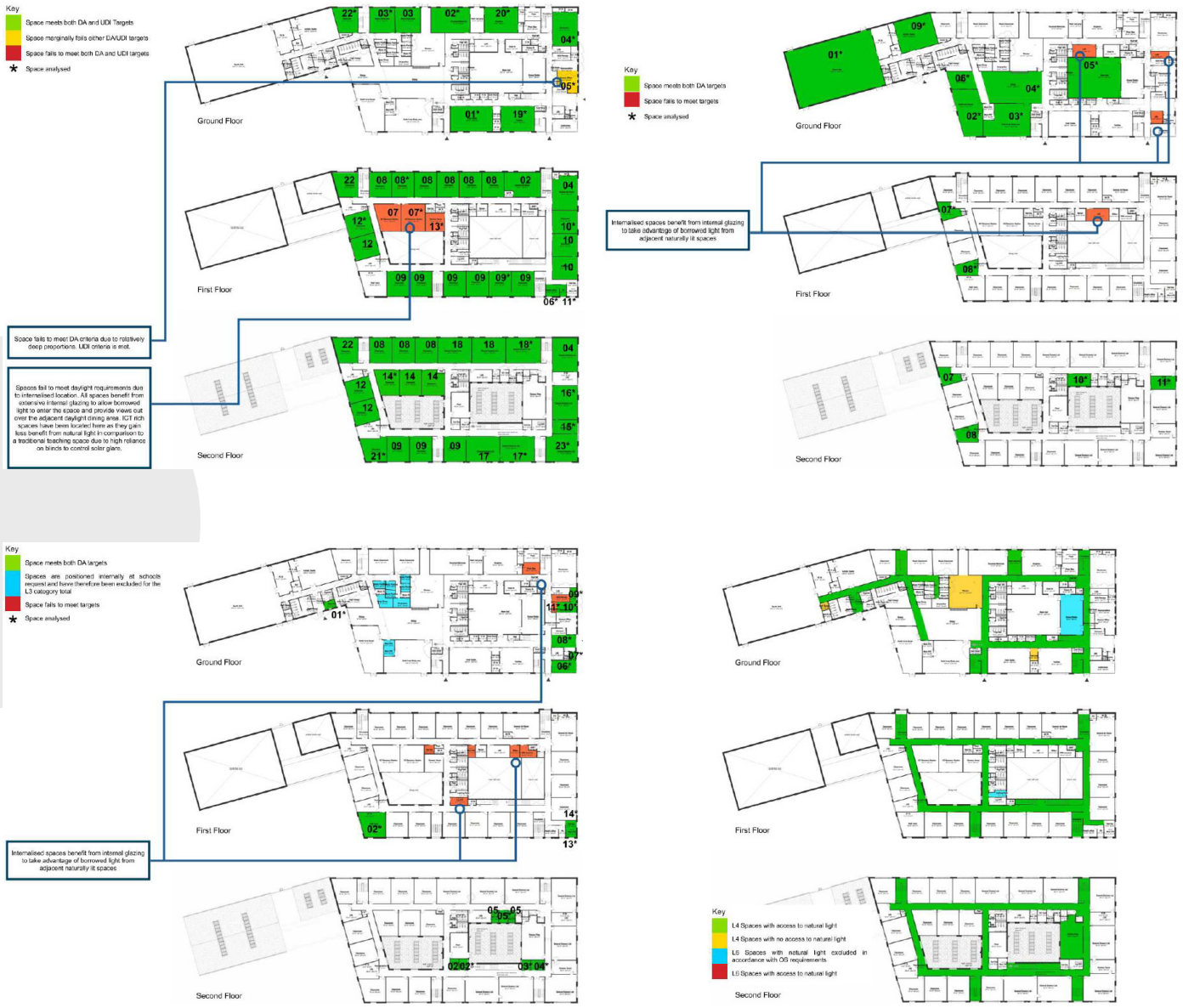


Figure 2.1 - Excerpt from Daylight Analysis Report

Image 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.

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 = 0.37) 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.

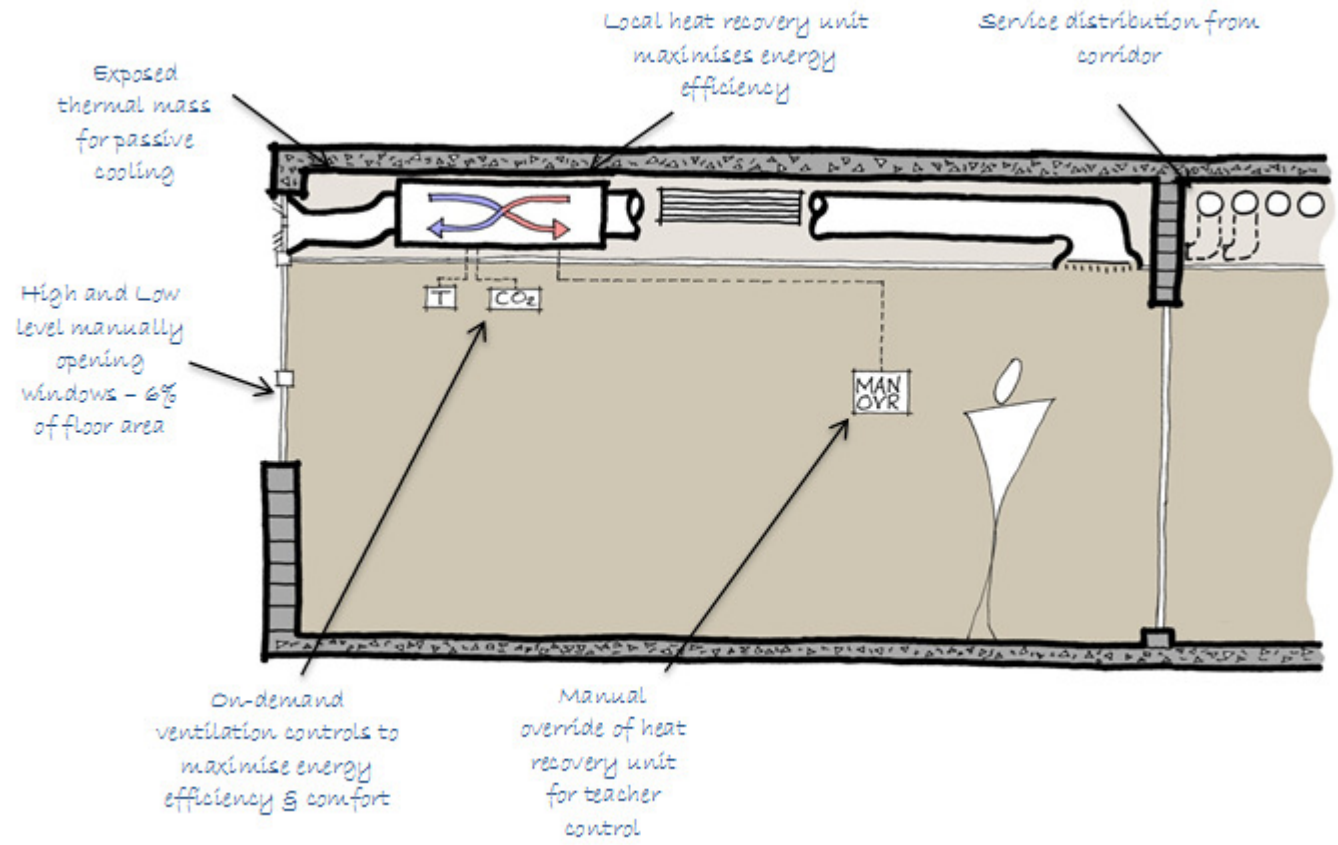


Figure 2.2 – Proposed environmental strategy for typical classroom – Turing House School

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.**

The requirement for cooling has been minimised in accordance with the London Plan 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. Rooms with higher internal gains, such as IT spaces and science laboratories have been positioned so that they are not facing south to minimise solar 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 TM52

The outcome of the adopted design strategy is a building that exceeds the requirements of TM52 whilst **eliminating the need for active cooling throughout the building** (except for the server room 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 London_LHR_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	4.8	13	4K
Pass/Fail	Pass	Fail	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	0.9	2	2K
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	4.7	13	5K
Pass/Fail	Pass	Fail	Fail
Room Analysed	**Criterion 1 hours of exceedance (He), < 6.17%**	**Criterion 2 daily weighted exceedance (We), <6**	**Criterion 3 upper limit temperature (Tupp), <4K**
Sports Hall	0.4	2	1K
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 TM52 criteria as criterion 1 is passing, so therefore is of acceptable risk. The full results can be found in Appendix C1.

Circulation spaces have also been assessed to determine they are at suitable low risk of overheating and have also been assessed against TM52 criterion 1. All circulation spaces pass the overheating risk assessment criteria and is summarised in Appendix C1.

2.4 Overheating Assessment against TM49

As well as modelling the building against TM52 criteria as described above, the building has been simulated against the three TM49 weather scenarios. The results of the TM49 weather scenario overheating simulations have been collated in Appendix C. The location used for this assessment has been Heathrow with the following files:

London_LHR_DSY1 (Appendix C2)

London_LHR_DSY2 (Appendix C3)

London_LHR_DSY3 (Appendix C4)

The simulation has been undertaken with regards to the BB101 criteria for overheating risk in schools, using the weather files described above. The analysis has assumed full occupancy during the non-heating period only, as per the BB101 methodology. The criteria used for determining whether the space is at risk of overheating remains to be Criterion 1, where any value reported below 6.1% is determined to be of acceptable risk. The TM49 analysis shows the design against extreme conditions under normal occupancy and proves the risk of overheating is low. The results have been summarised below:

Room Name	DSY1	DSY2	DSY3
GF:Conference	3.8	6.1	7
GF:Interview	2.3	5.4	8
GF:LRC	1.3	3.5	5
GF:Entrance	1.2	3.4	4.4
GF:SEN/Therapy	1.1	3.1	4.4
GF:LRC	2.1	4.5	6.2
GF:Med 1PO	0.6	2.8	2.9
GF:LRC	1.2	3.4	4.5
GF:Cent Stock (office)	0.9	2.8	3.5
GF:Food Prep	1.7	3.7	4.9
GF:Med 2PO	1.8	4	4.6
GF:Multi Mat Prep	0.5	2.3	1.8
GF:Ext Practice	2.4	4.6	5.5
FF: Small 1PO	0.3	1.7	1.5
FF:Seminar Room	2.4	4.9	6.1
FF:Med 2PO	0.2	1.4	1.1
FF:LRC 01	0.8	2.2	2.8
FF:Small Group	1.4	3.2	4.3
SF:Med 1PO	1.2	4	5.2
SF:SENco Office	1.2	3.8	5
SF:Med 1PO	1.1	3.8	4.3
SF:LRC	0.9	2.9	2
FF:Lrg 3PO	0.5	1.8	2.3
GF:2 Person Office	0.8	2.6	2.8
GF:Music Practice 01	0.9	2.6	3.7
GF:Music Practice 02	1.5	3.4	4.4
GF:Music Practice 03	1.8	3.2	4.4
GF:Music Practice 04	1.5	3.2	4.1
GF:Music Practice 05	2.1	4.3	4.9
GF:3-4 Person Office	1.4	3.1	4.3
GF:Sixth Form Social	0.9	4.6	0.9
GF:Sixth Form Study Area	3.5	5.8	6.9
GF:General Office	1.1	2.9	4.1
GF:Prep Man	0.8	2.4	3.2
FF:LRC 02	0.7	2.6	3
FF:2 Person Office	0.8	2.6	3.4
FF:IT Tech Room	0.5	1.7	1.8
GF:Kitchen	1.2	3.2	3.3
GF:Drama Studio	2.3	4.6	5.4
SF:LRC	0.9	3	3.5
GF:Sports Hall	0	0.7	0.6
GF:Main Hall	0.6	2.8	2.9
SF:Sml 2PO	0.9	3.2	4.4
SF:Lrg Group	1.7	4.6	6.3
SF:Sml 2PO	0.9	3.2	4.6
SF:Med 1PO	0.5	2	3.4
GF:Activity Studio	0.5	1.7	1.5
GF:Dining	0	0.9	0
GF:Textiles	2.8	5.7	7.2
GF:Food Studio	1.7	4.1	5.5
GF:Electronics	2.1	5.7	7.5
GF:Graphics	3.4	5.8	6.7
GF:Resistant Material	2	4.4	5.8
GF:Music Classroom 02	2.3	4.6	6.1

Room Name	DSY1	DSY2	DSY3
GF:Music Classroom 01	2.4	4.4	6.1
GF:Classroom	2.3	4.4	6.1
FF:General Art Room	1.4	4.1	5.8
FF:Classroom 07	2.1	4.9	6.7
FF:Classroom 08	2.1	5	6.7
FF:Heads Office	0.9	3.8	4.6
FF:PA Office	1.5	4.6	6.4
FF:Meeting room	0.9	3.1	3.8
FF:LRC 03	0.8	3.3	4.8
FF:Classroom 11	2.4	5.5	6.9
FF:Classroom 10	2	4.7	5.8
FF:Classroom 13	1.7	4.6	5.8
FF:Classroom 12	2	4.6	5.8
FF:Classroom 14	2	4.6	5.8
FF:Classroom 15	1.7	4.3	5.8
FF:Classroom 17	1.8	4.4	5.5
FF:Classroom 18	1.8	4.6	5.7
FF:LRC	0.7	2.5	2.8
FF:Classroom 16	1.5	3.8	5.5
FF:Classroom 01	1.5	4.1	5.7
FF:Classroom 02	1.5	4	5.7
FF:Classroom 03	1.5	4	5.5
FF:Classroom 04	1.5	3.8	5.7
FF:Classroom 05	1.5	3.8	5.5
FF:Classroom 06	1.5	3.8	5.5
FF:General Art Room	1.2	3.4	4.3
SF:General Science Lab 06	1.7	4.6	5.7
SF:General Science Lab 07	2.1	5.7	6.4
FF:Staff Room	1.4	3.5	4.7
SF:General Science Lab 08	2	4.7	6
SF:Classroom 01	2.3	5.2	6.3
SF:Classroom 02	2.3	5.2	6.3
SF:Classroom 14	2	4.6	6
SF:Classroom 09	1.4	3.7	5.2
SF:General Science Lab 01	2	4.9	7
SF:General Science Lab 02	1.7	4.6	6.4
SF:General Science Lab 03	1.5	4	5.8
SF:General Science Lab 04	1.5	4	5.8
SF:General Science Lab 05	1.5	4	5.8
SF:Classroom 05	1.5	4.1	5.7
SF:Classroom 06	1.5	3.8	5.5
SF:Classroom 07	1.5	4.1	5.7
SF:Classroom 08	1.2	3.5	4.3
SF:Classroom 13	1.2	3.2	4.4
SF:Classroom 11	1.7	4.3	5.4
SF:Science Prep	0.8	2.9	5
SF:Classroom 10	1.8	4.6	6
SF:Classroom 04	1.8	4.6	6
SF:Classroom 12	1.8	4.4	6
SF:LRC	0.5	2	3.3
SF:LRC	0.8	2.5	3.7
SF:Seminar Room	3.1	6	7.3
FF:ICT/Business Studies	3.4	5.8	6.9
FF:ICT/Business Studies	3.2	5.5	6.7

Two of the three scenarios show the building is not overheating, whereas the results from DSY3, show that a few rooms pose an overheating risk in a prolonged period of sustained warmth extreme scenario. As two of the three sets of results show compliance with TM52 criteria, it has been deemed that the building is of acceptable risk of overheating. The rooms shown as failing the DSY3 analysis will be monitored. Should they overheat in reality; additional ventilation shall be used.

Only the criterion 1 results are shown above. The full set of results are included in Appendices C2, C3 and C4.

3.0 Energy Strategy

This section of the report describes how the project has been designed in line with the London Plan hierarchy for CO_2 emission reduction.

3.1 Energy Hierarchy

Couch Perry Wilkes design philosophy for reducing energy consumption, implemented on the Turing House School, is demonstrated in the image below and is aligned with the London Plan Hierarchy, OS and CIBSE guidelines:

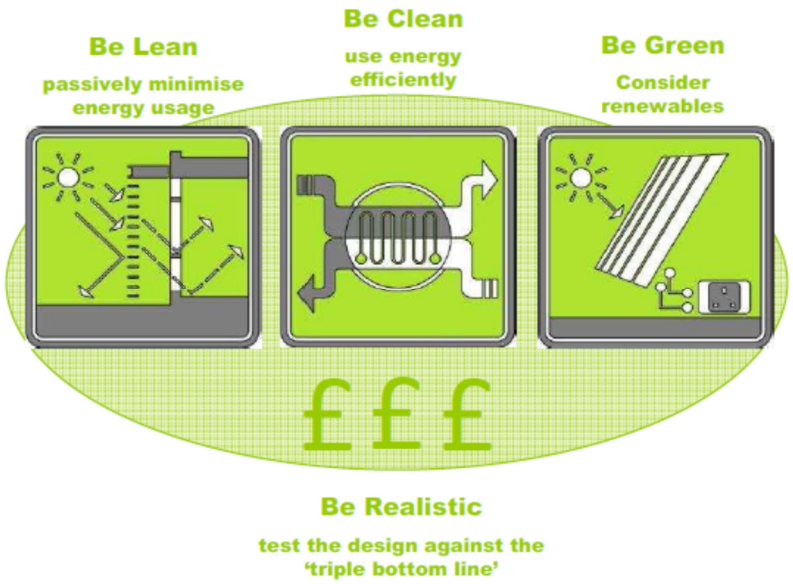


Figure 3.1 – Proposed environmental strategy for typical classroom – Turing House School

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

3.2 '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 efficiency 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	Turing House School [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: 0.37)

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 0.57 as direct solar gains are minimal from the North. The U-Value for the skylights in the model have also been set at 1.5 W/(m^2.K).

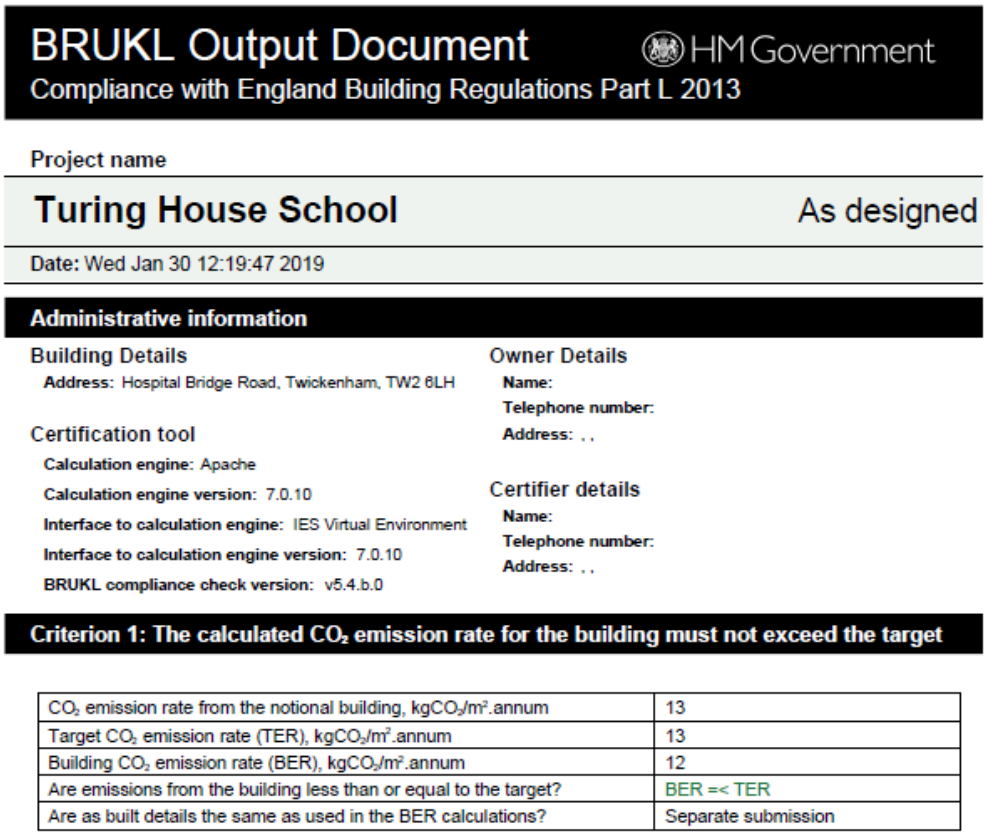
The weather file/scenario used to simulate the climate in all Part L compliance simulations in the Dynamic Simulation Modelling software was LondonTRY05.

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

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 (4.1.4) 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

3.2.1 Resultant CO_2 Reductions from 'Be Lean' Measures

The proposed Fabric First strategy stated in section 2.2 results in significant reductions in the projects CO_2 emissions. The image below shows the BRUKL output of the design stage Part L compliance model for the Turing House School 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

Turing House School — As designed

Date: Wed Jan 30 12:19:47 2019

Administrative information

Building Details
Address: Hospital Bridge Road, Twickenham, TW2 6LH

Certification tool
Calculation engine: Apache
Calculation engine version: 7.0.10
Interface to calculation engine: IES Virtual Environment
Interface to calculation engine version: 7.0.10
BRUKL compliance check version: v5.4.b.0

Owner Details
Name:
Telephone number:
Address: , ,

Certifier details
Name:
Telephone number:
Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	13
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	13
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	12
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

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

3.2.2 Energy Demand Following 'Be Lean' Measures

As required by the latest Greater London Authority guidance on preparing energy assessments, the estimated energy demand for the proposed building is reported in the below table:

Building Use	Energy Demand Following Energy Efficiency Measures (MWh/year)						
	Space Heating	Hot Water	Lighting	Auxiliary	Cooling	Unregulated Electricity	Unregulated Gas
Non-Residential Total	292.041	111.557	117.460	109.087	21.935	163.505	117.117

The above energy demands have been estimated using a 'Developed Energy' model that has been developed since this Energy Statement was originally developed. The unregulated gas has been estimated based on a catering demand of 0.65kWh/meal.

It should be noted that the above are initial estimations only and may differ significantly in the actual building dependant on the final detailed design proposals and actual building usage.

3.3 'Be Clean' - Heating Infrastructure

3.3.1 Existing District Heating Infrastructure

The image below shows the proposed site on the London Heat Map (http://www.londonheatmap.org.uk/). As can be seen in the image below there is no existing district heating network in the immediate vicinity of the site.

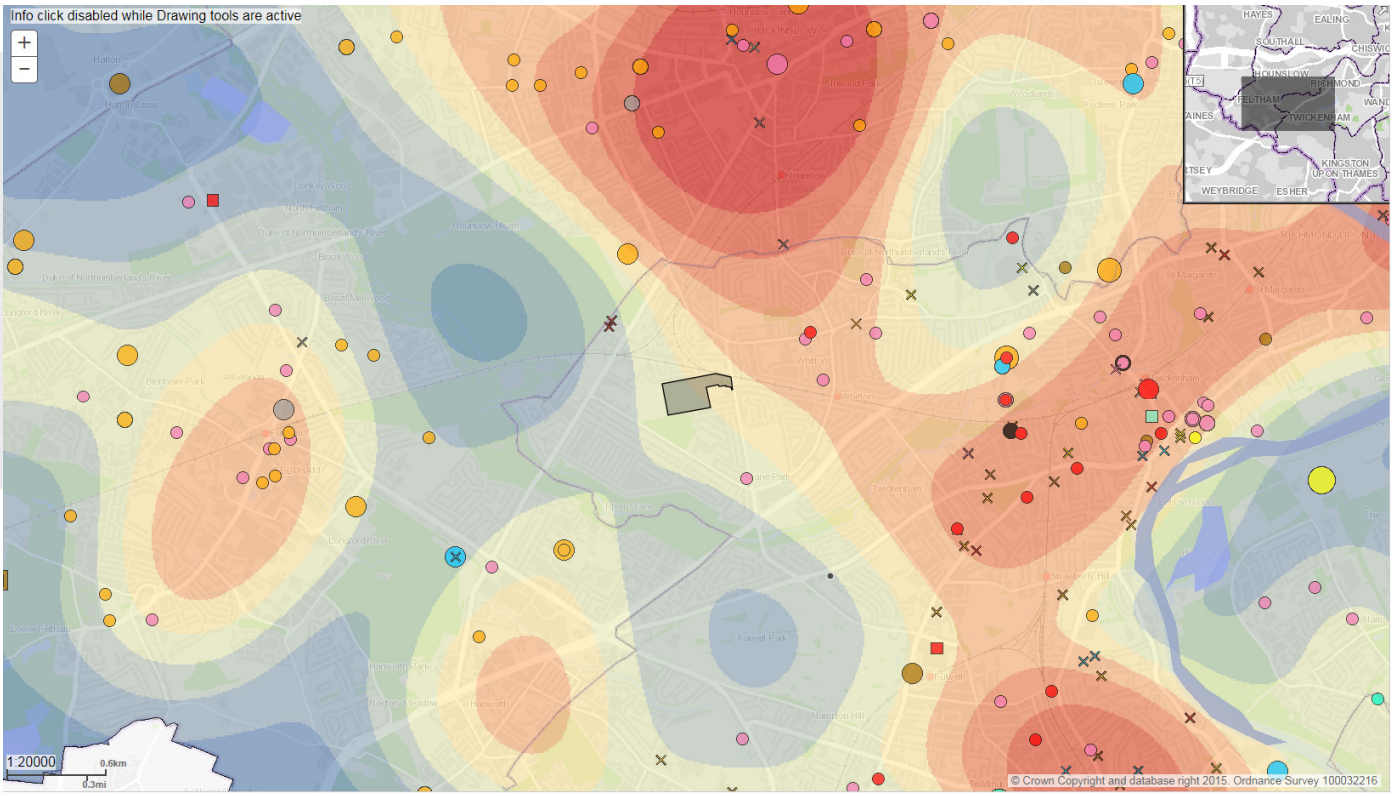


Figure 3.3 - London Heat Map – Turing House School, Hospital Bridge Road, Twickenham.

There is not currently a district heating network in close proximity to the site and it does not lie within an area defined as having potential high heat demand, as indicated by the contours. The coloured circles, squares and crosses, indicate potential anchor heat loads that could connect to a district heating network. The location of the site does not appear to be in a strategic location for linking anchor heat loads, but the facility shall be required to allow for the future connection.

3.3.2 Provisions for Future Connection to District Heating Network

The proposals for the Turing House School include the provision for the future connection of a local district heating network to the main LTHW header pipework as depicted in the image below taken from the project heating schematic: -

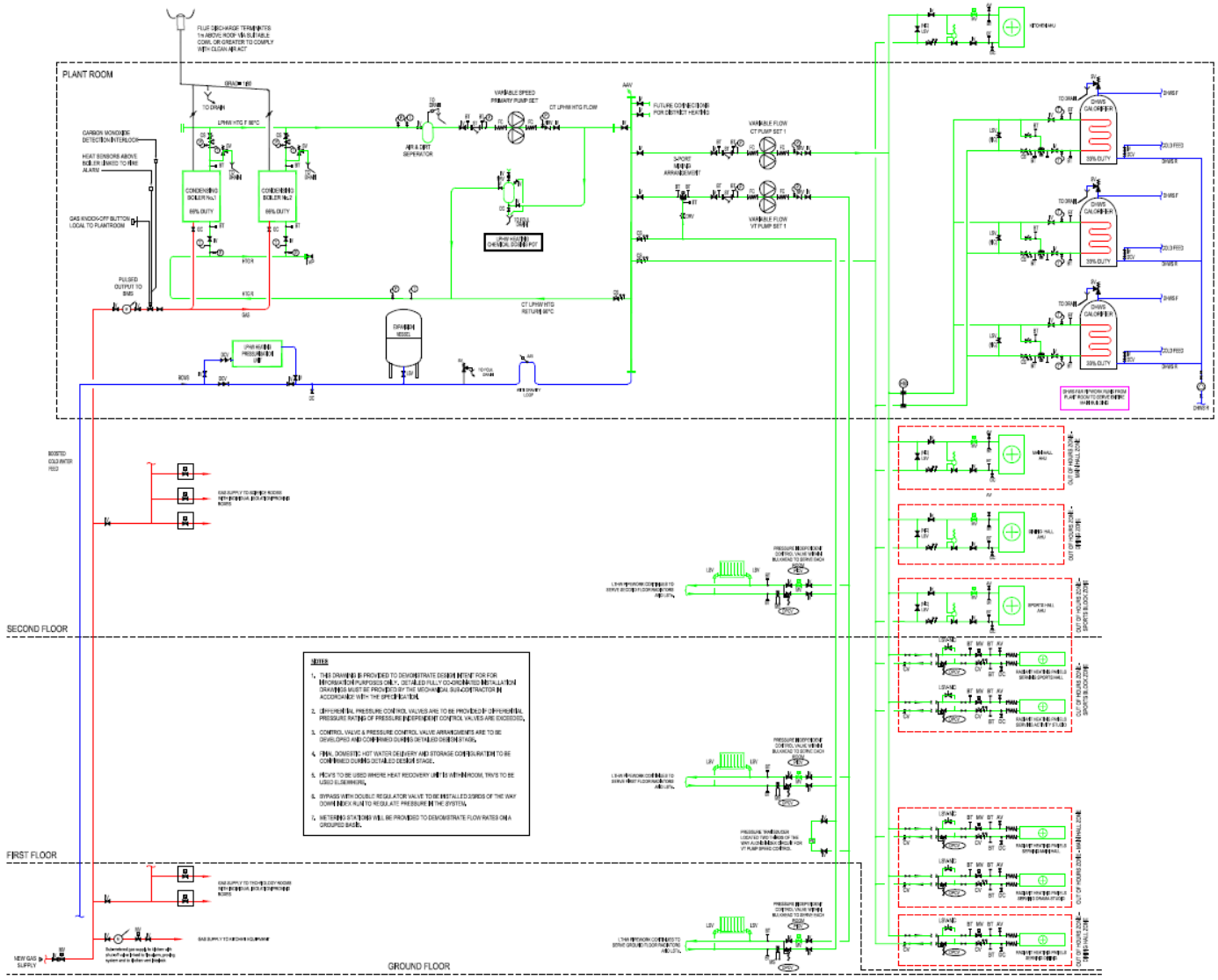


Figure 3.4 - Proposed Energy Centre Schematic – Turing House School

3.3.3 Site Wide Heat Network

The proposal for the Turing House School consists of a single super block building with a sports block attached to one side. Aligned with the Order of Preference of the London Plan, the proposal is to include a common heating system thus creating a site-wide heating network. The proposed external mechanical services are shown in Figure 3.5 below where the gas pipework connection is shown to enter at a single point to distribute to the central plantroom (where the centralised boiler plant is located at second floor level). Please refer to Appendix D1 and D2 for the Indicative Plant Room layouts.

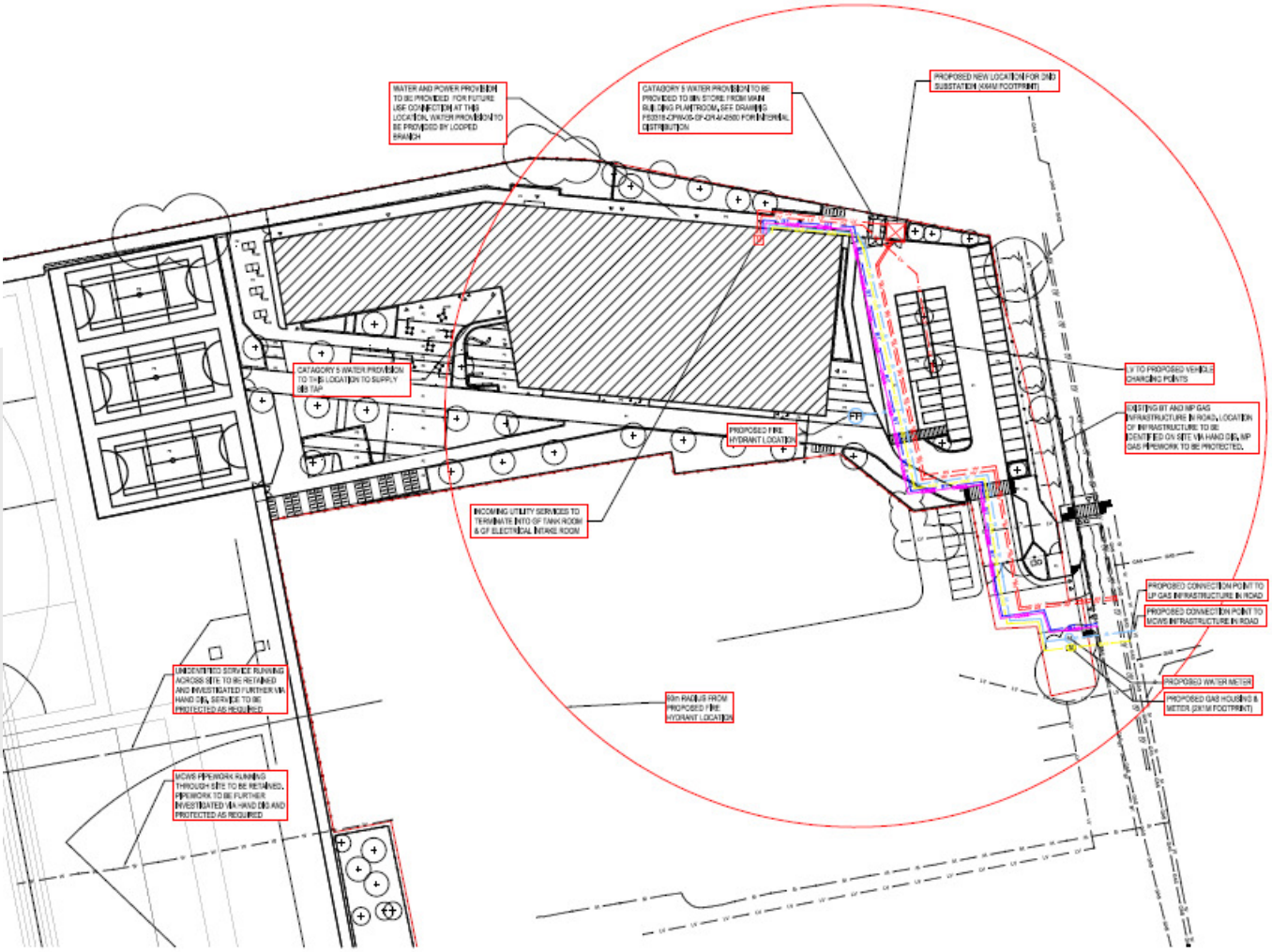


Figure 3.5 – External Services plan showing Site Wide Heat Network – Turing House School

The site wide heat network has the additional benefit of creating a single point of connection for any future connections to the existing heat network (as the single building on the site is served by a single system).

3.3.4 Onsite Combined Heat and Power (CHP) Feasibility

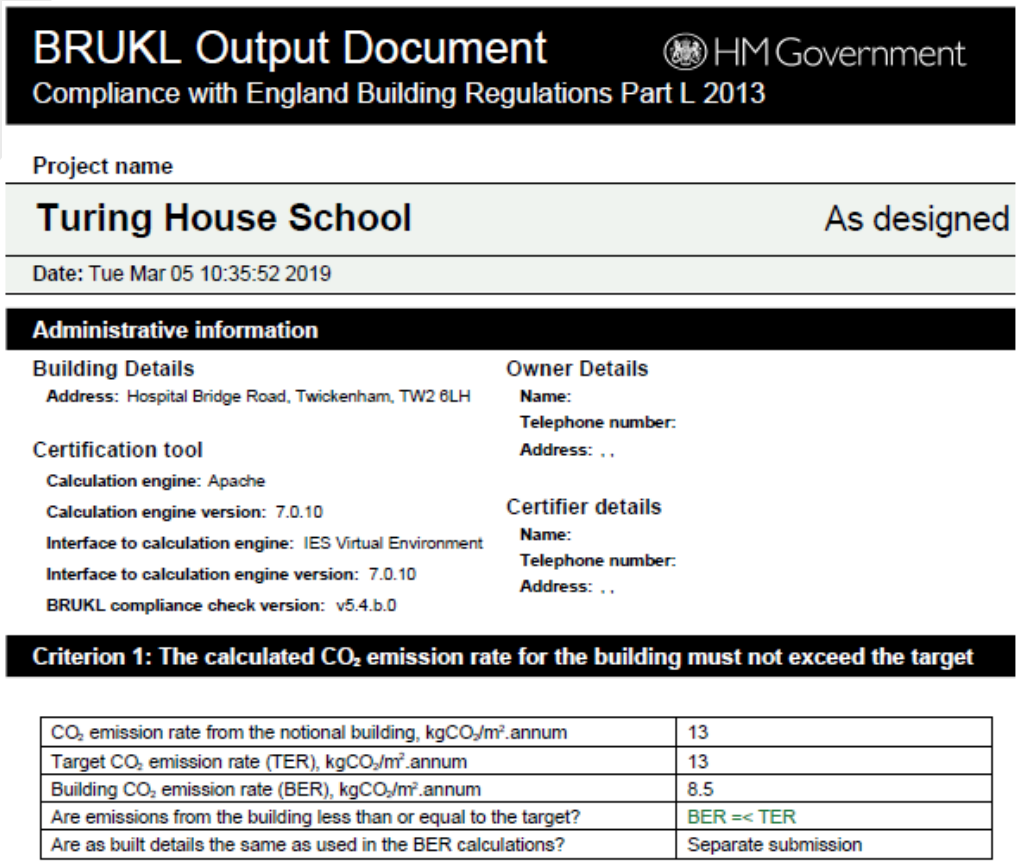
The proposed non-domestic Academic development will have a heat profile that will be significantly less than the 5,000 hours per annum stated as the threshold for consideration within the 'GLA guidance on preparing energy assessments' (clause 10.25). Therefore, onsite CHP is not considered viable in this case.

3.4 'Be Green' – Renewable Technology

3.4.1 Photovoltaic Panels (PV)

It is proposed to utilise Photovoltaic panels to further reduce the CO_2 emissions from the fabric first approach. After the 'Be Lean', measures, a 3.55 $kgCO_2/m^2$.annum reduction through photovoltaic panels is required to produce a 27.31 % "Be Green" reduction. Together with the 7.69 % reduction from the "Be Lean" measures provide a 35% decrease in CO_2 emissions against the Notional Building (Target Emissions Rate). **When the carbon reductions required has been calculated in relation to the 'Be Lean' measures along with the further carbon savings discussed in Appendix B1 the 35% total reduction in CO_2 emissions over the Notional building is surpassed and a 55.47% reduction is met.**

The image below shows the BRUKL output of the design stage Part L compliance model for the Turing House School development with a PV array that meets the carbon reduction target discussed above. The below image does not include the domestic hot water savings or active cooling displaced. The following BRUKL report shows a BER difference of 3.5 $kgCO_2/m^2$ in comparison to the 'Be Lean' BRUKL shown in Appendix A1. The full 'Be Green' BRUKL can be found in Appendix A2.



BRUKL Output Document — HM Government

Compliance with England Building Regulations Part L 2013

Project name

Turing House School — As designed

Date: Tue Mar 05 10:35:52 2019

Administrative information

Building Details

Address: Hospital Bridge Road, Twickenham, TW2 6LH

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.10

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.10

BRUKL compliance check version: v5.4.b.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	13
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	13
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	8.5
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

Figure 3.6 - BRUKL Report for Building Including PV and Excluding Other Carbon Reductions

Based on the required carbon offset from renewables to achieve the 35% reduction below the TER, an early stage quotation has been obtained to determine the required array size and to utilise the available roof space in the most cost-effective way possible to meet the 35% carbon reduction target. As described above, a 3.55kgCO_2/m^2.annum reduction is required, based on the 'Be Lean' BRUKL, which equates to a total annual required carbon offset of 29.72kgCO_2/annum from renewable technology. The early stage quotation attained provides the carbon offset required with an active PV area of 290m^2 and output of 55.05kWp.

The below image shows the indicative PV array layout on the usable portion of the upper roof that is angled towards the south orientation.

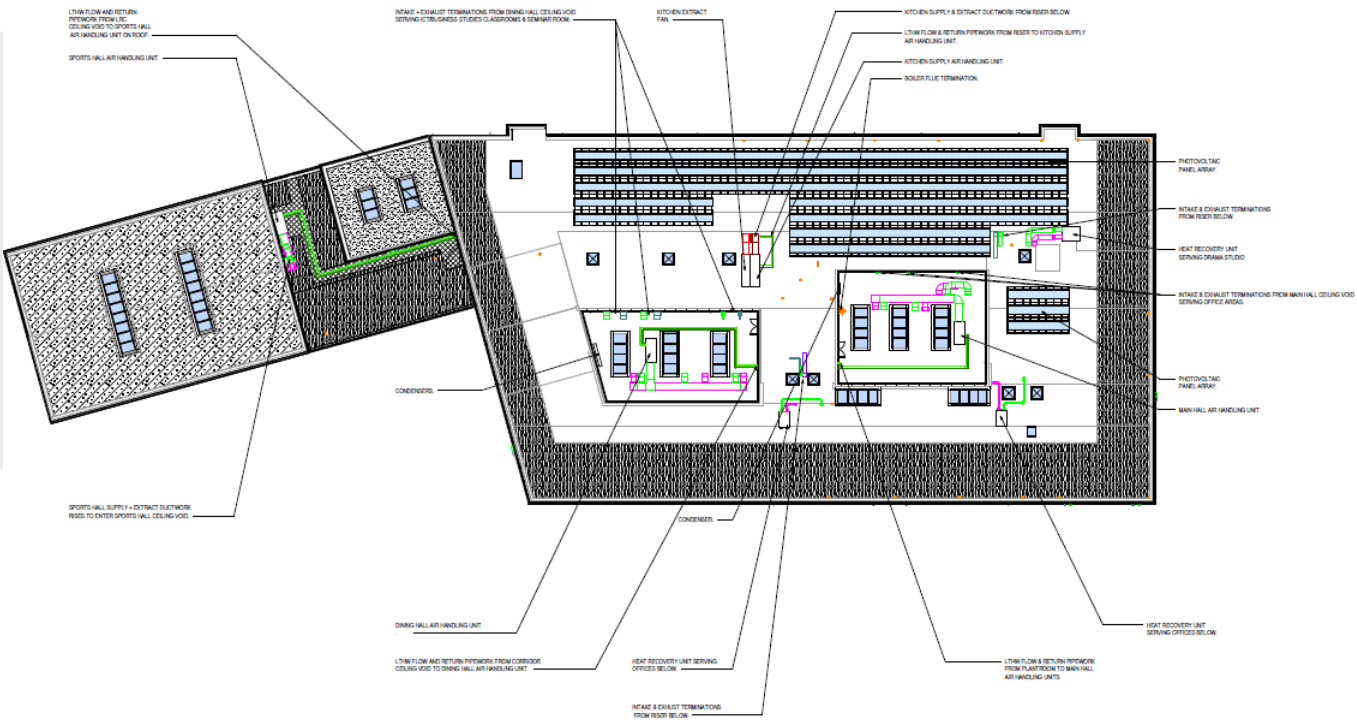


Figure 3.7 – Indicative Roof Layout including Roof Level plant and Photovoltaic Panel Arrays – Turing House School

3.5 Carbon Offsetting

In accordance with the London Plan 2018, a carbon offset fund is proposed to reduce the net carbon emission for the building to zero. As advised by the London Plan Energy Assessment Guide, the carbon factors to be utilised for calculation of the carbon offset fund shall be based on SAP10 and not SAP2012 as used in the previous calculation for the resultant carbon emissions in this document. Therefore, the carbon emissions shall be converted into SAP10 carbon emissions using the same BRUKLs as provided in Appendices A1 and A2 using the below carbon emission factors for electricity and gas:

SAP10 Gas carbon factor: 0.21 kgCO_2/kWh

SAP10 electric carbon factor: 0.233 kgCO_2/kWh

The below summary shows the corrected carbon emissions for the 'Be Lean' total annual emission as 'After energy demand reduction', the 'Be Clean' total annual emissions as 'After heat network / CHP' and 'Be Green' total annual emissions as 'After renewable energy'.

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	69.655	
After energy demand reduction	71.870	
After heat network / CHP	71.870	
After renewable energy	58.793	

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	-2.215	-3%
Savings from heat network / CHP	0.000	0%
Savings from renewable energy	13.077	19%
Total Cumulative Savings	**10.862**	**16%**

	Annual Zero carbon Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**69.655**	-
Shortfall	58.793	1,763.804
Cash in-lieu contribution (£)	**105,828.21**	-

Figure 3.8 – Corrected Carbon Emissions using SAP10 Carbon Factors for Carbon Offset Calculation – Turing House School

It should be noted that the above corrected results indicate that the building 'Be lean' (after energy demand reduction) emissions do not meet the baseline and also the 'Be Green' (savings from renewable energy) does not result in a 35% reduction before utilising cash in-lieu contribution to meet net-zero carbon emissions. Please note that the tables in the executive summary on page 4 clearly show the building meets the baseline figure using 'Be Lean' measures when calculating carbon emissions based on the current Building regulations carbon factors, and the same table also shows 35% carbon reduction is met when using the current Building regulations carbon factors and therefore these requirements are compliant.

The same 290m^2 area of Photovoltaic Panel array, as described in section 3.4 to comply with meeting a 35% reduction using current Building Regulation carbon factors, has been used in the calculation for calculating the required cash in-lieu contribution to result in net-zero carbon emissions which is understood to have been previously agreed for this site.

The final cash in-lieu payment to the carbon offset fund, based on a 30-year period and £60/tonne CO_2 is £105,828.21.

The below graph provides further indication of providing net-zero emissions based on SAP10 carbon emission rates.

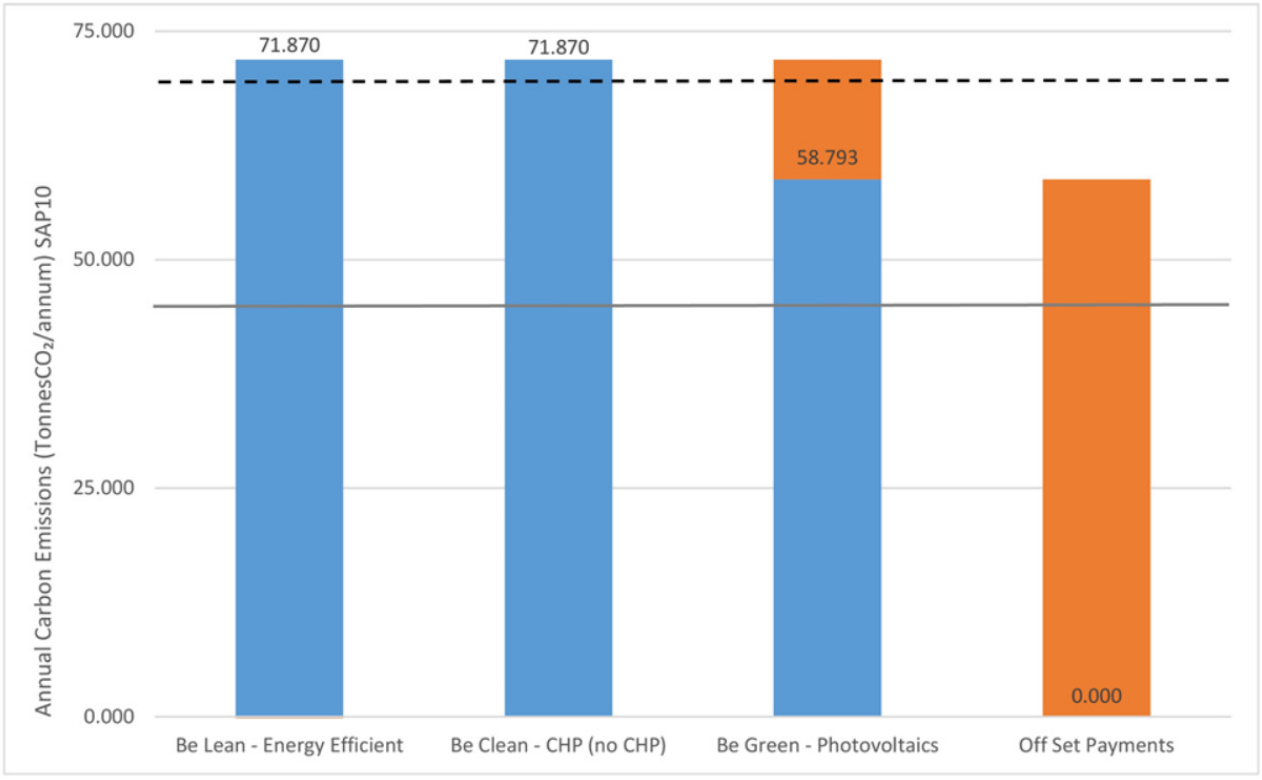


Figure 3.9 – Resultant Corrected Carbon Reduction showing Net-Zero Carbon Emissions Using SAP10 Carbon Emission Factors

The above results shown in Figures 3.8 and 3.9 have been developed using the GLA Carbon Emission Reporting Spreadsheet. The SAP 2012 and SAP10 carbon emission are provided in Appendix E and are based on the energy consumption by end use as reported in the BRUKLs provided in Appendices A1 and A2.

4.0 Conclusions

The project has been designed in line with the London Plan 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, rather than focussing on expensive 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 ESFA's new OS that provides a significantly better internal environment than previous education projects that complied with the Building Bulletins. 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 Turing House School to perform above the standards expected from a building that complies with the traditional Building Bulletins.

The fabric first design philosophy adopted helps to achieve a reduction of CO_2 emissions by 7.69 % as measured by the initial Part L assessment. This, together with the proposed PV provides a 35% reduction, with PVs providing a further 27.31 % reduction beyond the "Be Lean" measures.

Around 27% CO_2 reduction is achieved from the inclusion of onsite renewable technologies in the form of photovoltaic panels.

Energy Efficiency Measure	CO_2 Emission Savings	% CO_2 reduction for building
'Be Lean' - Fabric First Approach (BRUKL)	8.371 TonnesCO_2/year	7.69%
'Be Green' - Photovoltaic Panels	29.718 TonnesCO_2/year	27.31%
Initial Total CO_2 Emission Reduction	38.090 TonnesCO_2/year	**35%**

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 become available in the area. It also enables the school to incorporate an alternative heat generation fuel source in the future that will benefit the site.

The project avoids the need for active cooling systems favouring passive design solutions as described within section 2 of this report and Appendix B that meet the overheating requirements of TM52. By avoiding active cooling systems, the project's anticipated CO_2 emissions are reduced by a further 10.77 % 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 CO_2 emissions by 9.70 %. Including the further carbon saving measures, the proposed design features reduce the overall CO_2 emissions by approximately 55.47% when compared with the notional building from the Part L calculation, totalling a saving in excess of 60.3TonnesCO_2/annum Please refer to Appendix B for summarised tables and graphs showing the full extent of carbon savings for the building.

A cash in-lieu payment is proposed of £105,828.21, based on a 30-year period at £60/tonneCO_2, to the carbon offset fund as calculated in Section 3.5 using SAP10 carbon factors. This sum has been calculated based on the same quantity of Photovoltaic Panel array as calculated to provide a 35% reduction in comparison to the TER baseline using current Building Regulation carbon factors. It should be noted that a larger percentage of carbon emissions is proposed to be offset using cash in-lieu payment than the recommended 65% as is understood to have been agreed for this project.

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

Turing House School — As designed

Date: Wed Jan 30 12:19:47 2019

Administrative information

Building Details

Address: Hospital Bridge Road, Twickenham, TW2 6LH

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.10

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.10

BRUKL compliance check version: v5.4.b.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	13
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	13
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	12
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.21	0.26	FF000009:Surf[0]
Floor	0.25	0.21	0.21	GF000000:Surf[0]
Roof	0.25	0.16	0.16	FF000032:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.33	1.35	GF000006:Surf[1]
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

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = 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- Radiator Heating Hybrid Vent Offices (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.

2- 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.

3- 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.

4- 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.

5- Server Room Cooling

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	3.3	-	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.

6- Radiator Heating and DX cooling and Hybrid Vent Vent (local units)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	3.3	0	0	0.8
Standard value	0.91*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for 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.

7- Radiant 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	0.86	N/A	0.55	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

1- DHW (central gas fired)

	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	
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
GF:Conference	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:AWC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Interview	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Entrance	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:SEN/Therapy	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Med 1PO	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Staff WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:AWC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:CL St	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Cent Stock (office)	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Food Prep	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Med 2PO	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Multi Mat Prep	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Ext Practice	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:ICT/Business Studies	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Sml 1PO	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Seminar Room	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:2 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Server	-	-	0.5	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
FF:LRC 01	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Small Grp	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:AWC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:Cl St	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:CL St	0.5	-	-	-	-	-	-	-	-	-	N/A
SF:Med 1PO	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:SENco	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Med 1PO	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Staff WC	0.5	-	-	-	-	-	-	-	-	-	N/A
SF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:3 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Staff Change	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Hygiene	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:MEd 2PO	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Other Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Staff Change	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Music Practice 01	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Music Practice 02	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Music Practice 03	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Music Practice 04	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Music Practice 05	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:3-4 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Sixth Form Social	-	-	-	1.6	-	-	-	-	-	-	N/A
GF:Sixth Form Study Area	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:General Office	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Prep Man	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Indl WC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:LRC 02	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:ICT/Business Studies	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:2 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:ICT Tech	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Indl WC	0.5	-	-	-	-	-	-	-	-	-	N/A
SF:CL St	0.5	-	-	-	-	-	-	-	-	-	N/A
SF:AWC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
SF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
SF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Drama Studio	-	-	-	1.6	-	-	-	-	-	-	N/A
SF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Sports Hall	-	-	-	1.6	-	-	-	-	-	-	N/A
GF:Main Hall	-	-	-	1.6	-	-	-	-	-	-	N/A
SF:2 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Lrg Grp Rm	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:2 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Med 1PO	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Activity Studio	-	-	-	1.6	-	-	-	-	-	-	N/A
GF:Textiles	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Food Studio	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Electronics	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Graphics	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Resistant Material	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Music Classroom 02	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Music Classroom 01	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Classroom	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:General Art Room	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 07	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 08	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Heads Office	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:PA Office	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Meeting Room	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:LRC 03	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Classroom 11	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 10	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 13	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 12	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 14	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 15	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 17	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 18	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Classroom 16	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 01	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 02	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 03	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 04	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 05	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 06	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:General Art Room	-	-	-	1.2	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
SF:General Science Lab 06	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 07	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Staff Room	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:General Science Lab 08	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 01	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 02	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 14	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 09	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 01	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 02	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 03	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 04	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 05	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 05	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 06	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 07	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 08	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 13	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 11	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Science Prep	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Classroom 10	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 04	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 12	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Pupil Change Showers	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Pupil change	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Pupil Change Showers	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Pupil Change	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Seminar Room	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Dining	-	-	-	1.6	-	-	-	-	-	-	N/A
GF:Dining	-	-	-	1.6	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF:Conference	48	-	-	166
GF:AWC	-	202	-	21
GF:Interview	79	-	-	35
GF:LRC	56	-	-	71
GF:Circulation 08	-	126	-	77
GF:Cent Stock	90	-	-	36
GF:Circulation	-	103	-	104

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF:Entrance	71	-	-	51
GF:SEN/Therapy	60	-	-	78
GF:LRC	70	-	-	52
GF:Med 1PO	72	-	-	48
GF:DT St	110	-	-	30
GF:Dt St	110	-	-	30
GF:Circulation 07	-	99	-	130
GF:Plant	52	-	-	126
GF:Plant	71	-	-	57
GF:DT St	92	-	-	33
GF:Staff WC	-	201	-	20
GF:IT St	94	-	-	30
GF:Drama St	67	-	-	67
GF:App	86	-	-	41
GF:It St	88	-	-	34
GF:It St	92	-	-	30
GF:Cent Stock	85	-	-	36
GF:LRC	49	-	-	137
GF:Chair St	52	-	-	127
GF:DT St	88	-	-	39
GF:AWC	-	208	-	20
GF:CL St	120	-	-	5
GF:Exam St	115	-	-	24
GF:Cent Stock (office)	79	-	-	38
GF:Food Prep	66	-	-	53
GF:DT St	66	-	-	61
GF:Circulation 09	-	115	-	91
GF:Circulation 10	-	104	-	100
GF:Med 2PO	54	-	-	96
GF:Multi Mat Prep	47	-	-	180
GF:Music St	90	-	-	33
GF:Ext Practice	56	-	-	79
FF:Art St	86	-	-	34
FF:Circulation 07	-	99	-	130
FF:Kiln Room	98	-	-	27
FF:Art St	120	-	-	16
FF:Art St	120	-	-	16
FF:Circulation 8	-	99	-	132
FF:Circulation 05	-	99	-	133
FF:ICT/Business Studies	43	-	-	287
FF:Sml 1PO	68	-	-	48
FF:Art St	94	-	-	31
FF:Seminar Room	47	-	-	158

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
FF:SEN St	85	-	-	35
FF:2 Person Office	69	-	-	50
FF:Server	58	-	-	84
FF:LRC 01	49	-	-	135
FF:Small Grp	59	-	-	62
FF:AWC	-	220	-	18
FF:Cl St	120	-	-	7
FF:CL St	120	-	-	5
FF:Circulation 06	-	99	-	130
SF:Circulation 01	-	99	-	132
SF:Circulation 02	-	99	-	133
SF:Med 1PO	69	-	-	49
SF:SENco	63	-	-	60
SF:Med 1PO	69	-	-	49
SF:Exam St	74	-	-	50
SF:Chemical St	73	-	-	48
SF:Staff WC	-	220	-	18
SF:LRC	47	-	-	156
SF:Circulation	-	99	-	130
SF:Circulation 03	-	99	-	130
FF:IT St	92	-	-	31
FF:3 Person Office	60	-	-	75
GF:PE St	45	-	-	317
GF:PE St Act	70	-	-	75
GF:Hub	66	-	-	59
GF:Circulation 05	-	99	-	130
GF:Staff Change	-	162	-	29
GF:Ext PE St	71	-	-	50
GF:Circulation	-	106	-	93
GF:Hygiene	-	120	-	58
GF:MEd 2PO	69	-	-	47
GF:Other Pupil WC	-	241	-	15
GF:Staff Change	-	164	-	28
GF:Music Practice 01	70	-	-	41
GF:Music Practice 02	71	-	-	39
GF:Music St	90	-	-	34
GF:Music Practice 03	70	-	-	40
GF:Music Practice 04	72	-	-	37
GF:Music Practice 05	71	-	-	38
GF:Circulation 02	-	125	-	126
GF:3-4 Person Office	57	-	-	89
GF:Exam St	120	-	-	27
GF:Sixth Form Social	-	83	-	585

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF:Sixth Form Study Area	41	-	-	637
GF:Circulation	-	95	-	167
GF:General Office	44	-	-	336
GF:Prep Man	52	-	-	108
GF:Indl WC	-	203	-	23
FF:LRC 02	51	-	-	146
FF:Circulation 03	-	107	-	434
FF:ICT/Business Studies	43	-	-	300
FF:2 Person Office	72	-	-	57
FF:ICT Tech	59	-	-	87
FF:Indl WC	-	203	-	23
SF:CL St	120	-	-	18
SF:AWC	-	170	-	27
SF:Plant	45	-	-	276
SF:Circulation 05	-	105	-	501
SF:Circulation 02	-	107	-	409
SF:Circulation 03	-	114	-	185
FF:Circulation 01	-	112	-	309
GF:Pupil WC	-	107	-	87
GF:Pupil WC	-	123	-	72
GF:Pupil WC	-	123	-	73
GF:Pupil WC	-	123	-	68
GF:Circulation 03	-	108	-	420
GF:Pupil WC	-	123	-	72
GF:Circulation 04	-	99	-	556
FF:Pupil WC	-	123	-	72
FF:Pupil WC	-	123	-	72
FF:Pupil WC	-	123	-	73
FF:Pupil WC	-	123	-	72
SF:Pupil WC	-	123	-	72
SF:Circulation 01	-	111	-	483
SF:Pupil WC	-	123	-	72
GF:Circulation 06	-	103	-	116
GF:Kitchen	-	82	-	893
GF:Drama Studio	50	-	-	639
GF:Circulation 01	-	113	-	311
SF:LRC	49	-	-	135
GF:Sports Hall	-	84	-	3284
GF:Main Hall	45	-	-	1461
SF:2 Person Office	66	-	-	54
SF:Lrg Grp Rm	59	-	-	66
SF:2 Person Office	67	-	-	53
SF:Med 1PO	67	-	-	53

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
SF:Circulation 04	-	92	-	318
GF:Comm St	114	-	-	29
GF:Activity Studio	48	-	-	804
GF:Textiles	42	-	-	669
GF:Food Studio	41	-	-	811
GF:Electronics	42	-	-	660
GF:Graphics	42	-	-	658
GF:Resistant Material	41	-	-	764
GF:Music Classroom 02	43	-	-	295
GF:Music Classroom 01	43	-	-	288
GF:Classroom	43	-	-	255
FF:General Art Room	42	-	-	391
FF:Classroom 07	43	-	-	257
FF:Classroom 08	43	-	-	261
FF:Heads Office	56	-	-	83
FF:PA Office	74	-	-	41
FF:Meeting Room	54	-	-	94
FF:Circulation 04	-	93	-	569
FF:LRC 03	43	-	-	262
FF:Classroom 11	43	-	-	267
FF:Classroom 10	43	-	-	262
FF:Classroom 13	43	-	-	263
FF:Classroom 12	43	-	-	266
FF:Classroom 14	43	-	-	262
FF:Classroom 15	43	-	-	263
FF:Classroom 17	43	-	-	259
FF:Classroom 18	43	-	-	261
FF:Circulation	-	106	-	710
FF:LRC	48	-	-	141
FF:Classroom 16	43	-	-	255
FF:Classroom 01	43	-	-	256
FF:Classroom 02	43	-	-	257
FF:Classroom 03	43	-	-	258
FF:Classroom 04	43	-	-	257
FF:Classroom 05	43	-	-	257
FF:Classroom 06	43	-	-	258
FF:General Art Room	42	-	-	391
SF:General Science Lab 06	1	-	-	670
SF:General Science Lab 07	1	-	-	678
FF:Staff Room	43	-	-	318
SF:General Science Lab 08	1	-	-	665
SF:Classroom 01	43	-	-	266
SF:Classroom 02	43	-	-	262

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
SF:Classroom 14	43	-	-	263
SF:Classroom 09	43	-	-	261
SF:General Science Lab 01	1	-	-	654
SF:General Science Lab 02	1	-	-	653
SF:General Science Lab 03	1	-	-	680
SF:General Science Lab 04	1	-	-	662
SF:General Science Lab 05	1	-	-	655
SF:Classroom 05	43	-	-	259
SF:Classroom 06	43	-	-	266
SF:Classroom 07	43	-	-	256
SF:Classroom 08	43	-	-	255
SF:Classroom 13	47	-	-	259
SF:Classroom 11	43	-	-	261
SF:Science Prep	42	-	-	495
SF:Classroom 10	43	-	-	273
SF:Classroom 04	43	-	-	270
SF:Classroom 12	43	-	-	272
SF:LRC	51	-	-	132
SF:LRC	47	-	-	162
GF:Pupil Change Showers	-	152	-	37
GF:Pupil change	49	-	-	148
GF:Pupil Change Showers	-	107	-	101
GF:Pupil Change	50	-	-	237
SF:Seminar Room	47	-	-	167
GF:Dining	-	88	-	299
GF:Dining	-	88	-	1835

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF:Conference	NO (-19.7%)	NO
GF:Interview	NO (-47.9%)	NO
GF:LRC	N/A	N/A
GF:Entrance	N/A	N/A
GF:SEN/Therapy	N/A	N/A
GF:LRC	N/A	N/A
GF:Med 1PO	NO (-71.5%)	NO
GF:LRC	N/A	N/A
GF:Cent Stock (office)	N/A	N/A
GF:Food Prep	N/A	N/A
GF:Med 2PO	N/A	N/A
GF:Multi Mat Prep	N/A	N/A
GF:Ext Practice	N/A	N/A
FF:ICT/Business Studies	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
FF:Sml 1PO	N/A	N/A
FF:Seminar Room	N/A	N/A
FF:2 Person Office	N/A	N/A
FF:Server	N/A	N/A
FF:LRC 01	N/A	N/A
FF:Small Grp	N/A	N/A
SF:Med 1PO	NO (-22.5%)	NO
SF:SENco	NO (-36.2%)	NO
SF:Med 1PO	NO (-22.8%)	NO
SF:LRC	NO (-19.6%)	NO
FF:3 Person Office	N/A	N/A
GF:MEd 2PO	N/A	N/A
GF:Music Practice 01	N/A	N/A
GF:Music Practice 02	N/A	N/A
GF:Music Practice 03	N/A	N/A
GF:Music Practice 04	N/A	N/A
GF:Music Practice 05	N/A	N/A
GF:3-4 Person Office	N/A	N/A
GF:Sixth Form Social	NO (-9.1%)	NO
GF:Sixth Form Study Area	NO (-11.1%)	NO
GF:General Office	NO (-75.2%)	NO
GF:Prep Man	N/A	N/A
FF:LRC 02	NO (-51.3%)	NO
FF:ICT/Business Studies	N/A	N/A
FF:2 Person Office	N/A	N/A
FF:ICT Tech	N/A	N/A
GF:Drama Studio	N/A	N/A
SF:LRC	NO (-50.3%)	NO
GF:Sports Hall	NO (-73.7%)	NO
GF:Main Hall	NO (-28.7%)	NO
SF:2 Person Office	NO (-66.1%)	NO
SF:Lrg Grp Rm	NO (-79%)	NO
SF:2 Person Office	NO (-79%)	NO
SF:Med 1PO	NO (-64.7%)	NO
GF:Activity Studio	NO (-71.2%)	NO
GF:Textiles	NO (-37.3%)	NO
GF:Food Studio	NO (-48.3%)	NO
GF:Electronics	NO (-29.3%)	NO
GF:Graphics	NO (-31.4%)	NO
GF:Resistant Material	NO (-24.8%)	NO
GF:Music Classroom 02	NO (-11.6%)	NO
GF:Music Classroom 01	NO (-32.7%)	NO
GF:Classroom	NO (-34%)	NO
FF:General Art Room	NO (-37.8%)	NO
FF:Classroom 07	NO (-22.2%)	NO
FF:Classroom 08	NO (-23.3%)	NO
FF:Heads Office	NO (-58.5%)	NO
FF:PA Office	NO (-16.9%)	NO
FF:Meeting Room	NO (-56%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
FF:LRC 03	NO (-23.7%)	NO
FF:Classroom 11	NO (-32.6%)	NO
FF:Classroom 10	NO (-31.4%)	NO
FF:Classroom 13	NO (-31.7%)	NO
FF:Classroom 12	NO (-32.2%)	NO
FF:Classroom 14	NO (-31.4%)	NO
FF:Classroom 15	NO (-31.6%)	NO
FF:Classroom 17	NO (-27%)	NO
FF:Classroom 18	NO (-27.3%)	NO
FF:LRC	NO (-25%)	NO
FF:Classroom 16	NO (-34%)	NO
FF:Classroom 01	NO (-24.3%)	NO
FF:Classroom 02	NO (-24.6%)	NO
FF:Classroom 03	NO (-24.8%)	NO
FF:Classroom 04	NO (-24.5%)	NO
FF:Classroom 05	NO (-24.7%)	NO
FF:Classroom 06	NO (-24.7%)	NO
FF:General Art Room	NO (-36.1%)	NO
SF:General Science Lab 06	NO (-53.4%)	NO
SF:General Science Lab 07	NO (-38.2%)	NO
FF:Staff Room	NO (-56.8%)	NO
SF:General Science Lab 08	NO (-36.9%)	NO
SF:Classroom 01	NO (-32.2%)	NO
SF:Classroom 02	NO (-31.4%)	NO
SF:Classroom 14	NO (-31.6%)	NO
SF:Classroom 09	NO (-54.7%)	NO
SF:General Science Lab 01	NO (-35.1%)	NO
SF:General Science Lab 02	NO (-59%)	NO
SF:General Science Lab 03	NO (-33.5%)	NO
SF:General Science Lab 04	NO (-31.7%)	NO
SF:General Science Lab 05	NO (-31%)	NO
SF:Classroom 05	NO (-25.2%)	NO
SF:Classroom 06	NO (-27.2%)	NO
SF:Classroom 07	NO (-24.3%)	NO
SF:Classroom 08	NO (-67%)	NO
SF:Classroom 13	NO (-77.1%)	NO
SF:Classroom 11	NO (-27.3%)	NO
SF:Science Prep	NO (-9.2%)	NO
SF:Classroom 10	NO (-21.3%)	NO
SF:Classroom 04	NO (-17%)	NO
SF:Classroom 12	NO (-1.4%)	NO
SF:LRC	NO (-65.2%)	NO
SF:LRC	NO (-38.1%)	NO
SF:Seminar Room	NO (-9.9%)	NO
GF:Dining	NO (-0.9%)	NO
GF:Dining	NO (-55.5%)	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?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	8339.2	8339.2
External area [m²]	11186.9	11186.9
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	3526.91	4027.32
Average U-value [W/m²K]	0.32	0.36
Alpha value* [%]	10.12	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential 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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	6.04	6.84
Cooling	0.02	0.01
Auxiliary	4.8	3.23
Lighting	6.67	12.84
Hot water	22.57	15.54
Equipment*	19.54	19.54
TOTAL**	40.11	38.46

* 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 & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	19.32	21.36
Primary energy* [kWh/m²]	69.3	75.44
Total emissions [kg/m²]	12	13

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	14.2	0	4.4	0	6.1	0.9	0	0.96	0
	Notional	0	0	0	0	0	0	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	6.4	0	2	0	13.9	0.9	0	0.96	0
	Notional	15.2	0	4.9	0	4.4	0.86	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	23.3	147.3	7.2	16.6	2.1	0.9	2.47	0.96	3.3
	Notional	4.6	0	1.5	0	10.7	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	21	0	6.5	0	1.8	0.9	0	0.96	0
	Notional	20.8	92.1	6.7	6.8	1.3	0.86	3.79	----	----
[ST] Single room cooling system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	0	0	0	0	0	3.43	2.47	3.5	3.3
	Notional	22.2	0	7.1	0	1.1	0.86	0	----	----
[ST] Flued radiant heater, [HS] Unitary radiant heater, [HFT] Natural Gas, [CFT] Electricity										
	Actual	27.3	0	9.4	0	3.5	0.81	0	0.96	0
	Notional	0	0	0	0	0	2.56	3.79	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	29.5	0	9.1	0	5.1	0.9	0	0.96	0
	Notional	36.5	0	11.8	0	2	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	29.7	0	9.6	0	3.2	0.86	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{l\text{-}Typ}$	$U_{l\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.21	GF000000:Surf[11]
Floor	0.2	0.21	GF000000:Surf[0]
Roof	0.15	0.16	FF000043:Surf[0]
Windows, roof windows, and rooflights	1.5	1.2	GF00003E:Surf[17]
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

$U_{l\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{l\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

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

APPENDIX A2 - 'BE GREEN' BRUKL CALCULATION

The image below shows the output from the design stage Part L assessment with enough photovoltaic panels to meet the carbon saving required to meet the London Plan 35% reduction below the TER: -

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Turing House School — As designed

Date: Tue Mar 05 10:35:52 2019

Administrative information

Building Details

Address: Hospital Bridge Road, Twickenham, TW2 6LH

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.10

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.10

BRUKL compliance check version: v5.4.b.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	13
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	13
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	8.5
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	$U_{s\text{-}Limit}$	$U_{s\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.21	0.26	FF000009:Surf[0]
Floor	0.25	0.21	0.21	GF000000:Surf[0]
Roof	0.25	0.16	0.16	FF000032:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.33	1.35	GF000006:Surf[1]
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

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

* 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- Radiator Heating Hybrid Vent Offices (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.

2- 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.

3- 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.

4- 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.

5- Server Room Cooling

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	3.3	-	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.

6- Radiator Heating and DX cooling and Hybrid Vent Vent (local units)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	3.3	0	0	0.8
Standard value	0.91*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for 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.

7- Radiant 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	0.86	N/A	0.55	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

1- DHW (central gas fired)

	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	
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
GF:Conference	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:AWC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Interview	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Entrance	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:SEN/Therapy	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Med 1PO	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Staff WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:AWC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:CL St	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Cent Stock (office)	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Food Prep	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Med 2PO	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Multi Mat Prep	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Ext Practice	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:ICT/Business Studies	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Sml 1PO	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Seminar Room	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:2 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Server	-	-	0.5	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
FF:LRC 01	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Small Grp	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:AWC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:Cl St	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:CL St	0.5	-	-	-	-	-	-	-	-	-	N/A
SF:Med 1PO	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:SENco	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Med 1PO	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Staff WC	0.5	-	-	-	-	-	-	-	-	-	N/A
SF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:3 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Staff Change	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Hygiene	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:MEd 2PO	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Other Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Staff Change	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Music Practice 01	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Music Practice 02	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Music Practice 03	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Music Practice 04	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Music Practice 05	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:3-4 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Sixth Form Social	-	-	-	1.6	-	-	-	-	-	-	N/A
GF:Sixth Form Study Area	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:General Office	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Prep Man	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Indl WC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:LRC 02	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:ICT/Business Studies	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:2 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:ICT Tech	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Indl WC	0.5	-	-	-	-	-	-	-	-	-	N/A
SF:CL St	0.5	-	-	-	-	-	-	-	-	-	N/A
SF:AWC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
FF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
SF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
SF:Pupil WC	0.5	-	-	-	-	-	-	-	-	-	N/A
GF:Drama Studio	-	-	-	1.6	-	-	-	-	-	-	N/A
SF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Sports Hall	-	-	-	1.6	-	-	-	-	-	-	N/A
GF:Main Hall	-	-	-	1.6	-	-	-	-	-	-	N/A
SF:2 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Lrg Grp Rm	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:2 Person Office	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Med 1PO	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Activity Studio	-	-	-	1.6	-	-	-	-	-	-	N/A
GF:Textiles	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Food Studio	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Electronics	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Graphics	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Resistant Material	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Music Classroom 02	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Music Classroom 01	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Classroom	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:General Art Room	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 07	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 08	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Heads Office	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:PA Office	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Meeting Room	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:LRC 03	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Classroom 11	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 10	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 13	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 12	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 14	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 15	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 17	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 18	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
FF:Classroom 16	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 01	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 02	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 03	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 04	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 05	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Classroom 06	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:General Art Room	-	-	-	1.2	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
SF:General Science Lab 06	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 07	-	-	-	1.2	-	-	-	-	-	-	N/A
FF:Staff Room	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:General Science Lab 08	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 01	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 02	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 14	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 09	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 01	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 02	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 03	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 04	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:General Science Lab 05	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 05	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 06	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 07	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 08	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 13	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 11	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Science Prep	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Classroom 10	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 04	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:Classroom 12	-	-	-	1.2	-	-	-	-	-	-	N/A
SF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:LRC	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Pupil Change Showers	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Pupil change	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Pupil Change Showers	-	-	-	1.4	-	-	-	-	-	-	N/A
GF:Pupil Change	-	-	-	1.4	-	-	-	-	-	-	N/A
SF:Seminar Room	-	-	-	1.2	-	-	-	-	-	-	N/A
GF:Dining	-	-	-	1.6	-	-	-	-	-	-	N/A
GF:Dining	-	-	-	1.6	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF:Conference	48	-	-	166
GF:AWC	-	202	-	21
GF:Interview	79	-	-	35
GF:LRC	56	-	-	71
GF:Circulation 08	-	126	-	77
GF:Cent Stock	90	-	-	36
GF:Circulation	-	103	-	104

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF:Entrance	71	-	-	51
GF:SEN/Therapy	60	-	-	78
GF:LRC	70	-	-	52
GF:Med 1PO	72	-	-	48
GF:DT St	110	-	-	30
GF:Dt St	110	-	-	30
GF:Circulation 07	-	99	-	130
GF:Plant	52	-	-	126
GF:Plant	71	-	-	57
GF:DT St	92	-	-	33
GF:Staff WC	-	201	-	20
GF:IT St	94	-	-	30
GF:Drama St	67	-	-	67
GF:App	86	-	-	41
GF:It St	88	-	-	34
GF:It St	92	-	-	30
GF:Cent Stock	85	-	-	36
GF:LRC	49	-	-	137
GF:Chair St	52	-	-	127
GF:DT St	88	-	-	39
GF:AWC	-	208	-	20
GF:CL St	120	-	-	5
GF:Exam St	115	-	-	24
GF:Cent Stock (office)	79	-	-	38
GF:Food Prep	66	-	-	53
GF:DT St	66	-	-	61
GF:Circulation 09	-	115	-	91
GF:Circulation 10	-	104	-	100
GF:Med 2PO	54	-	-	96
GF:Multi Mat Prep	47	-	-	180
GF:Music St	90	-	-	33
GF:Ext Practice	56	-	-	79
FF:Art St	86	-	-	34
FF:Circulation 07	-	99	-	130
FF:Kiln Room	98	-	-	27
FF:Art St	120	-	-	16
FF:Art St	120	-	-	16
FF:Circulation 8	-	99	-	132
FF:Circulation 05	-	99	-	133
FF:ICT/Business Studies	43	-	-	287
FF:Sml 1PO	68	-	-	48
FF:Art St	94	-	-	31
FF:Seminar Room	47	-	-	158

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
FF:SEN St	85	-	-	35
FF:2 Person Office	69	-	-	50
FF:Server	58	-	-	84
FF:LRC 01	49	-	-	135
FF:Small Grp	59	-	-	62
FF:AWC	-	220	-	18
FF:Cl St	120	-	-	7
FF:CL St	120	-	-	5
FF:Circulation 06	-	99	-	130
SF:Circulation 01	-	99	-	132
SF:Circulation 02	-	99	-	133
SF:Med 1PO	69	-	-	49
SF:SENco	63	-	-	60
SF:Med 1PO	69	-	-	49
SF:Exam St	74	-	-	50
SF:Chemical St	73	-	-	48
SF:Staff WC	-	220	-	18
SF:LRC	47	-	-	156
SF:Circulation	-	99	-	130
SF:Circulation 03	-	99	-	130
FF:IT St	92	-	-	31
FF:3 Person Office	60	-	-	75
GF:PE St	45	-	-	317
GF:PE St Act	70	-	-	75
GF:Hub	66	-	-	59
GF:Circulation 05	-	99	-	130
GF:Staff Change	-	162	-	29
GF:Ext PE St	71	-	-	50
GF:Circulation	-	106	-	93
GF:Hygiene	-	120	-	58
GF:MEd 2PO	69	-	-	47
GF:Other Pupil WC	-	241	-	15
GF:Staff Change	-	164	-	28
GF:Music Practice 01	70	-	-	41
GF:Music Practice 02	71	-	-	39
GF:Music St	90	-	-	34
GF:Music Practice 03	70	-	-	40
GF:Music Practice 04	72	-	-	37
GF:Music Practice 05	71	-	-	38
GF:Circulation 02	-	125	-	126
GF:3-4 Person Office	57	-	-	89
GF:Exam St	120	-	-	27
GF:Sixth Form Social	-	83	-	585

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF:Sixth Form Study Area	41	-	-	637
GF:Circulation	-	95	-	167
GF:General Office	44	-	-	336
GF:Prep Man	52	-	-	108
GF:Indl WC	-	203	-	23
FF:LRC 02	51	-	-	146
FF:Circulation 03	-	107	-	434
FF:ICT/Business Studies	43	-	-	300
FF:2 Person Office	72	-	-	57
FF:ICT Tech	59	-	-	87
FF:Indl WC	-	203	-	23
SF:CL St	120	-	-	18
SF:AWC	-	170	-	27
SF:Plant	45	-	-	276
SF:Circulation 05	-	105	-	501
SF:Circulation 02	-	107	-	409
SF:Circulation 03	-	114	-	185
FF:Circulation 01	-	112	-	309
GF:Pupil WC	-	107	-	87
GF:Pupil WC	-	123	-	72
GF:Pupil WC	-	123	-	73
GF:Pupil WC	-	123	-	68
GF:Circulation 03	-	108	-	420
GF:Pupil WC	-	123	-	72
GF:Circulation 04	-	99	-	556
FF:Pupil WC	-	123	-	72
FF:Pupil WC	-	123	-	72
FF:Pupil WC	-	123	-	73
FF:Pupil WC	-	123	-	72
SF:Pupil WC	-	123	-	72
SF:Circulation 01	-	111	-	483
SF:Pupil WC	-	123	-	72
GF:Circulation 06	-	103	-	116
GF:Kitchen	-	82	-	893
GF:Drama Studio	50	-	-	639
GF:Circulation 01	-	113	-	311
SF:LRC	49	-	-	135
GF:Sports Hall	-	84	-	3284
GF:Main Hall	45	-	-	1461
SF:2 Person Office	66	-	-	54
SF:Lrg Grp Rm	59	-	-	66
SF:2 Person Office	67	-	-	53
SF:Med 1PO	67	-	-	53

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
SF:Circulation 04	-	92	-	318
GF:Comm St	114	-	-	29
GF:Activity Studio	48	-	-	804
GF:Textiles	42	-	-	669
GF:Food Studio	41	-	-	811
GF:Electronics	42	-	-	660
GF:Graphics	42	-	-	658
GF:Resistant Material	41	-	-	764
GF:Music Classroom 02	43	-	-	295
GF:Music Classroom 01	43	-	-	288
GF:Classroom	43	-	-	255
FF:General Art Room	42	-	-	391
FF:Classroom 07	43	-	-	257
FF:Classroom 08	43	-	-	261
FF:Heads Office	56	-	-	83
FF:PA Office	74	-	-	41
FF:Meeting Room	54	-	-	94
FF:Circulation 04	-	93	-	569
FF:LRC 03	43	-	-	262
FF:Classroom 11	43	-	-	267
FF:Classroom 10	43	-	-	262
FF:Classroom 13	43	-	-	263
FF:Classroom 12	43	-	-	266
FF:Classroom 14	43	-	-	262
FF:Classroom 15	43	-	-	263
FF:Classroom 17	43	-	-	259
FF:Classroom 18	43	-	-	261
FF:Circulation	-	106	-	710
FF:LRC	48	-	-	141
FF:Classroom 16	43	-	-	255
FF:Classroom 01	43	-	-	256
FF:Classroom 02	43	-	-	257
FF:Classroom 03	43	-	-	258
FF:Classroom 04	43	-	-	257
FF:Classroom 05	43	-	-	257
FF:Classroom 06	43	-	-	258
FF:General Art Room	42	-	-	391
SF:General Science Lab 06	1	-	-	670
SF:General Science Lab 07	1	-	-	678
FF:Staff Room	43	-	-	318
SF:General Science Lab 08	1	-	-	665
SF:Classroom 01	43	-	-	266
SF:Classroom 02	43	-	-	262

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
SF:Classroom 14	43	-	-	263
SF:Classroom 09	43	-	-	261
SF:General Science Lab 01	1	-	-	654
SF:General Science Lab 02	1	-	-	653
SF:General Science Lab 03	1	-	-	680
SF:General Science Lab 04	1	-	-	662
SF:General Science Lab 05	1	-	-	655
SF:Classroom 05	43	-	-	259
SF:Classroom 06	43	-	-	266
SF:Classroom 07	43	-	-	256
SF:Classroom 08	43	-	-	255
SF:Classroom 13	47	-	-	259
SF:Classroom 11	43	-	-	261
SF:Science Prep	42	-	-	495
SF:Classroom 10	43	-	-	273
SF:Classroom 04	43	-	-	270
SF:Classroom 12	43	-	-	272
SF:LRC	51	-	-	132
SF:LRC	47	-	-	162
GF:Pupil Change Showers	-	152	-	37
GF:Pupil change	49	-	-	148
GF:Pupil Change Showers	-	107	-	101
GF:Pupil Change	50	-	-	237
SF:Seminar Room	47	-	-	167
GF:Dining	-	88	-	299
GF:Dining	-	88	-	1835

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF:Conference	NO (-19.7%)	NO
GF:Interview	NO (-47.9%)	NO
GF:LRC	N/A	N/A
GF:Entrance	N/A	N/A
GF:SEN/Therapy	N/A	N/A
GF:LRC	N/A	N/A
GF:Med 1PO	NO (-71.5%)	NO
GF:LRC	N/A	N/A
GF:Cent Stock (office)	N/A	N/A
GF:Food Prep	N/A	N/A
GF:Med 2PO	N/A	N/A
GF:Multi Mat Prep	N/A	N/A
GF:Ext Practice	N/A	N/A
FF:ICT/Business Studies	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
FF:Sml 1PO	N/A	N/A
FF:Seminar Room	N/A	N/A
FF:2 Person Office	N/A	N/A
FF:Server	N/A	N/A
FF:LRC 01	N/A	N/A
FF:Small Grp	N/A	N/A
SF:Med 1PO	NO (-22.5%)	NO
SF:SENco	NO (-36.2%)	NO
SF:Med 1PO	NO (-22.8%)	NO
SF:LRC	NO (-19.6%)	NO
FF:3 Person Office	N/A	N/A
GF:MEd 2PO	N/A	N/A
GF:Music Practice 01	N/A	N/A
GF:Music Practice 02	N/A	N/A
GF:Music Practice 03	N/A	N/A
GF:Music Practice 04	N/A	N/A
GF:Music Practice 05	N/A	N/A
GF:3-4 Person Office	N/A	N/A
GF:Sixth Form Social	NO (-9.1%)	NO
GF:Sixth Form Study Area	NO (-11.1%)	NO
GF:General Office	NO (-75.2%)	NO
GF:Prep Man	N/A	N/A
FF:LRC 02	NO (-51.3%)	NO
FF:ICT/Business Studies	N/A	N/A
FF:2 Person Office	N/A	N/A
FF:ICT Tech	N/A	N/A
GF:Drama Studio	N/A	N/A
SF:LRC	NO (-50.3%)	NO
GF:Sports Hall	NO (-73.7%)	NO
GF:Main Hall	NO (-28.7%)	NO
SF:2 Person Office	NO (-66.1%)	NO
SF:Lrg Grp Rm	NO (-79%)	NO
SF:2 Person Office	NO (-79%)	NO
SF:Med 1PO	NO (-64.7%)	NO
GF:Activity Studio	NO (-71.2%)	NO
GF:Textiles	NO (-37.3%)	NO
GF:Food Studio	NO (-48.3%)	NO
GF:Electronics	NO (-29.3%)	NO
GF:Graphics	NO (-31.4%)	NO
GF:Resistant Material	NO (-24.8%)	NO
GF:Music Classroom 02	NO (-11.6%)	NO
GF:Music Classroom 01	NO (-32.7%)	NO
GF:Classroom	NO (-34%)	NO
FF:General Art Room	NO (-37.8%)	NO
FF:Classroom 07	NO (-22.2%)	NO
FF:Classroom 08	NO (-23.3%)	NO
FF:Heads Office	NO (-58.5%)	NO
FF:PA Office	NO (-16.9%)	NO
FF:Meeting Room	NO (-56%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
FF:LRC 03	NO (-23.7%)	NO
FF:Classroom 11	NO (-32.6%)	NO
FF:Classroom 10	NO (-31.4%)	NO
FF:Classroom 13	NO (-31.7%)	NO
FF:Classroom 12	NO (-32.2%)	NO
FF:Classroom 14	NO (-31.4%)	NO
FF:Classroom 15	NO (-31.6%)	NO
FF:Classroom 17	NO (-27%)	NO
FF:Classroom 18	NO (-27.3%)	NO
FF:LRC	NO (-25%)	NO
FF:Classroom 16	NO (-34%)	NO
FF:Classroom 01	NO (-24.3%)	NO
FF:Classroom 02	NO (-24.6%)	NO
FF:Classroom 03	NO (-24.8%)	NO
FF:Classroom 04	NO (-24.5%)	NO
FF:Classroom 05	NO (-24.7%)	NO
FF:Classroom 06	NO (-24.7%)	NO
FF:General Art Room	NO (-36.1%)	NO
SF:General Science Lab 06	NO (-53.4%)	NO
SF:General Science Lab 07	NO (-38.2%)	NO
FF:Staff Room	NO (-56.8%)	NO
SF:General Science Lab 08	NO (-36.9%)	NO
SF:Classroom 01	NO (-32.2%)	NO
SF:Classroom 02	NO (-31.4%)	NO
SF:Classroom 14	NO (-31.6%)	NO
SF:Classroom 09	NO (-54.7%)	NO
SF:General Science Lab 01	NO (-35.1%)	NO
SF:General Science Lab 02	NO (-59%)	NO
SF:General Science Lab 03	NO (-33.5%)	NO
SF:General Science Lab 04	NO (-31.7%)	NO
SF:General Science Lab 05	NO (-31%)	NO
SF:Classroom 05	NO (-25.2%)	NO
SF:Classroom 06	NO (-27.2%)	NO
SF:Classroom 07	NO (-24.3%)	NO
SF:Classroom 08	NO (-67%)	NO
SF:Classroom 13	NO (-77.1%)	NO
SF:Classroom 11	NO (-27.3%)	NO
SF:Science Prep	NO (-9.2%)	NO
SF:Classroom 10	NO (-21.3%)	NO
SF:Classroom 04	NO (-17%)	NO
SF:Classroom 12	NO (-1.4%)	NO
SF:LRC	NO (-65.2%)	NO
SF:LRC	NO (-38.1%)	NO
SF:Seminar Room	NO (-9.9%)	NO
GF:Dining	NO (-0.9%)	NO
GF:Dining	NO (-55.5%)	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?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	8339.2	8339.2
External area [m²]	11186.9	11186.9
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	3526.91	4027.32
Average U-value [W/m²K]	0.32	0.36
Alpha value* [%]	10.12	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential 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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	6.04	6.84
Cooling	0.02	0.01
Auxiliary	4.8	3.23
Lighting	6.67	12.84
Hot water	22.57	15.54
Equipment*	19.54	19.54
TOTAL**	40.11	38.46

* 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	6.73	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	19.32	21.36
Primary energy* [kWh/m²]	69.3	75.44
Total emissions [kg/m²]	8.5	13

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	14.2	0	4.4	0	6.1	0.9	0	0.96	0
	Notional	0	0	0	0	0	0	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	6.4	0	2	0	13.9	0.9	0	0.96	0
	Notional	15.2	0	4.9	0	4.4	0.86	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	23.3	147.3	7.2	16.6	2.1	0.9	2.47	0.96	3.3
	Notional	4.6	0	1.5	0	10.7	0.86	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	21	0	6.5	0	1.8	0.9	0	0.96	0
	Notional	20.8	92.1	6.7	6.8	1.3	0.86	3.79	----	----
[ST] Single room cooling system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	0	0	0	0	0	3.43	2.47	3.5	3.3
	Notional	22.2	0	7.1	0	1.1	0.86	0	----	----
[ST] Flued radiant heater, [HS] Unitary radiant heater, [HFT] Natural Gas, [CFT] Electricity										
	Actual	27.3	0	9.4	0	3.5	0.81	0	0.96	0
	Notional	0	0	0	0	0	2.56	3.79	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	29.5	0	9.1	0	5.1	0.9	0	0.96	0
	Notional	36.5	0	11.8	0	2	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	29.7	0	9.6	0	3.2	0.86	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	$U_{l\text{-}Typ}$	$U_{l\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.21	GF000000:Surf[11]
Floor	0.2	0.21	GF000000:Surf[0]
Roof	0.15	0.16	FF000043:Surf[0]
Windows, roof windows, and rooflights	1.5	1.2	GF00003E:Surf[17]
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

$U_{l\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{l\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

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

APPENDIX 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 CO_2 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 TM52 in all occupied spaces is testament to the passive design strategy that has been adopted and gives a significantly better performance then would be required to satisfy Building Bulletin 101 – Ventilation for School Buildings.

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 Target Emission Rate 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 CO_2 emissions of the TER is 11.720 TonnesCO_2/yr. When measured per unit of floor area, this equates to 1.4 kgCO_2/m^2/yr, the equivalent of a further 10.77 **%** reduction in the buildings CO_2 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 CO_2 saving would not be rewarded. In order to appraise the additional CO_2 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 Flow-rate	Turing Proposed Flow-rate	Annual CO_2 Saving	Annual CO_2 Saving by floor area
Showers	10 litres/min	6 litres/min	2,815.34 kgCO_2/yr	0.3363 kgCO_2/m^2/yr
Wash Hand Basin Taps	9 litres/min	2 litres/min	7,742.20 kgCO_2/yr	0.9248 kgCO_2/m^2/yr
Total Savings			10,557.54 kgCO_2/yr	**1.2611 kgCO_2/m^2/yr**

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

- 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 15 seconds per use
- Wash hand basin temperature is limited to 43°C

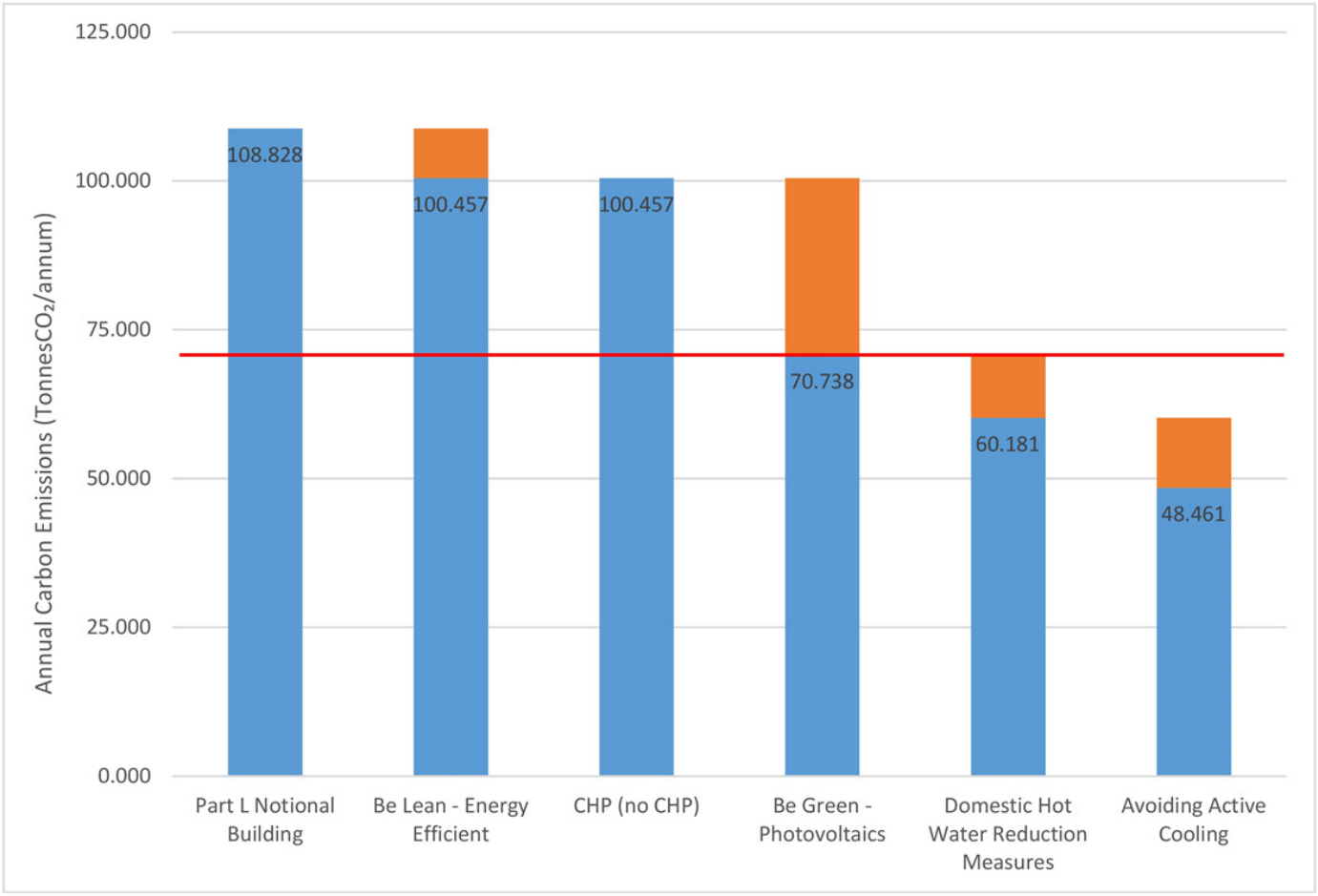
The overall CO_2 reduction for reducing domestic hot water consumption represents a further 9.70 % reduction when compared with the notional building.

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.

Energy Efficiency Measure	CO_2 Emission Savings	% CO_2 reduction for building
'Be Lean' - Fabric First Approach (BRUKL)	8.371 TonnesCO_2/year	7.69 %
'Be Green' - Photovoltaic Panels	29.718 TonnesCO_2/year	27.31 %
Avoiding Active Cooling	11.720 TonnesCO_2/year	10.77 %
Reduction in Hot Water Demand	10.558 TonnesCO_2/year	9.70 %
Total CO_2 Emission Reduction	60.367 TonnesCO_2/year	**55.47 %**

The carbon emission savings outlined in the table above is presented on the graph below in the GLA format to demonstrate CO_2 savings against each item relative to the GLA target.



The calculated further savings equate to an annual carbon emission reduction in excess of 22.2 TonnesCO_2/annum on top of the 'Be Lean' and 'Be Green' measures as discussed in the Main Report to produce a total carbon saving of more than 60.3 TonnesCO_2/annum which exceeds the 35% target reduction over the Notional Building.

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 Target Emission Rate (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

Turing House School — As built

Date: Thu Aug 16 17:38:52 2018

Administrative information

Building Details

Address: Hospital Bridge Road, Twickenham, TW2 6LH

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.9

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.9

BRUKL compliance check version: v5.4.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 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, $kgCO_2/m^2.annum$	14.4
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	14.4
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	16.1
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.21	0.26	FF000009:Surf[0]
Floor	0.25	0.21	0.21	GF000000:Surf[0]
Roof	0.25	0.16	0.16	FF000032:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.33	1.35	GF000006:Surf[1]
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

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

* 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

APPENDIX C1 - TM52 A MODERATELY WARM SUMMER FUTURE (2020) RESULTS

Room Name	Criteria 1	Criteria 2	Criteria 3
GF:Conference	5.2	14	5
GF:Med 1PO	1.2	6	3
GF:Interview	3.7	15	4
GF:LRC	2.6	12	4
GF:Entrance	2.1	8	4
GF:SEN/Therapy	2.1	8	4
GF:LRC	3.5	14	5
GF:LRC	3.7	13	5
GF:Drama Studio	5.2	12	5
GF:Cent Stock (office)	2.3	8	4
GF:Food Prep	2.8	9	4
GF:Food Studio	3.2	13	5
GF:Med 2PO	3.4	11	5
GF:Music Classroom 01	3.8	13	5
GF:Multi Mat Prep	1.1	6	3
GF:Ext Practice	4.6	12	6
GF:Main Hall	4.8	13	4
GF:Kitchen	1.9	11	4
GF:Activity Studio	2	9	3
GF:Sports Hall	0.4	2	1
GF:Dining	0.9	2	2
GF:Textiles	4.6	13	5
GF:Electronics	4	15	5
GF:Graphics	4.7	13	5
GF:Resistant Material	3.7	13	5
GF:Music Classroom 02	4.4	14	5
GF:Classroom	4.4	13	5
GF:2 Person Office	1.4	7	3
GF:Music Practice 01	2.1	8	4
GF:Music Practice 02	2.4	8	4
GF:Music Practice 03	3.1	9	5
GF:Music Practice 04	2.3	10	5
GF:Music Practice 05	3.2	11	5
GF:3-4 Person Office	2.9	11	5
GF:Sixth Form Social	0.9	2	2
GF:Sixth Form Study Area	5.5	20	6
GF:General Office	2	8	3
GF:Prep Man	1.5	7	4
FF:Classroom 07	3.7	13	5
FF:Heads Office	3.5	8	3
FF:PA Office	4	9	4
FF:LRC 03	2	10	3
FF: Small 1PO	0.6	3	2
FF:Seminar Room	4.6	13	5
FF:Med 2PO	0.6	3	2
FF:LRC 01	1.7	8	3
FF:Small Group	2.6	9	4
FF:Lrg 3PO	1.1	6	3
FF:General Art Room	2.6	10	4
FF:Classroom 08	3.8	14	5
FF:LRC	1.2	6	3
FF:Meeting room	1.5	6	3
FF:Classroom 11	4.7	13	5
FF:Classroom 10	3.7	13	5

Room Name	Criteria 1	Criteria 2	Criteria 3
FF:Classroom 13	3.7	13	5
FF:Classroom 12	3.7	13	5
FF:Classroom 14	3.7	13	5
FF:Classroom 15	3.5	13	5
FF:Classroom 17	3.2	12	5
FF:Classroom 18	3.5	12	5
FF:Classroom 16	3.2	11	4
FF:Classroom 01	3.2	11	4
FF:Classroom 02	3.2	12	5
FF:Classroom 03	3.4	13	5
FF:Classroom 04	3.2	11	4
FF:Classroom 05	3.2	11	4
FF:Classroom 06	3.2	11	4
FF:General Art Room	1.7	9	4
FF:Staff Room	2	9	4
FF:LRC 02	1.2	6	3
FF:ICT/Business Studies	6	13	5
FF:ICT/Business Studies	5.8	13	5
FF:2 Person Office	2.1	8	4
FF:IT Tech Room	0.9	5	3
SF:Classroom 08	1.7	9	4
SF:Classroom 09	2.4	10	4
SF:LRC	0.9	5	2
SF:Med 1PO	1.8	8	3
SF:General Science Lab 03	3.4	11	4
SF:Classroom 11	3.2	12	5
SF:Science Prep	2.4	7	3
SF:LRC	1.2	6	3
SF:LRC	1.8	9	3
SF:Sml 2PO	2.6	10	4
SF:Lrg Group	4.7	11	4
SF:General Science Lab 06	3.5	12	4
SF:Seminar Room	5.4	16	6
SF:Sml 2PO	2	8	3
SF:General Science Lab 07	5.5	13	5
SF:General Science Lab 08	4	13	5
SF:Classroom 14	3.7	13	5
SF:Classroom 01	3.7	13	5
SF:Classroom 02	3.7	13	5
SF:General Science Lab 01	3.8	14	5
SF:General Science Lab 02	2.9	11	4
SF:General Science Lab 05	3.2	11	4
SF:General Science Lab 04	3.2	11	4
SF:Classroom 05	3.2	11	4
SF:Classroom 07	3.2	11	4
SF:Classroom 06	3.2	11	4
SF:Classroom 13	1.7	9	4
SF:Classroom 10	3.4	12	4
SF:Classroom 04	3.4	13	5
SF:Classroom 12	3.4	13	5
SF:Med 1PO	2.3	9	4
SF:SENco Office	2.1	9	4
SF:Med 1PO	2	8	3
SF:LRC	1.6	9	3

Unnoccupied Spaces TM52 Criterion 1 Calculation	Criteria 1 (%Hrs Top-Tmax>=1K)
GF:Circulation 08	3.9
GF:Circulation	0.5
GF:Circulation 07	0.5
GF:Circulation 09	0.5
GF:Circulation 10	0.5
FF:Circulation 07	0.0
FF:Circulation 8	1.7
FF:Circulation 05	1.3
FF:Circulation 06	0.0
SF:Circulation 01	3.3

Unnoccupied Spaces TM52 Criterion 1 Calculation	Criteria 1 (%Hrs Top-Tmax>=1K)
SF:Circulation 02	0.5
SF:Circulation	0.0
SF:Circulation 03	0.0
GF:Circulation 05	0.5
GF:Circulation	0.5
GF:Circulation 02	0.1
GF:Circulation	0.8
FF:Circulation 03	0.0
SF:Circulation 05	0.3
SF:Circulation 02	0.0

Unnoccupied Spaces TM52 Criterion 1 Calculation	Criteria 1 (%Hrs Top-Tmax>=1K)
SF:Circulation 03	0.1
FF:Circulation 01	0.0
GF:Circulation 03	0.1
GF:Circulation 04	0.1
SF:Circulation 01	0.0
GF:Circulation 01	0.0
SF:Circulation 04	0.3
FF:Circulation 04	0.1
FF:Circulation	0.0

APPENDIX C2 - TM49 A MODERATELY WARM SUMMER (1989) RESULTS

Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)
GF:Conference	3.8	10	4
GF:Interview	2.3	11	4
GF:LRC	1.3	9	4
GF:Entrance	1.2	6	3
GF:SEN/Therapy	1.1	5	3
GF:LRC	2.1	10	4
GF:Med 1PO	0.6	3	2
GF:LRC	1.2	7	3
GF:Cent Stock (office)	0.9	5	3
GF:Food Prep	1.7	7	4
GF:Med 2PO	1.8	8	4
GF:Multi Mat Prep	0.5	3	2
GF:Ext Practice	2.4	9	5
FF: Small 1PO	0.3	1	1
FF:Seminar Room	2.4	11	5
FF:Med 2PO	0.2	1	1
FF:LRC 01	0.8	5	2
FF:Small Group	1.4	6	3
SF:Med 1PO	1.2	6	3
SF:SENco Office	1.2	6	3
SF:Med 1PO	1.1	5	2
SF:LRC	0.9	5	2
FF:Lrg 3PO	0.5	3	2
GF:2 Person Office	0.8	5	2
GF:Music Practice 01	0.9	5	3
GF:Music Practice 02	1.5	7	4
GF:Music Practice 03	1.8	7	4
GF:Music Practice 04	1.5	8	4
GF:Music Practice 05	2.1	8	4
GF:3-4 Person Office	1.4	7	4
GF:Sixth Form Social	0.9	1	1
GF:Sixth Form Study Area	3.5	17	5
GF:General Office	1.1	6	3
GF:Prep Man	0.8	5	3
FF:LRC 02	0.7	5	2
FF:2 Person Office	0.8	5	3
FF:IT Tech Room	0.5	3	2
GF:Kitchen	1.2	9	4
GF:Drama Studio	2.3	8	4
SF:LRC	0.9	6	3
GF:Sports Hall	0	0	0
GF:Main Hall	0.6	5	2
SF:Sml 2PO	0.9	5	2
SF:Lrg Group	1.7	8	4
SF:Sml 2PO	0.9	5	2
SF:Med 1PO	0.5	3	2
GF:Activity Studio	0.5	2	1
GF:Dining	0	0	0
GF:Textiles	2.8	11	4
GF:Food Studio	1.7	9	4
GF:Electronics	2.1	10	4
GF:Graphics	3.4	11	4
GF:Resistant Material	2	9	4
GF:Music Classroom 02	2.3	11	5

Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)
GF:Music Classroom 01	2.4	10	4
GF:Classroom	2.3	10	4
FF:General Art Room	1.4	6	3
FF:Classroom 07	2.1	10	4
FF:Classroom 08	2.1	10	4
FF:Heads Office	0.9	4	2
FF:PA Office	1.5	6	3
FF:Meeting room	0.9	5	2
FF:LRC 03	0.8	5	2
FF:Classroom 11	2.4	10	4
FF:Classroom 10	2	9	4
FF:Classroom 13	1.7	9	4
FF:Classroom 12	2	9	4
FF:Classroom 14	2	9	4
FF:Classroom 15	1.7	9	4
FF:Classroom 17	1.8	9	4
FF:Classroom 18	1.8	9	4
FF:LRC	0.7	6	3
FF:Classroom 16	1.5	9	4
FF:Classroom 01	1.5	9	4
FF:Classroom 02	1.5	9	4
FF:Classroom 03	1.5	9	4
FF:Classroom 04	1.5	9	4
FF:Classroom 05	1.5	9	4
FF:Classroom 06	1.5	9	4
FF:General Art Room	1.2	6	3
SF:General Science Lab 06	1.7	9	4
SF:General Science Lab 07	2.1	9	4
FF:Staff Room	1.4	7	3
SF:General Science Lab 08	2	9	4
SF:Classroom 01	2.3	9	4
SF:Classroom 02	2.3	9	4
SF:Classroom 14	2	9	4
SF:Classroom 09	1.4	9	4
SF:General Science Lab 01	2	10	4
SF:General Science Lab 02	1.7	9	3
SF:General Science Lab 03	1.5	9	4
SF:General Science Lab 04	1.5	9	4
SF:General Science Lab 05	1.5	9	4
SF:Classroom 05	1.5	9	4
SF:Classroom 06	1.5	9	4
SF:Classroom 07	1.5	9	4
SF:Classroom 08	1.2	6	3
SF:Classroom 13	1.2	6	3
SF:Classroom 11	1.7	9	4
SF:Science Prep	0.8	3	2
SF:Classroom 10	1.8	9	4
SF:Classroom 04	1.8	9	4
SF:Classroom 12	1.8	9	4
SF:LRC	0.5	3	2
SF:LRC	0.8	5	2
SF:Seminar Room	3.1	12	5
FF:ICT/Business Studies	3.4	11	4
FF:ICT/Business Studies	3.2	11	4

APPENDIX C3 - TM49 A YEAR WITH A VERY INTENSE WARM SPELL (2003) RESULTS

Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)
GF:Conference	6.1	23	7
GF:Interview	5.4	24	6
GF:LRC	3.5	18	6
GF:Entrance	3.4	13	5
GF:SEN/Therapy	3.1	12	5
GF:LRC	4.5	19	6
GF:Med 1PO	2.8	12	4
GF:LRC	3.4	15	6
GF:Cent Stock (office)	2.8	12	6
GF:Food Prep	3.7	15	6
GF:Med 2PO	4	14	6
GF:Multi Mat Prep	2.3	11	5
GF:Ext Practice	4.6	17	7
FF: Small 1PO	1.7	6	3
FF:Seminar Room	4.9	19	7
FF:Med 2PO	1.4	6	3
FF:LRC 01	2.2	10	4
FF:Small Group	3.2	13	5
SF:Med 1PO	4	16	6
SF:SENco Office	3.8	15	6
SF:Med 1PO	3.8	13	5
SF:LRC	2.9	17	5
FF:Lrg 3PO	1.8	8	4
GF:2 Person Office	2.6	12	5
GF:Music Practice 01	2.6	11	5
GF:Music Practice 02	3.4	13	6
GF:Music Practice 03	3.2	12	6
GF:Music Practice 04	3.2	14	6
GF:Music Practice 05	4.3	16	7
GF:3-4 Person Office	3.1	12	6
GF:Sixth Form Social	4.6	3	3
GF:Sixth Form Study Area	5.8	27	7
GF:General Office	2.9	13	5
GF:Prep Man	2.4	11	5
FF:LRC 02	2.6	14	5
FF:2 Person Office	2.6	12	5
FF:IT Tech Room	1.7	7	4
GF:Kitchen	3.2	19	7
GF:Drama Studio	4.6	15	6
SF:LRC	3	16	5
GF:Sports Hall	0.7	8	4
GF:Main Hall	2.8	13	5
SF:Sml 2PO	3.2	12	4
SF:Lrg Group	4.6	16	6
SF:Sml 2PO	3.2	10	4
SF:Med 1PO	2	10	4
GF:Activity Studio	1.7	6	3
GF:Dining	0.9	2	2
GF:Textiles	5.7	22	7
GF:Food Studio	4.1	19	7
GF:Electronics	5.7	22	7
GF:Graphics	5.8	20	7
GF:Resistant Material	4.4	19	7
GF:Music Classroom 02	4.6	20	7

Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)
GF:Music Classroom 01	4.4	19	7
GF:Classroom	4.4	19	7
FF:General Art Room	4.1	18	6
FF:Classroom 07	4.9	19	6
FF:Classroom 08	5	19	6
FF:Heads Office	3.8	13	5
FF:PA Office	4.6	17	6
FF:Meeting room	3.1	13	5
FF:LRC 03	3.3	18	5
FF:Classroom 11	5.5	22	7
FF:Classroom 10	4.7	21	7
FF:Classroom 13	4.6	20	7
FF:Classroom 12	4.6	21	7
FF:Classroom 14	4.6	20	7
FF:Classroom 15	4.3	19	7
FF:Classroom 17	4.4	18	7
FF:Classroom 18	4.6	18	7
FF:LRC	2.5	14	5
FF:Classroom 16	3.8	17	6
FF:Classroom 01	4.1	18	6
FF:Classroom 02	4	17	6
FF:Classroom 03	4	17	6
FF:Classroom 04	3.8	17	6
FF:Classroom 05	3.8	17	6
FF:Classroom 06	3.8	17	6
FF:General Art Room	3.4	14	5
SF:General Science Lab 06	4.6	21	7
SF:General Science Lab 07	5.7	22	7
FF:Staff Room	3.5	17	6
SF:General Science Lab 08	4.7	22	7
SF:Classroom 01	5.2	22	7
SF:Classroom 02	5.2	22	7
SF:Classroom 14	4.6	20	7
SF:Classroom 09	3.7	17	6
SF:General Science Lab 01	4.9	20	6
SF:General Science Lab 02	4.6	19	6
SF:General Science Lab 03	4	18	6
SF:General Science Lab 04	4	18	6
SF:General Science Lab 05	4	18	6
SF:Classroom 05	4.1	18	6
SF:Classroom 06	3.8	17	6
SF:Classroom 07	4.1	18	6
SF:Classroom 08	3.5	16	6
SF:Classroom 13	3.2	15	6
SF:Classroom 11	4.3	18	7
SF:Science Prep	2.9	9	3
SF:Classroom 10	4.6	20	7
SF:Classroom 04	4.6	20	7
SF:Classroom 12	4.4	20	7
SF:LRC	2	10	4
SF:LRC	2.5	14	5
SF:Seminar Room	6	23	7
FF:ICT/Business Studies	5.8	21	7
FF:ICT/Business Studies	5.5	20	7

APPENDIX C4 - TM49 A YEAR WITH A PROLONGED PERIOD OF SUSTAINED WARMTH (1976) RESULTS

Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)
GF:Conference	7	13	5
GF:Interview	8	13	4
GF:LRC	5	10	4
GF:Entrance	4.4	7	4
GF:SEN/Therapy	4.4	6	3
GF:LRC	6.2	11	4
GF:Med 1PO	2.9	7	3
GF:LRC	4.5	8	4
GF:Cent Stock (office)	3.5	5	3
GF:Food Prep	4.9	8	4
GF:Med 2PO	4.6	8	4
GF:Multi Mat Prep	1.8	4	2
GF:Ext Practice	5.5	9	5
FF: Small 1PO	1.5	3	2
FF:Seminar Room	6.1	11	5
FF:Med 2PO	1.1	3	2
FF:LRC 01	2.8	6	3
FF:Small Group	4.3	8	4
SF:Med 1PO	5.2	7	3
SF:SENco Office	5	7	3
SF:Med 1PO	4.3	6	3
SF:LRC	2	6	3
FF:Lrg 3PO	2.3	3	2
GF:2 Person Office	2.8	6	3
GF:Music Practice 01	3.7	6	3
GF:Music Practice 02	4.4	8	4
GF:Music Practice 03	4.4	8	4
GF:Music Practice 04	4.1	8	4
GF:Music Practice 05	4.9	8	4
GF:3-4 Person Office	4.3	7	4
GF:Sixth Form Social	0.9	1	1
GF:Sixth Form Study Area	6.9	13	4
GF:General Office	4.1	6	3
GF:Prep Man	3.2	5	3
FF:LRC 02	3	6	3
FF:2 Person Office	3.4	6	3
FF:IT Tech Room	1.8	3	2
GF:Kitchen	3.3	8	4
GF:Drama Studio	5.4	8	4
SF:LRC	3.5	7	3
GF:Sports Hall	0.6	2	1
GF:Main Hall	2.9	8	4
SF:Sml 2PO	4.4	6	3
SF:Lrg Group	6.3	9	4
SF:Sml 2PO	4.6	6	3
SF:Med 1PO	3.4	5	2
GF:Activity Studio	1.5	3	2
GF:Dining	0	0	0
GF:Textiles	7.2	13	5
GF:Food Studio	5.5	9	4
GF:Electronics	7.5	13	5
GF:Graphics	6.7	14	5
GF:Resistant Material	5.8	11	5
GF:Music Classroom 02	6.1	12	5

Room Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)
GF:Music Classroom 01	6.1	11	5
GF:Classroom	6.1	11	5
FF:General Art Room	5.8	11	4
FF:Classroom 07	6.7	12	4
FF:Classroom 08	6.7	12	4
FF:Heads Office	4.6	6	3
FF:PA Office	6.4	8	3
FF:Meeting room	3.8	6	3
FF:LRC 03	4.8	11	3
FF:Classroom 11	6.9	13	5
FF:Classroom 10	5.8	10	4
FF:Classroom 13	5.8	10	4
FF:Classroom 12	5.8	10	4
FF:Classroom 14	5.8	10	4
FF:Classroom 15	5.8	10	4
FF:Classroom 17	5.5	10	4
FF:Classroom 18	5.7	11	5
FF:LRC	2.8	6	3
FF:Classroom 16	5.5	10	4
FF:Classroom 01	5.7	11	4
FF:Classroom 02	5.7	11	4
FF:Classroom 03	5.5	10	4
FF:Classroom 04	5.7	11	4
FF:Classroom 05	5.5	10	4
FF:Classroom 06	5.5	10	4
FF:General Art Room	4.3	9	4
SF:General Science Lab 06	5.7	10	4
SF:General Science Lab 07	6.4	13	5
FF:Staff Room	4.7	9	4
SF:General Science Lab 08	6	10	4
SF:Classroom 01	6.3	12	5
SF:Classroom 02	6.3	12	5
SF:Classroom 14	6	10	4
SF:Classroom 09	5.2	9	4
SF:General Science Lab 01	7	13	4
SF:General Science Lab 02	6.4	12	4
SF:General Science Lab 03	5.8	11	4
SF:General Science Lab 04	5.8	11	4
SF:General Science Lab 05	5.8	11	4
SF:Classroom 05	5.7	11	4
SF:Classroom 06	5.5	10	4
SF:Classroom 07	5.7	11	4
SF:Classroom 08	4.3	9	4
SF:Classroom 13	4.4	9	4
SF:Classroom 11	5.4	10	4
SF:Science Prep	5	7	3
SF:Classroom 10	6	10	4
SF:Classroom 04	6	10	4
SF:Classroom 12	6	10	4
SF:LRC	3.3	6	3
SF:LRC	3.7	9	3
SF:Seminar Room	7.3	13	5
FF:ICT/Business Studies	6.9	12	5
FF:ICT/Business Studies	6.7	12	5

APPENDIX D1 – INDICATIVE SECOND FLOOR PLANT ROOM LAYOUTS AND LOCATION PLAN

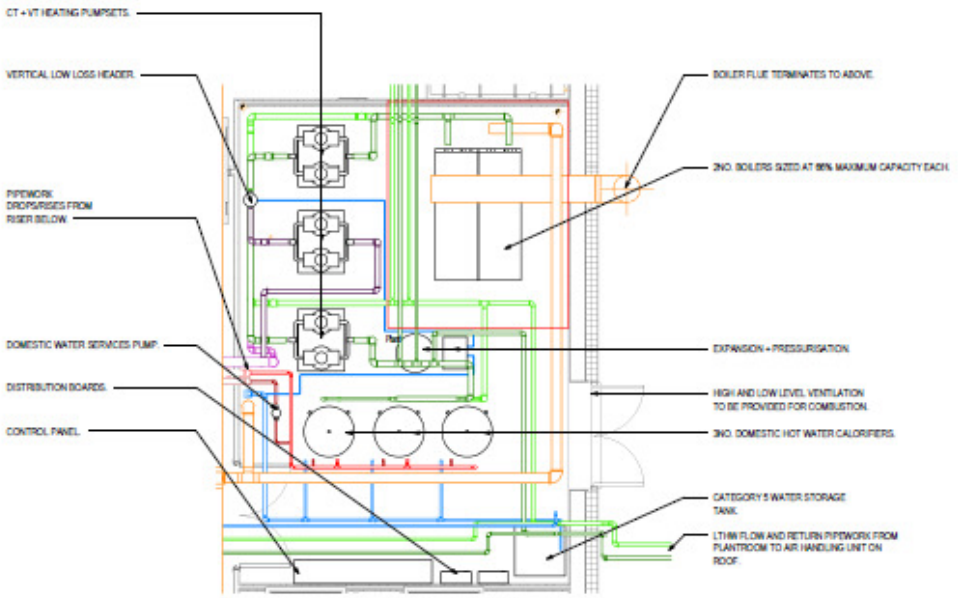


Figure D1.1 - Second Floor (44.5m^2) Plantroom Layout – Turing House School

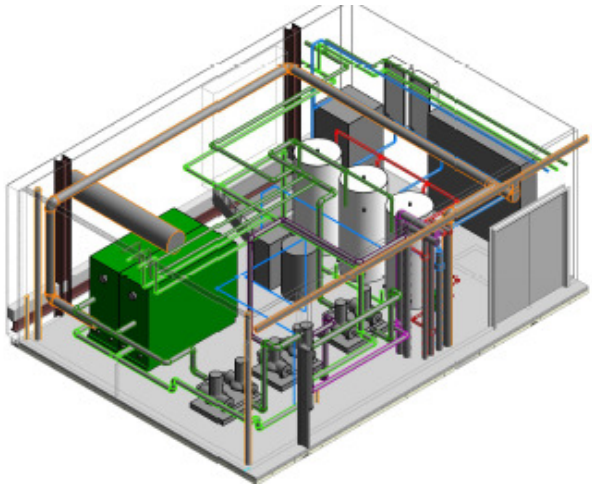


Figure D1.2 – 3D Second Floor Plantroom – Turing House School

Figure D1.3 –Second Floor Plantroom Location Plan – Turing House School

APPENDIX D2 – INDICATIVE GROUND FLOOR PLANT ROOM LAYOUTS AND LOCATION PLAN

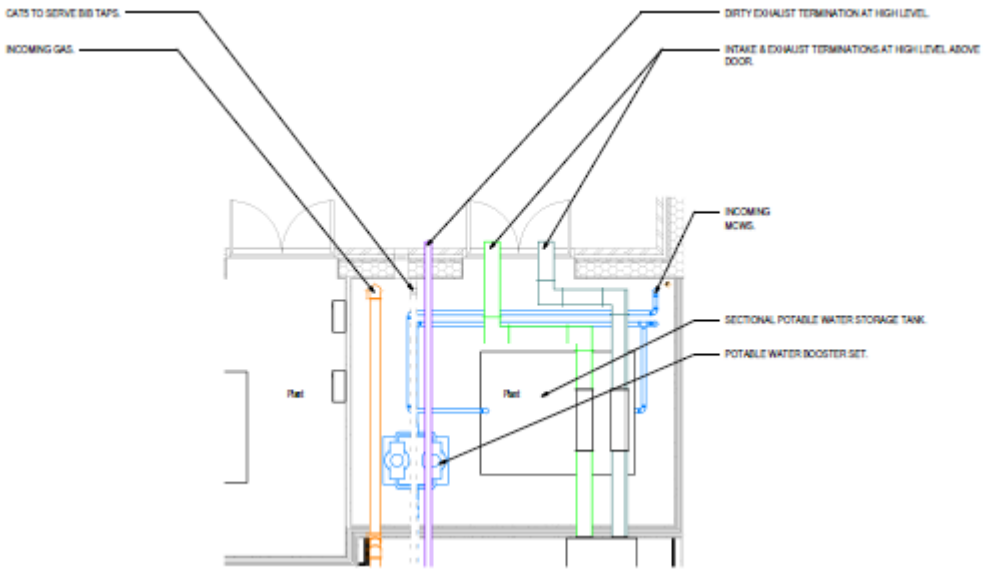


Figure D2.1 - Ground Floor (20.9m^2) Plantroom Layout – Turing House School

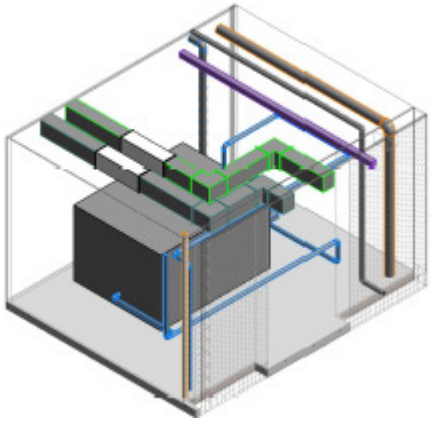


Figure D2.2 – 3D Ground Floor Plantroom – Turing House School

Figure D2.3 –Ground Floor Plantroom Location Plan – Turing House School

APPENDIX E – GLA CARBON EMISSION REPORTING SPREADSHEET RESULTS

SAP 2012 PERFORMANCE

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	107.608	
After energy demand reduction	99.305	
After heat network / CHP	99.305	
After renewable energy	69.945	

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	8.303	8%
Savings from heat network / CHP	0.000	0%
Savings from renewable energy	29.360	27%
Total Cumulative Savings	**37.663**	**35%**

	Annual Zero carbon Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**107.608**	-
Shortfall	69.945	2,098.347
Cash in-lieu contribution (£)	**125,900.84**	-

SAP10 PERFORMANCE

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	69.655	
After energy demand reduction	71.870	
After heat network / CHP	71.870	
After renewable energy	58.793	

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	-2.215	-3%
Savings from heat network / CHP	0.000	0%
Savings from renewable energy	13.077	19%
Total Cumulative Savings	**10.862**	**16%**

	Annual Zero carbon Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**69.655**	-
Shortfall	58.793	1,763.804
Cash in-lieu contribution (£)	**105,828.21**	-

Figure E.1 – Cash In-Lieu Summary from GLA Carbon Emission Reporting Spreadsheet Results – Turing House School