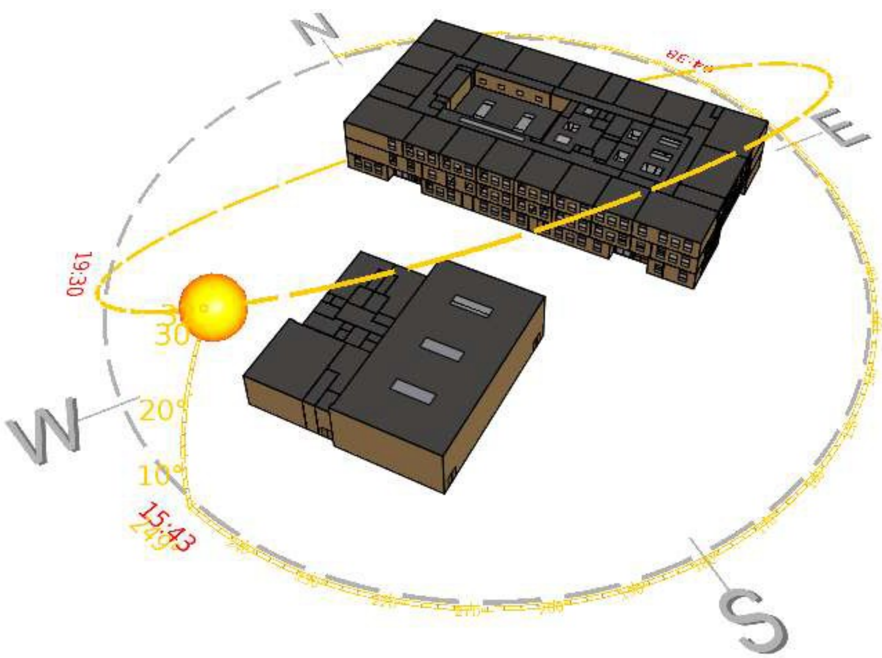
# FS0954-RPS-ZZ-XX-RP-N-0013-S2-P01

# Energy & Sustainability Statement

# Trinity Academy St Edwards, Barnsley




| Revision record for document *PW288 L2A* | | |
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| P01 | First Issue | 25/10/2021 |
| | | |

| Author's details | | *Other details* | |
|---|---|---|---|
| Name | Paul Welsh | *Project Number* | *PW288* |
| Qualifications/Associations | CEng, MCIBSE, MSc, BSc | *Model References:* | *PW288 TASE L2A Rev 2_1* |
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# CONTENTS

# 1 EXECUTIVE SUMMARY

Paul Welsh Consulting Ltd provides independent and accredited thermal modelling services to the construction industry and in this instance has been commissioned by RPS Ltd to assess the energy strategy for Trinity Academy St Edwards, Barnsley. The proposed development will create a new 6 form-entry secondary school comprising of a main school block and a sports building. Bowmer and Kirkland Ltd is the Main Contractor.

This energy strategy report has been completed for draft CP Submission (draft Contractor's Proposals). It has been drafted to demonstrate compliance with the project requirements.

Insofar as energy efficiency and carbon emissions are concerned, the project must comply with Part L of the Building Regulations: Approved Document L2A, 'L2A Conservation of fuel and power in buildings other than dwellings', 2013 edition incorporating 2016 amendments – for use in England. Separately to this, the project must also achieve a BREEAM rating of 'Very Good', this being a condition of Planning. This particular requirement has been assessed by others. Refer to separate Pre-Assessment Report.

In accordance with the Barnsley Council Sustainable Travel Plan Supplementary Planning Document, Electric Vehicle Charging Points will be provided to 10% of the parking spaces provided.

A detailed modelling exercise has been undertaken to assess the performance of the draft Contractor's Proposals against the above requirements. In developing the design to meet the project requirements the team have adopted the best practice energy hierarchy whereby considerations are tiered in the following order (1) 'Be Lean', (2) 'Be Clean' and (3) 'Be Green'. Effectively this hierarchy underpins a sustainable approach to building design. In conclusion, the design proposals stated within this report **meet the project requirements**.

The key design features are as follows:

- *U values as stated in the main body of the report.*
- *Fabric air permeability of 5.0 $m^3/m^2.h$ at 50 Pa.*
- *Efficient gas heating via LTHW circulation. Heat to the majority of rooms is delivered via LTHW coils in the ventilation system otherwise local emitters are used (typically fan convectors or pipe coils).*
- *Hot water is generated using:*
    - *Efficient electric air source heat pump for the kitchen*
    - *Elsewhere, distributed electric point of use (POU) with storage.*
- *Building is predominantly mechanically ventilated as per the RPS outline strategy, largely using efficient units including heat recovery at 80%.*
- *Typically, MVHR systems respond to demand, based upon $CO_2$ sensing and variable speed control.*
- *Lighting power: Efficient design using LED and/or T5 luminaires. Figures as declared by RPS using 'typical' design data from previous similar projects.*
- *TM39 compliant metering and sub-metering strategy.*
- *'Out of range' energy use warnings to be automatically reported via the BMS.*
- *A PV array is required for compliance. This needs to generate a minimum annual yield of 8,650 kWh. More precise sizing will be necessary at CP stage.*

Performance in terms of L2A compliance against Criterion 1 can be summarised as follows:

| Target (TER) $kgCO_2/m^2.yr$ | Building (BER) $kgCO_2/m^2.yr$ | Criteria met, BER≤TER? | Percentage betterment |
|---|---|---|---|
| **15.4** | 15.3 | Yes | < 1% |

Performance in terms of regulated energy is as follows:

| **Detail** | **Regulated energy consumption** kWh/yr | **Percentage change** |
|---|---|---|
| Notional building | 292,940 | |
| Draft CP design, regulated consumption | 260,583 | -11% |

Since the two buildings share the same energy centre, a single EPC covers both the main school block and the sports block. The proposals achieve an EPC asset rating of 29. 'A'-rated certificates are in the range 0-25 whilst 'B' ratings lie between 26-50. The design therefore achieves a strong 'B'.

It should be noted this report confirms specific design features and sets performance levels for many aspects of the design. To achieve the quoted performance, it is critical that the design & construction team adhere to, or better, the design detail described.

The design BRUKL report and draft EPC are provided as separate PDF documents. These are referenced in Appendix C.

Any changes to the design should be assessed in a timely fashion to determine the impact.

Following completion of construction and in preparation for handover, the Contractor is required to complete an 'as constructed' model for BRUKL and EPC purposes. This model must reflect the building 'as constructed' capturing any changes relevant to the BRUKL and EPC calculation that may have occurred as well as some 'as measured' parameters (eg air permeability results, specific fan powers etc). A final 'as constructed' BRUKL document is required for Building Control sign-off and a formal 'as constructed' EPC will need to be lodged and displayed.

In relation to thermal comfort (and the avoidance of air conditioning), a separate Overheating Risk Assessment has been prepared, demonstrating compliance in this regard. The 'cooling hierarchy' provides a sustainable approach and is referred to in this report.

This commission has been completed by Paul Welsh Consulting Ltd for RPS Ltd. The author is an experienced thermal modelling specialist, a CIBSE certified Low Carbon Energy Assessor (LCEA) and Chartered Engineer. A 'Level 5' assessment has been adopted using the IES VE 'Apache' simulation engine.

# 2 INTRODUCTION

Paul Welsh Consulting Ltd has been commissioned by RPS Ltd to undertake an assessment of the proposed energy strategy for Trinity Academy, Barnsley. This report can be used to support the planning submission.

This report provides the following:

1. A scheme overview.
2. A summary of applicable legislation, planning policies and other targets.
3. A summary of the energy hierarchical approach to design, including a brief appraisal of low and zero carbon technologies.
4. A summary of the cooling hierarchical approach to design.
5. Discussion on the expected change regarding electrical carbon emission factors.
6. An ADL2A carbon and energy assessment of the project.
7. A presentation of the results and recommendations.

**Note:** *This report is intended for an audience familiar with the requirements and detail of Approved Document L2A. It addresses matters in relation to BRUKL and EPC thermal modelling. ADL2A places additional non-thermal modelling duties upon the design and construction team. It is important these duties are understood and competently discharged. Please contact the author should there be any confusion regarding roles and responsibilities. For readers less familiar with ADL2A, Appendices A and B provide some background information.*

# 3 SCHEME OVERVIEW

The proposed development will create a new academy.

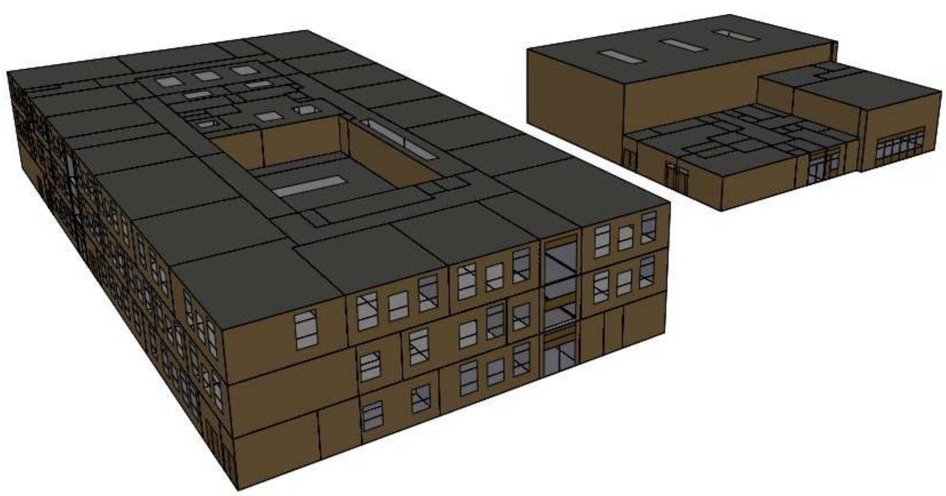


**Figure 1:** Model image of proposed buildings

# 4 BUILDING ENERGY AND $CO_2$ EMISSIONS: APPLICABLE REGULATIONS, POLICIES AND TARGETS

This section details project specific regulations, policies and targets governing building energy use and $CO_2$ emissions insofar as this report is concerned.

## 4.1 NATIONAL LEVEL BUILDING REGULATIONS

The regulations applicable to this project are detailed within Approved Document L2A, 'L2A Conservation of fuel and power in buildings other than dwellings', 2013 edition incorporating 2016 amendments – for use in England.

## 4.2 NATIONAL LEVEL PLANNING POLICY

**NATIONAL PLANNING POLICY FRAMEWORK (2021)**

Section 14 sets out the importance of transitioning to a low carbon future, including encouraging the reuse of existing resources, including the conversion of existing buildings and the support of renewable and low carbon energy and associated infrastructure.

Paragraph 154 states that new development should be planned for in ways that:

> a) Avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
>
> b) Can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

Paragraph 157 requires new development to:

> a) Comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
>
> b) Take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

## 4.3 REGIONAL AND LOCAL LEVEL PLANNING POLICY

Local planning requires compliance with the prevailing Building Regulations and a BREEAM score of 'Very Good'.

## 4.4 CONDITIONS OF FUNDING

There are no additional requirements attached to conditions of funding.

## 4.5 VOLUNTARY TARGETS

No voluntary targets have been set for this development.

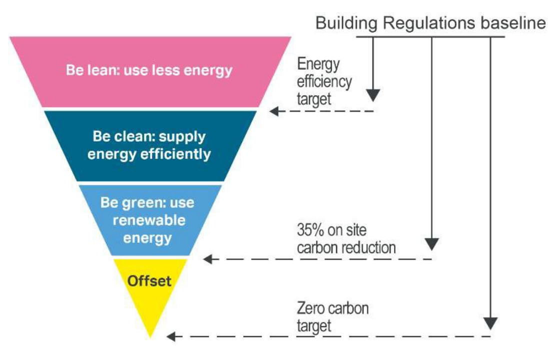
## 4.6 SUMMARY OF TARGETS

The following table summarises the requirements for this project.

| Policy Level | Standard | Status |
|---|---|---|
| **National** | **Building Regulations ADL2A for England, 2013** | **Compulsory** |
| **Regional/Local** | **BREEAM 'Very Good'** | **Compulsory** |
| Condition of funding | None | |
| Voluntary | None | |

# 5 ENERGY HIERARCHY

The adopted energy hierarchy is shown diagrammatically below. For this project the three stages 'Be Lean', 'Be Clean' and 'Be Green' are considered.




Source: Greater London Authority

## 5.1 'BE LEAN'

Aiming to create an energy efficient, low carbon development, focus is applied to ensure energy demands are reduced to reasonable levels. Matters for consideration include:

- Well thought-through building layouts and elevations.
- Fabric performance to reduce heating demands (primarily insulation levels and air permeability).
- Daylight penetration to offset electric lighting (glazing provision and specification).
- Design to promote natural ventilation.
- Careful building and systems design to reduce fan and pump energy, pipework heat losses etc.
- Specification of high efficiency services.
- Development of simple but effective energy control strategies.

Also integral to the 'Be Lean' approach is the desire to achieve thermal comfort with minimal use of mechanical cooling. Passive design features should be implemented wherever possible, such as:

- Control of solar gains through a mix of limiting glass area and appropriate g value selection.
- Inclusion of exposed thermal mass coupled with night cooling.
- Use of external shading.
- Natural ventilation and/or efficient mechanical ventilation.

Thermal comfort is subject to a separate detailed analysis.

## 5.2 'BE CLEAN'

Consideration should be given to supplying energy from the most efficient networks. Often there is no alternative but to connect to mains gas and the National Grid but some projects may have opportunities to connect to low carbon local networks or to create one. Such opportunities should be considered.

## 5.3 'BE GREEN'

The use of low or zero carbon technologies should only be considered following the 'Be Lean' and 'Be Clean' stages.

## 5.4 LOCAL ENERGY NETWORKS

There are no local energy networks available, and the creation of a local energy centre is not considered viable (see entry below for Combined Heat and Power). The 'Be Clean' stage is, therefore, not possible for this particular project.

## 5.5 LOW AND ZERO CARBON TECHNOLOGIES

This section briefly discusses the LZCT options for this project.

| LZCT | $CO_2$ impact | Cost | Considerations |
|---|---|---|---|
| **Photovoltaic panels (PV)** | **Medium** | **Medium** | Ample roof-space available. Low planning impact. Affordable and established low maintenance technology. **Favoured option if required for compliance.** |
| Solar thermal hot water | Low | Medium | Competes with PV for roof-space. Maintenance burden is considered to outweigh benefits. Energy cannot be stored/used/exported in summer. Considered unviable. |
| **Air source heat pumps** | **Medium** | **Medium** | Viable alternative to gas boilers although can be more expensive. The Part L SBEM calculation still uses the SAP 2012 carbon factor of 0.519 kg/$CO_2$/kWh for electricity. Expect systems to become widespread when the regulations are revised to include current, and much lower, electrical carbon factors. Low planning impact. **Viable option but conventional gas boilers preferred for heating. ASHP will be installed to generate hot water for the kitchen.** |
| Ground source heat pumps | Medium | High | Unknown ground conditions create risk. High installation cost. Considered unviable. |
| Wind turbines | Medium/High | High | Planning risk. Site is small and probably unsuitable, especially given SEND school status. |

| | | | |
|---|---|---|---|
| | | | Considered unviable. |
| Biomass | High | High | Considered unsuitable due to confluence of fuel supply vehicles and building users, concerns surrounding fuel quality and supply, release of particulates, higher maintenance requirements and high capital costs. |
| Combined heat and power | Medium | High | CHP considered unviable due to insufficient year-round loads, expected low run hours, complexity in operation and expense to maintain. |

# 6 COOLING HIERARCHY

The commonly accepted hierarchy for cooling (as described in the London Plan) is as follows:

1. Minimise internal heat generation through efficient design.
2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls.
3. Manage the heat within the building through exposed internal thermal mass and high ceilings.
4. Passive ventilation.
5. Mechanical ventilation.
6. Active cooling systems (ensuring they are the lowest carbon options).

The proposed design was developed using this hierarchy.

# 7 CONTEMPORARY CARBON EMISSION FACTORS

## 7.1 CARBON EMISSION FACTORS

Carbon emission factors are used to determine how much $CO_2$ is released from consuming 1 kWh of a particular fuel. The unit of measurement is $kgCO_2$ / kWh. These factors are central to the determination of carbon intensity of buildings and it is important to use accurate figures.

The latest version of ADL2A (as used in this assessment, for the purposes of satisfying Building Regulations) uses carbon emission factors from the Standard Assessment Procedure (SAP) 2012. These are now out of date and, certainly in relation to electricity, current figures are very different, as the table below illustrates.

| Fuel type | SAP 2012 emission factor | SAP 10.0 emission factor | SAP 10.1 emission factor |
|---|---|---|---|
| *Date of publication* | *October 2013* | *July 2018* | *October 2019* |
| **Mains gas** | 0.216 | 0.210 | 0.210 |
| **Electricity** | 0.519 | 0.233<br>***(only 44% of SAP 2012)*** | 0.136<br>***(only 26% of SAP 2012)*** |

The more recent figures for electricity, much lower than those used in the current ADL2A assessment, reflect the decarbonisation of grid electricity primarily due to reduced reliance on coal fired power and inefficient gas stations and increased contribution from renewables.

## 7.2 IMPLICATIONS FOR THE FUTURE

Lower carbon emissions for electricity, certainly of the magnitude illustrated above, will have serious implications for building services design. Electric heating and hot water, in the form of heat pumps and even direct resistance heating, will out-perform conventional gas systems. Thus, we expect to see a significant shift away from gas heating and hot water towards lower carbon electrical solutions.

# 8 ADL2A MODELLING

The ADL2A compliance model is based on information current at the time, October 2021. This section indicates the key input data.

To ensure compliance with the project requirements it is imperative that the design and construction team adhere to the performance targets and servicing strategies here laid out.

## 8.1 PROJECT DESCRIPTION AND FLOOR AREA

The proposals would create a new secondary school.

The model has a floor area of approximately 6,900m². Note this is a gross area measurement taken directly from the model, using IES VE modelling conventions. Areas quoted within this report are for modelling purposes only.

## 8.2 BUILT FORM

The model geometry reflects the project proposals as the following figures illustrate.

*Note: In some instances models may not fully reflect the architectural intent; simplification is sometimes necessary for means of efficient calculation.*

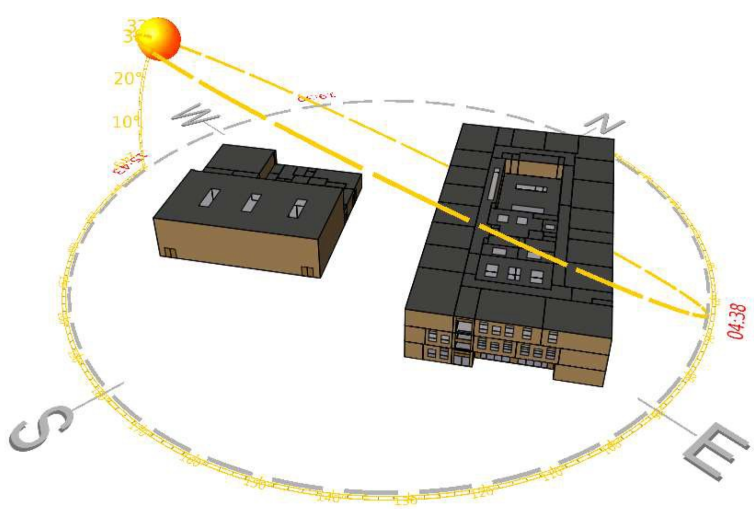



**Figure 2:** Model site plan and orientation

**Figure 3:** Main school, northeast elevation

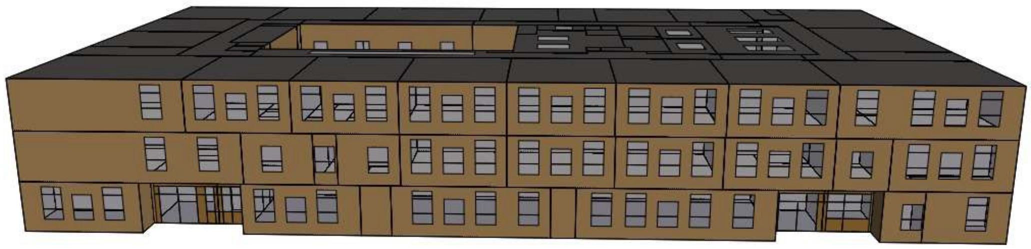


**Figure 4:** Main school, southwest elevation

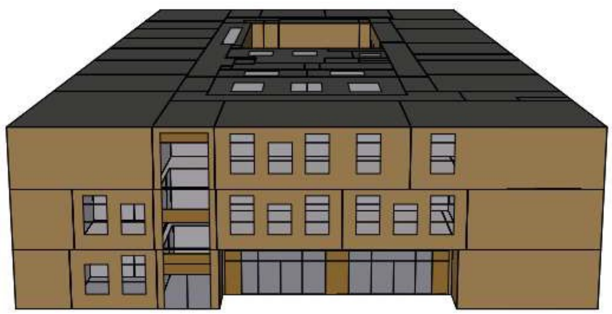


**Figure 5:** Main school, southeast elevation

**Figure 6:** Main school, northwest elevation

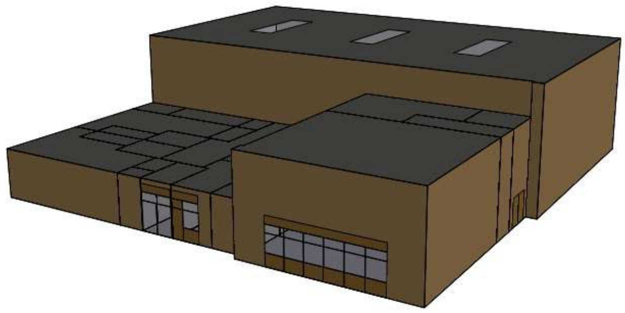


**Figure 7:** Sports Block, perspective view

In accordance with the 'Be Lean' requirement of the energy hierarchy, the building layout and elevations have been carefully developed, key points as follows:

- Room depths are limited to provide sufficient daylight penetration, significantly offsetting the use of electric lighting.
- Daylighting performance achieves the requirements set within the Output Specification.
- Solar gains are kept to a manageable level allowing comfort to be achieved without the use of air conditioning. Primary features are:
    - Avoidance of excessive glazing: glazing areas are limited to achieve daylighting targets.
    - Careful selection of glass solar g values.
- Natural ventilation, via manual opening windows, will be exploited during the warmer seasons.

## 8.3 WEATHER DATA

Weather data for ADL2A (England) assessments is provided by CIBSE in the format of Test Reference Years.

The 10 locations across England are as follows;

- Birmingham
- **Leeds**
- London
- Manchester
- Newcastle
- Norwich
- Nottingham
- Plymouth
- Southampton
- Swindon

This project uses the TRY weather file for Leeds, this being the most appropriate for the site.

## 8.4 BUILDING FABRIC

The constructions assigned to the model have the basic properties as follows. The choice of U values and air permeability is part of the 'Be Lean' strategy, aiming to reduce heat loss to acceptable levels.

The glazing g values limit summertime solar gains, thereby limiting overheating; as part of a separate thermal comfort study, the team have demonstrated that the design can achieve the comfort targets without air conditioning.

### *External opaque elements*

| | General description | U value W/m².K |
|---|---|---|
| Ground floor | Solid concrete. Carpet or vinyl covering. | 0.25 |
| External wall | A lightweight construction (SIPs) internally lined with plasterboard . | 0.21 |
| Roof | Insulated flat roof of lightweight construction. | 0.16 |

### *Windows, rooflights and glazed doors*

Windows, glazed doors and curtain walling (including spandrel panels) are entered with an overall average thermal transmission (frame plus glass) of 1.25 W/m²K.

Solar transmission factors (glass only g value to BS EN410) and light transmission factors have been chosen to suit both the energy hierarchy and cooling hierarchy. The specification indicated in the graphic below will be applied to the various elevations:

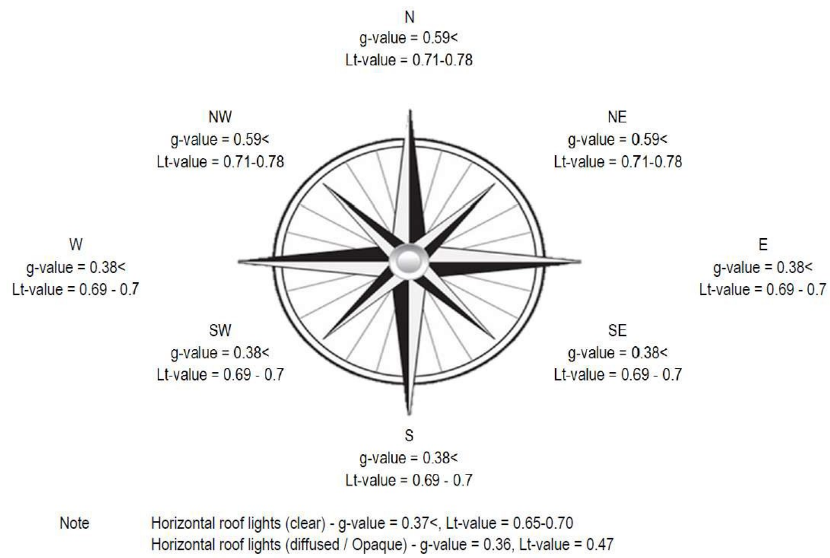



**Figure 8:** Glass g values

Rooflights are entered at 1.35 W/m$^2$K (in the horizontal) with g values of 0.38.

### *Internal blinds*

Internal blinds are not required to satisfy Criterion 3.

### *Solid doors*

The solid doors have an average overall U value of 2.2 W/m².K.

### *Shading*

There is no external shading in the model.

### *Internal elements*

| | General description |
|---|---|
| Internal partitions | Lightweight stud partitions. Generally single layer of plasterboard either side of an insulated cavity. |
| Ceilings | Partial exposed concrete to teaching areas on ground and first floor (as per next table) else lightweight (e.g. plasterboard or ceiling tiles). |
| Internal floor finish | Lightweight (e.g. carpet or vinyl). |

### *Rooms with exposed concrete ceilings (plus lightweight bulkhead housing ventilation plant)*

| | |
|---|---|
| MB 00 1112 Art General | MB 01 1013 English 6 |
| MB 00 1113 Art 3D | MB 01 1014 English 7 |
| MB 00 1114 Music | MB 01 1019 Humanities 1 |
| MB 00 1116 RM Workshop | MB 01 1020 Humanties 2 |
| MB 00 1119 Graphics ICT | MB 01 1021 Humanties 3 |
| MB 00 1120 Construction Textiles | MB 01 1022 Humanties 4 |
| MB 01 1008 English 1 | MB 01 1023 Humanties 5 |
| MB 01 1009 English 2 | MB 01 1101 ICT Rich |
| MB 01 1010 English 3 | MB 01 1102 ICT Business Studies |
| MB 01 1011 English 4 | MB 01 3001 LRC |
| MB 01 1012 English 5 | |

### *Fabric air permeability*

Target air permeability = 5.0 $m^3/m^2$.h at 50 Pa.

## 8.5 BUILDING SERVICES

The following sections identify the key modelling inputs describing the building services. As part of the 'Be Lean' stage of the energy hierarchy, the team has targeted efficient system design and plant selection.

### *Heating*

- High efficiency gas boilers. Minimum SBEM seasonal efficiency = 94%.
- Majority of heating delivered via the ventilation systems. Circulation spaces tend to utilise LTHW fan convectors. Some ancillary spaces have LTHW pipecoil emitters.
- Heating delivery efficiency > 90% (well insulated LTHW pipework to limit losses).
- LTHW pumps: variable speed with inverter drives referencing pressure across the pumps.

- Energy efficient controls including time control, room-by-room set-point control and optimum start/stop.

### *Domestic hot water*

- Electric ASHP generates DHW for the kitchen. Key system details as follows:
  - SCoP of 2.8 applies.
  - 300 litre storage vessel (storage losses < 0.0060 kWh/l.day).
  - DHW secondary circulation losses set to 8.0 W/m.
  - Time switch to be present to efficiently control hot water generation and secondary circulation pump.
- Electric POU water heaters elsewhere. Key details as follows:
  - Total storage of all heaters is 650 litres for the main school, 60 litres for the sports block.
  - Storage losses of 0.04 kWh/(l.day) apply.
- In the model it has been assumed that the hot water systems are off during holidays. This management procedure significantly reduces standing losses.

### *Ventilation*

- Ventilation is generally provided by efficient mechanical systems with heat recovery.
- Opening windows are provided for use during the warmer months. Site acoustics do not impact on window use.
- Mechanical ventilation has been applied as per the RPS outline strategy.
- All MVHR units are modelled with a recovery efficiency of 80%.
- Use of local ventilation units helps to keep specific fan powers low (as declared in the BRUKL output).
- Kitchen ventilation: Supply SFP=1.1 W/l/s. Extract SFP=1.0 W/l/s. No heat recovery.
- Mechanical extract vent to WCs/Cleaner's stores/other ad-hoc spaces:
  - Ducted systems: SFP = 0.5 W/l/s
  - Through-the-wall systems: SFP = 0.3 W/l/s
- Where dedicated mech vent systems serve single spaces these shall respond to demand (based upon $CO_2$ sensing and variable speed control). These dominate in the strategy.

### *Cooling*

- To server room only.

### *Lighting*

- All lighting systems shall be compliant with the Non-domestic Building Services Compliance Guide.
- Efficient lighting: Lighting powers as declared by RPS using 'typical' design data from previous similar projects. Luminaires will utilise a mix of LED and T5 lamps.
- Efficient Controls: RPS strategy includes efficient controls throughout the scheme including absence detection/presence detection/daylight dimming designated in accordance with room activity and daylight availability.

### *Metering*

- TM39 compliant metering and sub-metering strategy.
- At least 90% of the estimated annual energy consumption of each fuel should be capable of being assigned to the various end user categories (heating, lighting etc).
- The output of any renewable system to be separately monitored.

- In buildings with a total useful floor area greater than 1000m², automatic meter reading and data collection facilities.
- 'Out of range' energy use warnings to be automatically reported via the BMS.

### *Power Factor Correction*

- Power factor control will not be provided.

### *Renewable energy systems*

- PV system with annual yield >= 8,650 kWh (final sizing subject to detailed design during CP stage)

# 9 RESULTS

## 9.1 ASSESSING THE DESIGN FOR L2A COMPLIANCE AGAINST CRITERION 1 (TER VERSES BER)

Assessment of the design proposals gives the following compliant carbon results.

| **Target (TER)** $kgCO_2/m^2.yr$ | **Building (BER)** $kgCO_2/m^2.yr$ | **Criteria met, BER≤TER?** | **Percentage betterment** |
|---|---|---|---|
| **15.4** | 15.3 | Yes | < 1% |

The chart below shows the comparison of regulated $CO_2$ emissions for the Notional and Actual Buildings.

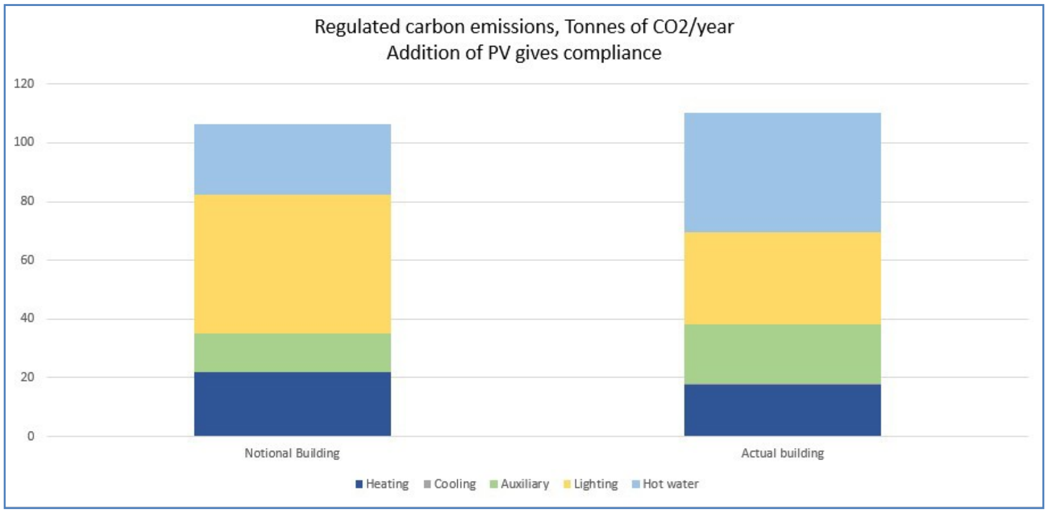



**Figure 9:** Comparison of regulated $CO_2$ emissions ($TCO_2$/year) for Notional and Actual buildings

The proposals achieve an EPC asset rating of **29**. 'A'-rated certificates are in the range 0-25 whilst 'B' ratings lie between 26-50. The design therefore achieves a very strong 'B'.

The design BRUKL report and draft EPC are provided as separate PDF documents. These are referenced in Appendix C.

## 9.2 REGULATED ENERGY

Performance in terms of regulated energy is as follows:

| Detail | Regulated energy consumption kWh/yr | Percentage change |
|---|---|---|
| Notional building | 292,940 | |
| Draft CP design, regulated consumption | 260,583 | -11% |

## 9.3 L2A CRITERION 2 – LIMITS ON DESIGN FLEXIBILITY:

Refer to Appendix C for accredited output.

The following are better than the minimum performance requirements:

- Construction U values
- Targeted air permeability
- Efficiencies of the main services plant
- Average lighting efficiency

## 9.4 L2A CRITERION 3 – LIMITING THE EFFECTS OF HEAT GAINS IN SUMMER

For this project solar gains are managed by limiting window size and through careful selection of glazing g values. The results are reported within the separate BRUKL document. All spaces are found to be compliant with the exception of the dining room (due to the 'atria' roof lights). All spaces, including the dining room, have been subject to a separate detailed Overheating Risk Assessment and found to be compliant without the use of air conditioning. The ORA takes precedence, so the criterion 3 fail is of no consequence.

Note: For buildings without mechanical cooling compliance with Criterion 3 does NOT ensure occupant comfort. Proving comfort for such buildings requires a separate more detailed study, completed in accordance with the prevailing standard. Such a study has been completed for this project and compliance demonstrated.

# 10 APPENDIX A - AN INTRODUCTION TO THE REQUIREMENTS OF ADL2A 2013 (FOR ENGLAND)

ADL2A 2013 for England stipulates a full building energy calculation for all newly constructed buildings. Formal calculations are required during both the design phase and following construction.

Energy Performance Certificates (EPCs) are mandatory upon construction, sale or rental of any non-domestic building. An assessment must be carried out by a certified assessor and an EPC generated, which gives the building a rating of A – G, with A being the most energy efficient.

Key excerpts from ADL2A 2013 for England are presented below.

## 10.1 PART L SCHEDULE 1 –CONSERVATION OF FUEL AND POWER

The requirements of Part L are as follows:

| *Requirement* | *Limits on application* |
|---|---|
| **Schedule 1 – Part L Conservation of fuel and power** | |
| **L1.** Reasonable provision shall be made for the conservation of fuel and power in buildings by: | |
| (a) limiting heat gains and losses– | |
| (i) through thermal elements and other parts of the building fabric; and | |
| (ii) from pipes, ducts and vessels used for space heating, space cooling and hot water services; | |
| (b) providing fixed building services which– | |
| (i) are energy efficient; | |
| (ii) have effective controls; and | |
| (iii) are commissioned by testing and adjusting as necessary to ensure they use no more fuel and power than is reasonable in the circumstances. | |

## 10.2 DESIGN STANDARDS

### REGULATIONS 35, 24 AND 25

Regulations 35, 24 and 25 state that:

**Interpretation**

**35(1).** 'Energy performance of a building' means the calculated or measured amount of energy needed to meet the energy demand associated with a typical use of the building, which includes, inter alia, energy used for heating, cooling, ventilation, hot water and lighting.

**Methodology of calculation of the energy performance of buildings**

**24.** (1) The Secretary of State shall approve–

(a) a methodology of calculation of the energy performance of buildings, including methods for calculating asset ratings and operational ratings of buildings; and

(b) ways in which the energy performance of buildings, as calculated in accordance with the methodology, shall be expressed.

(2) In this regulation–

'asset rating' means an energy performance indicator determined from the amount of energy estimated to meet the different needs associated with a standardised use of the building; and

'operational rating' means an energy performance indicator determined from the amount of energy consumed during the occupation of a building over a period of time and the energy demand associated with a typical use of the building over that period.

**Minimum energy performance requirements for buildings**

**25.** Minimum energy performance requirements shall be set by the Secretary of State calculated and expressed in accordance with the methodology approved pursuant to regulation 24, for–

(a) new buildings (which shall include new dwellings), in the form of target $CO_2$ emission rates; and

(b) new dwellings, in the form of target fabric efficiency rates.

### TARGET EMISSION RATE (TER)

The Target Emission Rate (TER) is the minimum performance requirement for a new building based on the methodology approved by the Secretary of State. It is expressed in terms of the mass of $CO_2$ emitted per square metre per year.

The TER must be calculated using an accredited methodology. Accredited tools include:

a. The Simplified Building Energy Model (SBEM) for those buildings whose design features are capable of being adequately modelled by SBEM; or
b. other software tools approved under the Notice of Approval.

The accredited tool utilised for compliance by Paul Welsh Consulting Ltd, in this instance, is IES Virtual Environment. This is accredited software for Level 3, 4 and 5 assessments.

## 10.3 CRITERION 1 – ACHIEVING THE TER:

Regulation 26 states that:

> **$CO_2$ emission rates for new buildings**
>
> **26.** Where a building is erected, it shall not exceed the target $CO_2$ emission rate for the building that has been approved pursuant to regulation 25.

### CALCULATING THE $CO_2$ EMISSIONS

To demonstrate that the requirement in regulation 26 has been met, the actual Building Emission Rate (BER) must be no greater (no worse) than the TER.

The BER and TER values are obtained from the simulated carbon dioxide emissions of two buildings.

The 'actual building', which forms the basis of the BER calculation, is the building as designed, but subject to standard operating conditions dictating levels and patterns of occupancy, internal gain and service provision.

The 'notional building', which forms the basis of the TER calculation, is a version of the actual building modified in accordance with rules relating to glazing area, fabric performance and system provision and efficiency (Appendix B refers). These rules are related to the standards laid down in the National Calculation Methodology (NCM). The notional building is also subject to the same standard operating conditions.

Both buildings are simulated over a typical year using standard weather data appropriate to the building location.

The standard operating conditions are functions of the building type and the activities occurring within each room. They are laid down in the NCM. It is important to note that the stipulation of standard operating conditions and weather for L2A compliance calculations means that results as calculated for L2A will NOT be a measure of actual expected energy use but rather they enable comparison of overall efficiency.

*NOTE: REGULATORY COMPLIANCE IS NOT AN INDICATOR OF COMPLIANCE WITH ANY ADDITIONAL REQUIREMENTS THAT MAY BE IMPOSED BY THE PLANNING AUTHORITY.*

It must be emphasised that the SBEM/NCM is a tool for demonstrating compliance with Part L and is NOT a building simulation or optimisation tool. It needs to be understood by all designers that 'passing' the SBEM test and demonstrating compliance does not mean that we have the most energy efficient or sustainable solution. The NCM/SBEM method shows compliance with the letter of the law, not necessarily its spirit.

Finally, the reader will need to recall that the SBEM does not, and was never meant to, predict actual energy 'in-use'. Should this be required then a separate CIBSE TM54 study should be commissioned.

## TIMING OF CALCULATIONS

Regulation 27 of the Building Regulations states:

**$CO_2$ emission rate calculations**

**27.** (1) This regulation applies where a building is erected and regulation 26 applies.

(2) Not later than the day before the work starts, the person carrying out the work shall give the local authority a notice which specifies–

(a) the target $CO_2$ emission rate for the building,

(b) the calculated $CO_2$ emission rate for the building as designed, and

(c) a list of specifications to which the building is to be constructed.

(3) Not later than five days after the work has been completed, the person carrying out the work shall give the local authority–

(a) a notice which specifies–

(i) the target $CO_2$ emission rate for the building,

(ii) the calculated $CO_2$ emission rate for the building as constructed, and

(iii) whether the building has been constructed in accordance with the list of specifications referred to in paragraph (2)(c), and if not a list of any changes to those specifications; or

(b) a certificate of the sort referred to in paragraph (4) accompanied by the information referred to in sub-paragraph (a).

(4) A local authority is authorised to accept, as evidence that the requirements of regulation 26 have been satisfied, a certificate to that effect by an energy assessor who is accredited to produce such certificates for that category of building.

(5) In this regulation, 'specifications' means specifications used for the calculation of the $CO_2$ emission rate.

**NOTE:** *Where the BCB is an approved inspector see regulation 20 of the Building (Approved Inspectors etc.) Regulations 2010 (as amended).*

The calculation of the BER/TER needs to be carried out twice:

1. A 'design stage' assessment being carried out and submitted the day before work starts.
2. A final simulation is then required for the 'as constructed' building incorporating any changes to the fabric or building systems, changes during construction and using the measured permeability performance, ductwork leakage and commissioned fan performance. This has to be submitted not later than five days after the work has been completed.

## 10.4 CRITERION 2 – LIMITS ON DESIGN FLEXIBILITY:

Criterion 2 imposes constraints on U-values and other aspects of building and system performance.

Limiting fabric standards (U-values and air permeability) are stated in Table 3 below. The IES VE software applies checks for compliance with this requirement before performing the actual and notional building simulations. Recall the Notional Building is built to the concurrent standards given in Appendix B. These standards are considerably better than the limits below.

**Table 3 Limiting fabric parameters**

| | |
|---|---|
| Roof | 0.25 W/(m²·K) |
| Wall | 0.35 W/(m²·K) |
| Floor | 0.25 W/(m²·K) |
| Swimming pool basin[1] | 0.25 W/(m²·K) |
| Windows, roof windows, roof-lights[2], curtain walling and pedestrian doors[3,4] | 2.2 W/(m²·K) |
| Vehicle access and similar large doors | 1.5 W/(m²·K) |
| High-usage entrance doors | 3.5 W/(m²·K) |
| Roof ventilators (inc. smoke vents) | 3.5 W/(m²·K) |
| Air permeability | 10.0 m³/(h·m²) at 50 Pa |

Notes:

1. Where a swimming pool is constructed as part of a new building, reasonable provision should be made to limit heat loss from the pool basin by achieving a U-value no worse than 0.25 W/(m²·K) as calculated according to BS EN ISO 13370.
2. For the purposes of checking compliance with the limiting fabric values for roof-lights, the true U-value based on aperture area can be converted to the U-value based on the developed area of the roof-light. Further guidance on evaluating the U-value of out-of-plane roof-lights is given in *Assessment of thermal performance of out-of-plane rooflights*, NARM Technical Document NTD 2 (2010).
3. Excluding display windows and similar glazing. There is no limit on design flexibility for these exclusions but their impact on $CO_2$ emissions must be taken into account in calculations.
4. In buildings with high internal heat gains, a less demanding area-weighted average U-value for the glazing may be an appropriate way of reducing overall $CO_2$ emissions and hence the BER. If this case can be made, then the average U-value for windows can be relaxed from the values given above. However, values should be no worse than 2.7 W/(m²·K).

Requirements are also laid down for the following:

- Controls
- System efficiencies
- Energy Meters
- Centralised switching of appliances

Limiting services efficiencies are provided in the DCLG 'Non-domestic Building Services Compliance Guide' and include;

- Heating and hot water service systems
- Cooling plant
- Air handling plant
- Insulation of pipes, ducts and vessels
- Lighting
- Pumps

The requirements of ADL2A 2013 include the following:

| **Clause 2.43 – Controls. The following features would normally be appropriate:** | |
|---|---|
| a. | The systems should be sub divided into separate zones to correspond to each area of the building that has a significantly different solar exposure, or pattern or type of use; and |
| b. | Each separate control zone should be capable of independent timing and temperature control and, where appropriate, ventilation and air recirculation rate; and |
| c. | The provision of the service should respond to the requirements of the space it serves. If both heating and cooling are provided, they should be controlled so as not to operate simultaneously; and |
| d. | Central plant should operate only as and when the zone systems require it. The default condition should be off |

| **Clause 2.45, 2.46 – System Efficiencies:** |
|---|
| 2.45 Each fixed building service shall be at least as efficient as the worst acceptable values for the particular type of appliance as set out in the *Non-domestic Building Services Compliance Guide.* |
| 2.46 The efficiency claimed for the fixed building service should be based on the appropriate test standard set out in the *Non-domestic Building Services Compliance Guide* and the test data should be certified by a notified body. It is reasonable for BCBs to accept such data at face value. In the absence of quality assured data, the BCB should satisfy itself that the claimed performance is justified. |

| **Clause 2.47, 2.48- Energy Meters** | |
|---|---|
| **2.47** Reasonable provision for energy meters would be to install energy metering systems that enable: | |
| a. | at least 90% of the estimated annual energy consumption of each fuel assigned to the various end user categories (heating, lighting etc.). All to be in compliance with the guidance given in CIBSE TM 39; and |
| b | the output of any renewable system to be separately monitored; and |
| c. | in buildings with a total useful floor area greater than 1000m$^2$-, automatic meter reading and data collection facilities. |
| **2.48** The metering provisions should be designed such as to facilitate the benchmarking of energy performance as set out in CIBSE TM 46 *Energy Benchmarks.* | |

| **Clause 2.49 Centralised switching of appliances:** |
|---|
| Consideration should be given to the provision of centralised switches to allow the facilities manager to switch off appliances when they are not needed (e.g. overnight and at weekends).<br>Where appropriate, these should be automated (with manual override) so that energy savings are maximised. |

## 10.5 CRITERION 3 - LIMITING THE EFFECTS OF HEAT GAINS IN SUMMER:

This applies to all buildings, irrespective of whether they are air conditioned or not. The intention is to limit solar gains during the summer period to either:

a) Reduce the need for air conditioning; or
b) Reduce the installed capacity of any air conditioning system that is installed.

If the criterion set out is satisfied this is NOT evidence that the internal environment of the building will be satisfactory. Many factors that are not covered by the compliance assessment procedure will have a bearing on the incidence of overheating (incidental gains, thermal capacity, ventilation provisions etc.). *The developer should therefore, work with the design team to specify what constitutes an acceptable indoor environment in the particular case and carry out the necessary design assessments to develop solutions that meet the agreed brief.*

## 10.6 CRITERION 4 - BUILDING PERFORMANCE CONSISTENT WITH THE BER

Regulation 43 makes it mandatory that new buildings, including dwellings, are tested for air leakage to demonstrate that the construction meets the design assumptions.

Regulation 44 requires fixed building services to be commissioned by testing and adjustment as necessary to ensure that they use no more fuel and power than is reasonable in the circumstances. In order to demonstrate that the heating and hot waters systems will be adequately commissioned it would be useful to prepare a commissioning plan, identify systems that need to be tested and the tests that will be carried out and provide this with this design stage compliance report under separate cover to the BCB.

The BER/TER calculation must be reproduced for the building 'as built'. This means reproducing the SBEM calculations to demonstrate the acceptability of variations since the design assessment. The 'as measured' air permeability and specific fan powers should be used in the final calculation.

## 10.7 CRITERION 5 – PROVISIONS FOR ENERGY-EFFICIENT OPERATION OF THE BUILDING

There should be provisions put in place (building log-book) to enable energy efficient operation of the building to be undertaken. This should be passed over to the building occupier on completion.

The data used to calculate the TER and the BER (within the SBEM calculation) should be included in the log book.

## 10.8 CONSIDERATION OF HIGH-EFFICIENCY ALTERNATIVE SYSTEMS

In addition to the aforementioned requirements, ADL2A also requires consideration of high-efficiency alternative systems during the design phase, as follows. For this project these requirements are subject to a separate report by others.

### Consideration of high-efficiency alternative systems for new buildings

**25A.** (1) Before construction of a new building starts, the person who is to carry out the work must analyse and take into account the technical, environmental and economic feasibility of using high-efficiency alternative systems (such as the following systems) in the construction, if available—

(a) decentralised energy supply systems based on energy from renewable sources;

(b) cogeneration;

(c) district or block heating or cooling, particularly where it is based entirely or partially on energy from renewable sources; and

(d) heat pumps.

(2) The person carrying out the work must—

(a) not later than the beginning of the day before the day on which the work starts, give the local authority a notice which states that the analysis referred to in paragraph (1)—

(i) has been undertaken;

(ii) is documented; and

(iii) the documentation is available to the authority for verification purposes; and

(b) ensure that a copy of the analysis is available for inspection at all reasonable times upon request by an officer of the local authority.

(3) An authorised officer of the local authority may require production of the documentation in order to verify that this regulation has been complied with.

(4) The analysis referred to in paragraph (1)—

(a) may be carried out for individual buildings or for groups of similar buildings or for common typologies of buildings in the same area; and

(b) in so far as it relates to collective heating and cooling systems, may be carried out for all buildings connected to the system in the same area.

(5) In this regulation—

(a) 'cogeneration' means simultaneous generation in one process of thermal energy and one or both of the following—

(i) electrical energy;

(ii) mechanical energy;

(b) 'district or block heating or cooling' means the distribution of thermal energy in the form of steam, hot water or chilled liquids, from a central source of production through a network of multiple buildings or sites, for the use of space or process heating or cooling;

(c) 'energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases; and

(d) 'heat pump' means a machine, a device or installation that transfers heat from natural surroundings such as air, water or ground to buildings or industrial applications by reversing the natural flow of heat such that it flows from a lower to a higher temperature. (For reversible heat pumps, it may also move heat from the building to the natural surroundings.)

**NOTE:** *Where the BCB is an approved inspector see regulation 20 of the Building (Approved Inspectors etc.) Regulations 2010 (as amended).*

# 11 APPENDIX B – SUMMARY OF CONCURRENT NOTIONAL BUILDING SPECIFICATION

**Table 5 Summary of concurrent notional building specification**

| Element | Side lit or unlit (where HVAC specification is heating only) | Side lit or unlit (where HVAC specification includes cooling) | Top lit |
|---|---|---|---|
| Roof U-value (W/(m²·K)) | 0.18 | 0.18 | 0.18 |
| Wall U-value (W/(m²·K)) | 0.26 | 0.26 | 0.26 |
| Floor U-value (W/(m²·K)) | 0.22 | 0.22 | 0.22 |
| Window U-value (W/(m²·K)) | 1.6 (10% FF) | 1.6 (10% FF) | N/A |
| G-value (%) | 40 | 40 | N/A |
| Light transmittance (%) | 71 | 71 | N/A |
| Roof-light U-value (W/(m²·K)) | N/A | N/A | 1.8 (15% FF) |
| G-value (%) | N/A | N/A | 55 |
| Light transmittance (%) | N/A | N/A | 60 |
| Air permeability (m³/(m²·hour)) Gross internal area less than or equal to 250 m² | 5 | 5 | 7 |
| Air permeability (m³/(m²·hour)) Gross internal area greater than 250 m² and less than 3500 m² | 3 | 3 | 7 |
| Air permeability (m³/(m²·hour)) Gross internal area greater than or equal to 3500 m² and less than 10,000 m² | 3 | 3 | 5 |
| Air permeability (m³/(m²·hour)) Gross internal area greater than or equal to 10,000 m² | 3 | 3 | 3 |
| Lighting luminaire (lm/circuit watt) | 60 | 60 | 60 |
| Occupancy control (Yes/No) | Yes | Yes | Yes |
| Daylight control (Yes/No) | Yes | Yes | Yes |
| Maintenance factor | 0.8 | 0.8 | 0.8 |
| Constant illuminance control | No | No | No |
| Heating efficiency (heating and hot water) (%) | 91 | 91 | 91 |
| Central ventilation SFP (W/(l·s)) | 1.8 | 1.8 | 1.8 |
| Terminal unit SFP (W/(l·s)) | 0.3 | 0.3 | 0.3 |
| Cooling (air-conditioned) (SEER/SSEER) | N/A | 4.5 / 3.6 | 4.5 / 3.6 |
| Cooling (mixed mode) (SSEER)[1] | N/A | 2.7 | 2.7 |
| Heat recovery efficiency (%) | 70 | 70 | 70 |
| Variable speed control of fans and pumps, controlled via multiple sensors | Yes | Yes | Yes |
| Demand control (mechanical ventilation only). Variable speed control of fans via $CO_2$ sensors | Yes | Yes | Yes |

Note 1: Mixed mode assumed to be cooled by DX unit where SSEER includes indoor and outdoor units and fans, pumps and losses

# 12 APPENDIX C – DESIGN STAGE BRUKL REPORT AND DRAFT EPC

Refer to separate PDF documents for full BRUKL and EPC details:

- 'Trinity Academy St Edwards Rev 2_1_brukl'
- 'Trinity Academy St Edwards Rev 2_1_epc'