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# HAMPTON PRE-PREP SCHOOL EXTENSION
## Energy Statement

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# HAMPTON PRE-PREP SCHOOL EXTENSION
# Energy Statement

## Contents



## Appendices



**Registration of Amendments**

| Revision | Amendment Details | Revision Prepared By | Revision Approved By |
|---|---|---|---|
| | | | |
| | | | |

## EXECUTIVE SUMMARY

This Energy Statement is submitted to support the planning application for the proposed development at Hampton Pre-prep School, in the London Borough of Richmond-upon-Thames. The strategy has been prepared in the context of the adopted Richmond Local Plan 2018, specifically Policy LP 22, which states that all developments are required to incorporate measures to improve energy conservation and efficiency, and should achieve a 35% carbon emission reduction over the Part L compliant case.

The adopted policy requires all developments to integrate the principles of sustainable design and construction into the design of the new proposal. This energy strategy demonstrates the carbon reductions that can be achieved through addressing the fabric energy efficiency measures and efficient servicing solutions throughout.

The assessment of predicted carbon emissions was carried out using the current (SAP 2012) fuel carbon factors. The scale of the development does not classify it as a referable application and therefore the existing fuel carbon factors are deemed appropriate for this development.

**'Be Lean':** The strategy aims to reduce energy demands by specifying a highly efficient building fabric and efficient heating and ventilation system. This is to ensure that the highest possible standards are achieved for the site. The proposal will ensure the development achieves an overall reduction of 3.5% from 'Be Lean' measures only.

**'Be Clean':** The opportunity for the proposed development to link into an existing or planned decentralised energy network has been considered. The development is not located within the immediate proximity of a proposed district heat network with the London Heat Map showing the closest potential heat network located 12 km away from the site. The connection to district heating has therefore not been further explored.

**'Be Green':** A feasibility study has been undertaken to establish suitability of the new building for integration of renewable technology on site. It has been concluded that the most feasible technology will be 4 kWp photovoltaic system mounted on the flat roof of the school hall. London Borough of Richmond-upon-Thames $CO_2$ emissions reduction requirement (35% improvement over Part L 2013) and London Plan Policy 5.7 target (20% carbon emissions reduction from renewable technology) have been met for the site.

The incorporation of PV panels will also ensure that the proposal achieves the required energy credits to support the BREEAM assessment for the site.

# 1.0 INTRODUCTION

1.1 Create Consulting Engineers Ltd has been commissioned by Hampton School to prepare an Energy Statement to support a full planning application for the proposed new school hall stand-alone building and extension to the Pre-prep School in Hampton, in the London Borough of Richmond-upon-Thames.

1.2 The objective of the Energy Statement is to assess the proposed development against the policy requirements of the adopted Richmond Local Plan and specifically Policy LP22: Sustainable Design and Construction.

**Site Location and Description**

1.3 The Site is the existing Pre-prep and Prep School, located on Wensleydale Road. Please refer to figure 1.1 below for the Site Location Plan.


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**Figure 1.1: Site Location Plan**

1.4 The proposal comprises the demolition of the current kindergarten building and provision of a new stand-alone school hall building to be located in place of the existing storage sheds. The proposed re-development also includes the side two-storey extension to the existing school together with the addition of a conservatory to the west elevation. Minor internal layout changes to the existing building are also proposed.

**Objectives**

1.5 The objectives of this report are to:

- Demonstrate how the proposed development has been assessed against the policy requirements of the adopted Richmond Local Plan, specifically Policy LP 22.
- Identify the most suitable passive and energy efficient design approach for the scheme, the feasibility of Low and Zero Carbon technologies and operational Best Practice.
- Identify the drivers relating to an energy efficient design over and above minimum compliance with current Building Regulations and energy targets.

## 2.0 CURRENT AND FUTURE PLANNING POLICIES/GOOD PRACTICE REVIEW AND PROJECT REQUIREMENTS

**National Planning Policy Framework (February 2019)**

2.1 The National Planning Policy Framework sets out the Government's planning policies for England and how these are expected to be applied. Taken together, these policies articulate the Government's vision of sustainable development, which should be interpreted and applied locally to meet local aspirations. The ministerial foreword of this NPPF highlights that 'the purpose of planning is to contribute to the achievement of sustainable development' and that at the heart of the framework is a presumption in favour of sustainable development.

2.2 Sustainable development is defined in the NPPF as comprising developments "meeting the needs of the present without compromising the ability of future generations to meet their own needs" in line with the definition of the Brundtland Commission ('Our Common Future', 1987). The NPPF also refers to the three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways – an economic objective, a social objective and an environmental objective.

**The London Plan, March 2016**

2.3 This Spatial Development Strategy for Greater London includes objectives to reduce the capital's impact on, and exposure to, the effect of climate change. The policies that are appropriate to the development proposals are detailed in the following sections.

<u>Policy 5.2: 'Minimising Carbon Dioxide Emissions'</u>

2.4 Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the energy hierarchy.

<u>Policy 5.6: 'Decentralised Energy in Development proposals'</u>

2.5 Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

<u>Energy and Carbon Dioxide Emission - Mayor's Priorities</u>

2.6 The overall carbon dioxide emissions from a development should be minimised through the implementation of the energy hierarchy set out in London Plan Policy 5.2. To avoid complexity and extra costs for developers, the Mayor will adopt a flat carbon dioxide improvement target beyond Part L 2013 of 35% to both residential and non-residential development. Developers should aim to achieve Part L 2013 Building Regulations requirements through design and energy efficiency alone, as far as is practical.

**Draft New London Plan**

2.7 A draft new London Plan was published by the Mayor for consultation in December 2017. The consultation period ended on 2 March 2018. The Plan is at an advanced stage. Policies contained in the Intend to Publish London Plan (December 2019) that are not subject to a direction by the Secretary of State carry significant weight.

2.8 The information published by the Mayor of London states that "the current 2016 Plan (The London Plan consolidated with alterations since 2011) is still the adopted Development Plan, but the *Draft London Plan is a material consideration in planning decisions. The significance given to it is a matter for the decision maker, but it gains more weight as it moves through the process to adoption."*

2.9 Policy SI2 within the proposed Chapter 9: Sustainable Infrastructure confirms the London principles for minimising greenhouse gas emissions.

**Greater London Authority (GLA) guidance on preparing energy assessments as part of planning applications Draft (April 2020)**

2.10 The April 2020 draft revision to the GLA guidance on preparing energy statements confirms the calculation methodology for new developments and refurbishments, and sets an expectation for all referable applications to use SAP 10 fuel carbon emission factors.

**Local Planning Policy**

<u>London Borough of Richmond-upon-Thames Local Plan (2018)</u>

2.11 The new Richmond Local Plan, adopted on July 2018, sets out the planning framework to guide the future development of the borough to 2033. The following policy has been identified as appropriate for assessing the energy performance and water efficiency of new developments and refurbishments:

- Policy LP 22: Sustainable Design and Construction.

  *"Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:*

  *1. Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.*

  *2. (…).*

*3. New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard*

*Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:*
*1. (…)*
*2. (…)*
*3. All non-residential buildings over 100sqm should achieve a 35% reduction. (…)*

*This should be achieved by following the Energy Hierarchy:*
*1. Be lean: use less energy*
*2. Be clean: supply energy efficiently*
*3. Be green: use renewable energy*

**Building Regulations Approved Document Part L: 2013**

2.12 Part L of the current Building Regulations (2013) considers the reduction of carbon emissions in new and existing buildings. As the proposals consist of the creation of new non-domestic building and extension to the existing building, they fall under Part L2A and L2B of the Regulations.

2.13 The overall structure of compliance with the 2013 Building Regulations for new buildings includes five criteria to comply with:

- **Criterion 1** – The Building Emission Rate (BER) should be better than the Target Emission Rate (TER);
- **Criterion 2** - Limit on design flexibility;
- **Criterion 3** - Limiting effects of heat gain in summer;
- **Criterion 4** - Commissioning and air-tightness;
- **Criterion 5** - Efficient operation of buildings.

2.14 The Approved Document L2B: Conservation of fuel and power in existing non-dwellings gives guidance on energy efficiency requirements for retained, upgraded and new elements in existing buildings and buildings that undergo change of use or change of energy status. It also sets out the minimum requirements for the provision or extension of controlled fittings (windows, doors) and controlled services (heating, cooling, ventilation and lighting).

2.15 The detailed energy strategy for the scheme will be developed to ensure the scheme meets the relevant requirements of the Building Regulations.

**Summary of Policy Requirements for the Proposed Development**

2.16 The proposed development is required to meet the following standards:

- 35% reduction in $CO_2$ emissions over the baseline scenario for the new built school hall;
- Part L2B standards for building fabric and services for the side extension and rear conservatory;
- Submit an Energy Statement;
- Submit a Sustainable Construction Checklist;
- BREEAM New Construction 'Excellent' rating for the new school hall, where feasible.

## 3.0 ENERGY EFFICIENCY STRATEGY – 'BE LEAN'

**Introduction**

3.1 The proposed energy strategy has, as its first priority, minimised energy consumption through the performance of the building envelope and services. The following section details the energy efficiency features of the development. The cooling hierarchy set out within the London Plan has been followed.

3.2 This analysis includes:

- Building Regulations Approved Document L2A and L2B (2013) initial compliance assessment, identifying the potential for the design to comply with and exceed Building Regulations requirements.
- An energy demand assessment of the proposed scheme contained within this document provides carbon dioxide emissions estimates from the analysis of passive energy efficiency enhancements and Low and Zero Carbon potential. This will utilise Building Regulations 2013 carbon dioxide fuel factors.

3.3 In further detail, the energy efficiency strategy of the scheme has been achieved by incorporating the following design and technology features:

**Energy Efficiency Features Proposed**

Physical Form and Orientation of the Building

3.4 While the orientation of the development is limited due to it being erected on a small parcel of land, the facades of the new block have been optimised in order to provide a balance of thermal control, both from within and outside the buildings.

3.5 Passive solar design involves adapting the internal layout and glazing to best respond to the local climate and annual sun path, with the aim of reducing energy demands and improving occupant comfort through the use of heat and light from the sun. The new school hall building will utilise the passive solar design principles through orientation of its windows towards south. This will enable daylight penetration into the new building, reducing its heating load.

Overheating

3.6 Overheating is reduced through the inclusion of openable windows to enable effective purge ventilation. Additionally, operable roof lights are proposed, which will be equipped with rain sensors to make the most of the potential for passive stack ventilation.

3.7 All windows to the main hall will be utilising glazing with a low solar thermal transmittance factor of 0.35 to further reduce solar gains during summer months.

3.8 Shading control systems in the form of individually controlled interior opaque blinds will offer efficient solar control as they provide both solar shading and glare control, which in turn improves occupier comfort and reduces the risk of overheating within the building.

Building Envelope Specification and Thermal Performance

3.9 The heat losses of the spaces will be reduced by optimising the thermal performance of the building fabric and limiting the air permeability through a very high standard of construction. This strategy will lead to a steady but extremely low space heating load for all of the buildings of the scheme.

3.10 The new school hall building is proposed to be constructed of modular elements, which will be manufactured to meet the desired specification.

3.11 The side extension to the main school building will be constructed of traditional brick-block cavity wall and timber frame roof structure.

3.12 Building fabric thermal transmittance is measured by the U-value of each building element in Watts/m²/K. The U-Value is essentially a measure of the rate at which energy is lost through a building element; the greater the U-Value, the higher the rate of energy loss.

3.13 Table 3.1 below details the U-values for the development at in relation to Building Regulations notional values for new builds and table 3.2 details the U-values for the extension and the rear conservatory that will be met as minimum.

| Energy Efficiency Features | Part L2A-2013 Reference Values for Notional Building | Proposed Building |
|---|---|---|
| **U-Value Walls (W/m²K)** | 0.26 | 0.26 |
| **U-Value Ground Floor/ Upper Exposed Floor (W/m²K)** | 0.22 | 0.22 |
| **U-Value Roof (W/m²K)** | 0.18 | 0.18 |
| **U-Value Windows (W/m²K)** | 1.6 | 1.6<br>g-factor = 0.35 for all windows in the hall |
| **U-Value Doors - solid (W/m²K)** | 2.2 | n/a |
| **Permeability Rate (m³/hm²) @ 50Pa** | 3 | 3-4 |
| **Thermal Bridging (W/m²K)** | Accredited Construction Details | Accredited Construction Details, where available |

**Table 3.1: Proposed building fabric performance for the new School Hall**

| Energy Efficiency Features | Part L2B (2013) Limiting Fabric Parameter | Proposed Values |
|---|---|---|
| | New elements | |
| **External solid brick walls (W/m²K)** | 0.28 | 0.28 |
| **Ground Floor** | 0.22 | 0.22 |
| **Roof - Insulation at rafter level** | 0.18 | 0.18 |
| **New windows** | 1.8 | 1.8 or better |

**Table 3.2: Building Fabric Standard Specified for the Side Extension and Rear Conservatory**

Air Tightness and Ventilation Strategy/Scope for Natural Ventilation

3.14 Air permeability is a measure of infiltration. It indicates how often the entire air quantity in a building is exchanged with outside air within 1 hour without any ventilation in place. Any air exchange with outside air is carrying heat energy away from the building, resulting in a higher heating load. Lower air permeability levels are desirable for conserving heat energy and in the case of mechanical ventilation systems for reducing fan power consumption. Infiltration is different from ventilation. Infiltration is essentially unwanted air exchanges through imperfections in the building fabric while ventilation is the air exchanges intended by the designer.

3.15 As detailed in Table 3.1 it is envisaged that the air permeability of the proposed new building will be improved to at least 4 $m^3/m^2$@50PA/hr for all spaces.

3.16 The new building and the proposed extension are proposed to be naturally ventilated with extract fans provided to all wet rooms.

Overheating

3.17 Overheating is reduced through the inclusion of openable windows to enable effective ventilation and cross-ventilation of the rooms.

3.18 Additionally, the south facing windows in the proposed hall will have a low solar thermal transmittance (g-value), in the region of 0.35 limiting solar gains and preventing overheating.

3.19 Shading control systems in the form of individually controlled interior curtains or blinds will offer additional solar control as they provide both solar shading and glare control, which in turn improves occupier comfort and reduces the risk of overheating within the rooms.

3.20 Comfort cooling will not be needed for the spaces reducing energy demand for the development.

Lighting and Appliances

3.21 High efficiency low energy lighting and controls have been specified throughout. All new spaces will utilise 100% low energy lighting.

3.22 Lighting will be designed in accordance with CIBSE (Chartered Institute of Building Service Engineers) Guide A: Environmental Design and relevant CIBSE Lighting Guides.

3.23 Unnecessary light spill will be reduced by avoiding the use of external decorative lighting; providing fittings only where they are required for security and maintenance purposes. External luminaires have been chosen to minimise sky glow and overspill and located to ensure that only the level of lighting that is required is achieved.

3.24 The lighting solution will make use of modern luminaire and lamp technology, including constant illuminance control and photoelectric dimmable LEDs in the main hall, and occupancy sensors in the toilets, stores and circulation areas. All lamps efficacy will be minimum 70 lumens/circuit Watt. The position of individual light fittings will also be chosen to minimise over-provision whilst ensuring that lux uniformity is maintained.

3.25 All appliances will be very energy efficient (A to A+++ rated). Information on the EU Energy Efficiency Labelling Scheme will be provided.

The Choice and Design of Building Systems and Plant – Gas Boiler

3.26 The building systems and plant have been chosen to optimise the efficiency of the systems by matching installed capacity to anticipated building demand. Items of equipment, which make up the building's mechanical building services installation, will be specified to achieve high annual energy efficiency in operation and will be serviced regularly to maintain their performance.

3.27 A highly efficient condensing gas combi boiler has been proposed for the new school hall. It will provide space heating to all rooms and hot water to the kitchen, cleaner's cupboard and the accessible toilet. The hot water provision in the main pupils' toilet will be satisfied by an electric, small storage multi-point heater (e.g. 10 litre Heatrae Sadia) ensuring instant hot water provision.

3.28 The efficiency of the proposed gas boiler will be in the region of 92%. The space heating will be provided by radiators and the system will be controlled via a programmer and room thermostats.

3.29 This strategy minimises the potential visual and noise impacts of the heating system on the property and the surrounding area.

3.30 A gas boiler strategy is considered to be the most suitable option for a modular building where floor construction might limit the use of underfloor heating desirable for low heat technologies, e.g. heat pumps.

3.31 The proposed side extension to the main school building will be connected to the existing heating system. The heating controls will include room thermostat and TRVs (thermostatic radiator valves).

**Energy requirement and $CO_2$ emissions of the development**

<u>GLA Guidance</u>

3.32 The GLA guidance on preparing energy assessments clarifies the calculation methodology for residential and non-domestic developments to ensure the consistency of the calculations across all boroughs.

3.33 The energy assessment must first establish the regulated $CO_2$ emissions assuming the development complies with Part L 2013 of the Building Regulations. When determining this baseline, it should be assumed that the heating would be provided by gas boilers and that any active cooling would be provided by electrically powered equipment. The boilers should be assumed to have an efficiency of 91% for non-residential developments. All controls should align with the Part L notional building assumptions. This is to demonstrate the $CO_2$ emissions savings achieved through incorporation of passive design and efficient building fabric.

<u>Simplified Building Energy Model (SBEM)</u>

3.34 IES VE uses the National Calculation Methodology (NCM) and SBEM platform to demonstrate building compliance for non-residential buildings with Part L2A of the Building Regulations 2013. It can also be used to determine the building's regulated energy demand, consumption and carbon dioxide emissions.

3.35 The calculations determine a Building Emissions Rate or 'BER'. This value is compared to the energy requirements and emissions of a notional building of the same shape and dimensions which determines a compliant building (the Target Emission Rate or 'TER'). The BER must be equal to or less than the TER.

<u>Results of the Energy Simulation</u>

3.36 The total $CO_2$ emissions have been estimated based on the results from the energy modelling for the proposed building. Please refer to Table 3.3 below and Appendix A.

| Carbon Dioxide Emissions | Carbon Dioxide Emissions [tonnes/year] | |
|---|---|---|
| | **Regulated** | **Unregulated** |
| **Baseline: Part L 2013 of the Building Regulations Compliant Development (gas boilers– GLA guidance)** | 2.28 | 2.58 |
| **Be Lean - After energy demand reduction** | 2.20 | 2.58 |
| **Improvement over Part LA: 2013** | **0.08** | **Tonnes $CO_2$ per annum** |
| | **3.5** | **%** |

**Table 3.3: $CO_2$ emissions and energy consumption for the 'Be Lean' case**

**Results of the Energy Simulation**

3.37 The regulated $CO_2$ emissions of the proposed scheme have been estimated as approximately 2.2 tonnes of $CO_2$ per year.

3.38 The estimated $CO_2$ emissions calculated for the 'Be Lean' scenario for the development demonstrate that the proposed building fabric and systems' efficiencies exceed those required by the Building Regulations, showing the commitment to reducing carbon emissions through incorporation of energy efficiency features in first instance.

3.39 It is worth noting that due to the current calculation methodology used for Part L compliance and the GLA Energy Assessment methodology, the $CO_2$ savings achieved through the provision of energy efficient appliances (unregulated loads) are not included, hence the $CO_2$ savings presented in this report are considered to be conservative. The unregulated $CO_2$ emissions have been considered similar for all the different stages of the London Plan energy hierarchy. It is however expected that this scheme will lead to unregulated $CO_2$ emissions significantly lower than those of a standard Part L 2013 compliant scheme.

3.40 The results of the energy simulation demonstrate that the proposal will meet the requirements for energy efficient design outlined in the adopted Local Plan Policy LP 22.

## 4.0 'BE CLEAN': SUPPLY ENERGY EFFICIENTLY

4.1 Connection to a decentralised energy network and the use of combined heat and power is a recognised method of generating energy more efficiently. The adopted Local Plan Policy LP 22 requires development proposals to explore the opportunities to link into an existing or planned decentralised energy network. Where an existing decentralised energy network is not present, an assessment of the feasibility of establishing a decentralised energy system for the proposed development should be undertaken; including an assessment of the feasibility of a Combined Heat and Power (CHP) communal heating system.

**Decentralised Energy Networks**

4.2 The London Heat Map tool is an interactive tool that allows users to identify opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study. All information has been updated and the map is now in a user friendly format using an interactive GIS system. This tool details the existing and proposed major heat loads and supplies within London as well as existing and proposed heat distribution networks.

4.3 The London Heat Map tool indicates the location of future decentralised energy networks approximately 11 kilometres from the proposed development site (Please refer to Figure 4.1). The site is not located within a viable distance of the heat networks; therefore, connection to a decentralised energy network is considered unfeasible at the present time.

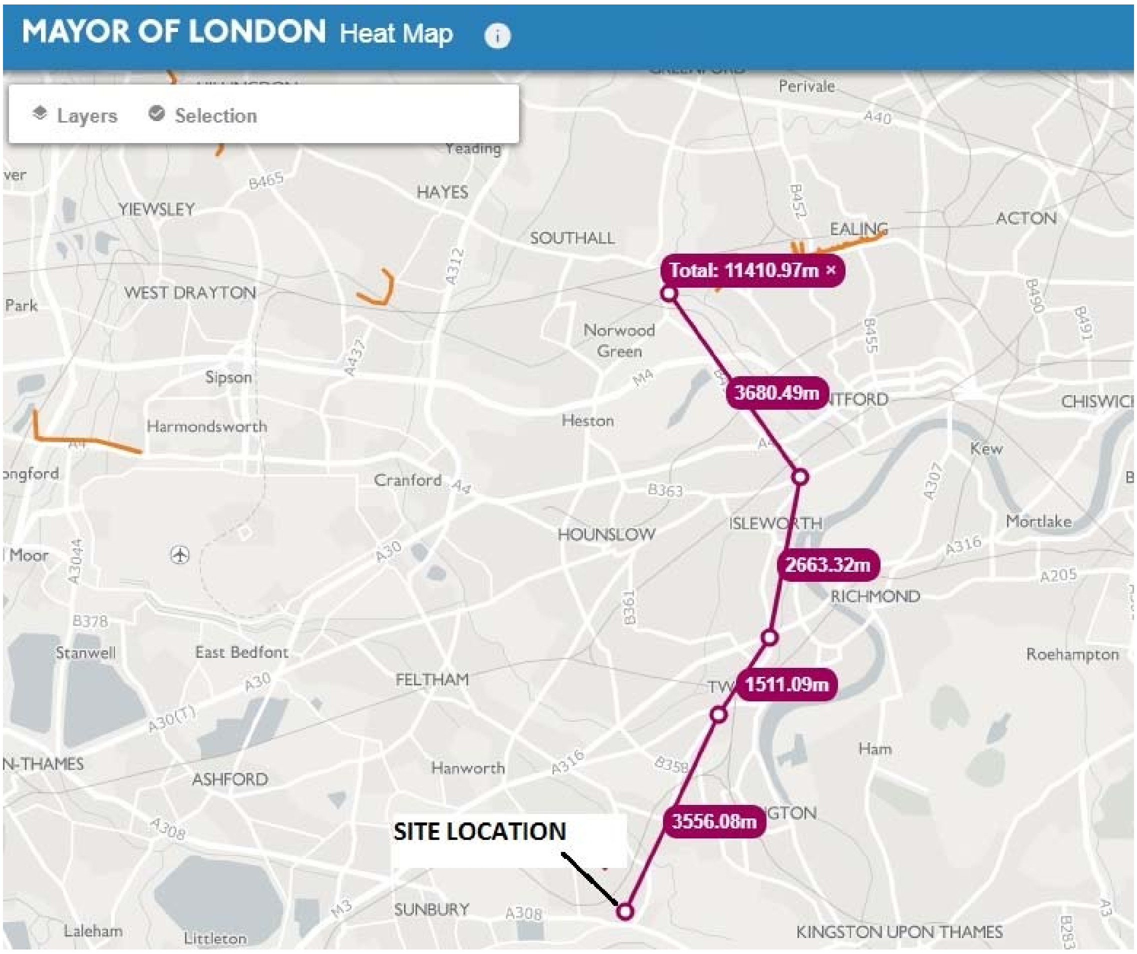


**Figure 4.1: Location of the proposed site in relation to potential energy networks.**

## 5.0 LOW AND ZERO CARBON TECHNOLOGIES – 'BE GREEN'

**Overview**

5.1 The final step in the energy hierarchy requires that the clean generation of energy by renewable energy technologies be examined.

5.2 A feasibility study has been undertaken to establish the most technically and economically viable renewable technology which provides the highest overall reduction in carbon dioxide emissions for the proposed development to help achieve the planning policy target and to maximise on BREEAM energy credits. The renewable technologies reviewed in this study and their feasibility for the proposed development are summarised in Table 5.1 below.

| Low and Zero Carbon Technology | Suitability for the proposed development |
|---|---|
| **Photovoltaic Panels** | **SUITABLE** |
| **Heat Pumps** | **LIMITED SUITABILITY** |
| **Solar thermal panels** | **NO** |
| **Biomass boilers** | **NO** |
| **Wind turbines** | **NO** |

**Table 5.1: Review of suitability of LZC technology for the site.**

5.3 Key parameters which have been considered when selecting appropriate combinations of technologies include:

- Opportunities of the site and energy demand of the development;
- Visual impact of the system;
- Practical implementation considerations;
- Maintenance requirements;
- Implications for internal arrangement and space allocation, infrastructure and site layout;
- Public acceptability;
- Deliverability;
- Management options;
- Interactions of the technologies with one another;
- Client's preference.

**Low and Zero Carbon Technologies – Feasibility**

**Photovoltaic Panels**

5.4 Photovoltaic cells directly convert sunlight into electrical current using semiconductors. The output of a cell is directly proportional to the intensity of the light received by the active surface of the cell. The location and positioning of PV cells is therefore critical to achieving acceptable performance. Exposure to sunlight causes electricity to flow through the cells. Mono-crystalline PV cells provide higher levels of electricity generating performance over other panel types. PV panels can be incorporated into a range of building designs and positions, provided they are located in a shade-free environment and facing as close to south as possible.

5.5 Photovoltaics are generally technically suitable for all types of developments.

5.6 Areas of PV modules vary between manufacturers, however on average 1 PV module covers an area of approximately 1.6 $m^2$. PV panels are produced in various sizes with power outputs ranging from 0.165 kWp to 1 kWp per module. The most commonly used generate approximately 0.25-0.35 kW of electricity.

5.7 It is generally recommended that solar PV modules are installed on the south, south-west (SW) or south-east (SE) orientated tilted (30-40 degrees) roofs for maximum electricity generation. However horizontally (10-15 degrees inclination) mounted PV panels provide a good amount of electricity, only 12% less than the highest figures achieved for the most favourably located panels.

5.8 Due to the location of the proposal, surrounded by residential properties, the positioning of PV panels has to be carefully considered to have a minimal visual impact. The flat roof of the proposal is suitable for installation of PV panels. The solar collectors could be mounted at a slight tilt to avoid excessive protrusion from the building's roof. The panels' south orientation would generate a fair amount of electricity that could be used within the building or fed back to the national grid.

5.9 The proposal is to install approximately 4 kWp PV system (i.e. approx. 16 panels), which would generate over 3 MWh of electricity per year. Overall carbon emission reductions achieved by the proposed PV system would reach 1.58 tonnes per year, when calculated using current carbon factors for electricity (i.e. SAP 2012).

5.10 The roof of the proposed school hall has enough available area to fit a sufficient number of PV panels to offset 35% carbon emissions (please refer to Figure 5.1 below).

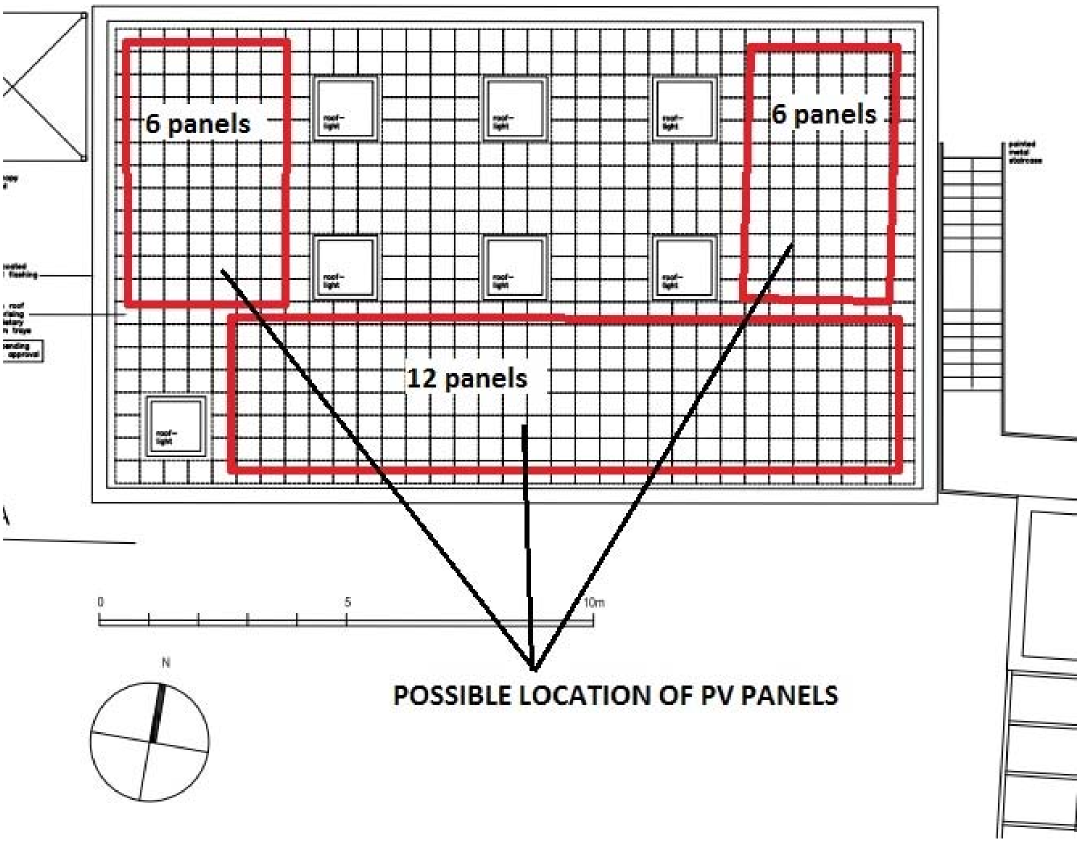


**Figure 5.1: Possible location of PV panels (sketch based on architect's drawing)**

5.11 Please refer to table 5.2 for details of the savings achieved by the estimated 4 kWp PV system and Appendix B for BRUKL document.

| Carbon Dioxide Emissions | Carbon Dioxide Emissions [tonnes/year] | |
|---|---|---|
| | Regulated | Reduction achieved |
| Baseline: Part L 2013 of the Building Regulations Compliant Development (gas boilers– GLA guidance) | 2.28 | n/a |
| Be Lean - After energy demand reduction | 2.20 | 0.08 |
| | | 3.5% |
| Be Green – 4kWp PV | 0.62 | 1.58 |
| | | 71.8% |
| Cumulative reduction | | 0.08 + 1.58 = 1.66 |
| | | **72.80%** |

**Table 5.2: PV system size needed to reduce carbon emissions by 35%**

5.12 The carbon emission reduction achieved for the proposal with the energy efficiency measures in place and 4 kWp PV system fitted on the flat roof will comfortably exceed the planning policy target of 35% over the base case scenario. The amount of PVs to be fitted on the roof is dictated by the BREEAM strategy prepared for the building, aiming to maximise on energy credits achieved by the proposal. Please refer to BREEAM Pre-Assessment, report ref: TH/CC/P20-2140/01.

**Air Source Heat Pumps (ASHP)**

5.13 Heat Pumps, utilising low grade heat, provide high efficiency, low carbon heating. They are a thermodynamic device based on the vapour compression cycle. The four elements of the refrigeration circuit are: the evaporator, compressor, heat exchanger and condenser. The heat, which is extracted from the medium, goes through a number of processes and is distributed throughout the building through a standard wet central heating system. Heat pumps utilise electricity to drive their pumps and compressor units. They are essentially a form of efficient electric heating. The efficiency of a heat pump is rated by its coefficient of performance (CoP).

5.14 The CoP is a measure of the electricity input to the system and the heat energy extracted. Several factors affect the CoP of a heat pump; the consistency of the heat source and the required output temperature. Heat pump efficiency is greatest when the required output temperature rise is lowest; hence heat pumps are commonly paired with under floor heating systems.

5.15 Due to the proposed construction technology utilising modular pre-fabricated elements to reduce the construction time of the building, there is potential difficulty with incorporation of underfloor heating within the building fabric.

5.16 An additional consideration for all heat pump applications would be the available capacity in the sites electrical infrastructure. A heat pump powered building has a correspondingly far greater electrical demand than a conventional gas heated building. Upgrading of electrical supply infrastructure can add substantially to the cost of the development, along with potential delays.

5.17 ASHPs extract energy from the air and therefore require space for external units. The external space adjacent to the school hall is suitable for the location of the external units of the system, however mitigation measures to reduce noise impact of the system would have to be incorporated into the design of the ASHP enclosure.

5.18 For these reasons, it is concluded that air source heat pumps, although potentially feasible, are not recommended for the proposed development.

5.19 Please refer to Appendix C for the summary of other renewable technologies considered for the proposed development but concluded to be unfeasible.

## 6.0 CONCLUSION AND RECOMMENDATIONS

6.1 This report has been developed to detail the energy efficient features of the development and assesses how they relate to the relevant planning policy including the adopted Local Plan and its Policy LP 22.

6.2 The energy strategy of the development has been compiled to respond to and improve on the planning requirements of the adopted Richmond Local Plan Policy LP 22, requiring reduction in predicted energy demand from the development to be achieved through incorporation of energy efficient building fabric, efficient services design and low and/or renewable energy technology, where feasible.

6.3 The energy assessment follows the principles of the energy hierarchy: ‘Be Lean’, ‘Be Clean’ and ‘Be Green’. The overriding objective in the formulation of the energy strategy for the scheme has been to maximise the viable reductions in total carbon dioxide emissions within the framework of the energy hierarchy.

6.4 The energy strategy of the scheme has considered measures to adapt and mitigate the effects of climate change leading to significant $CO_2$ emission reductions, in particular through the application of ‘fabric first’ approach leading to an improvement in the thermal performance of the existing building envelope.

6.5 A highly optimised energy strategy based on passive design, building fabric performance and building services systems and controls as well as installation of 4 kWp PV system will allow the scheme to achieve an improvement over the baseline scenario of over 70% exceeding the planning policy target of 35%.

6.6 The carbon reductions achieved for the development will help the building score highly under the energy category of the BREEAM assessment required for the site.

## 7.0 DISCLAIMER

7.1 Create Consulting disclaims any responsibility to the Client and others in respect of any matters outside the scope of this report.

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# APPENDICES

# APPENDIX A

# BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

**Project name**

# Hampton Pre-prep School Extension

As designed

**Date:** Mon Nov 23 11:29:14 2020

## Administrative information

### Building Details

**Address:** Address 1, Address 2, London, Postcode

### Certification tool

**Calculation engine:** SBEM

**Calculation engine version:** v5.6.b.0

**Interface to calculation engine:** Virtual Environment

**Interface to calculation engine version:** v7.0.13

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

### Certifier details

**Name:** Name

**Telephone number:** Phone

**Address:** Street Address, City, Postcode

## 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 | 14.7 |
| Target $CO_2$ emission rate (TER), $kgCO_2/m^2$.annum | 14.7 |
| Building $CO_2$ emission rate (BER), $kgCO_2/m^2$.annum | 14.2 |
| Are emissions from the building less than or equal to the target? | BER =< TER |
| Are as built details the same as used in the BER calculations? | Separate submission |

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

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

**Building fabric**

| Element | $U_{a-Limit}$ | $U_{a-Calc}$ | $U_{i-Calc}$ | Surface where the maximum value occurs* |
|---|---|---|---|---|
| Wall** | 0.35 | 0.26 | 0.26 | "SC000001_W1" |
| Floor | 0.25 | 0.22 | 0.22 | "SC000001_F" |
| Roof | 0.25 | 0.18 | 0.18 | "SC000001_C" |
| Windows***, roof windows, and rooflights | 2.2 | 1.68 | 1.8 | "SC000001_W2_O0" |
| Personnel doors | 2.2 | - | - | "No external personnel doors" |
| Vehicle access & similar large doors | 1.5 | - | - | "No external vehicle access doors" |
| High usage entrance doors | 3.5 | - | - | "No external high usage entrance doors" |

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a-Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i-Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

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

| Air Permeability | Worst acceptable standard | This building |
|---|---|---|
| $m^3/(h.m^2)$ at 50 Pa | 10 | 4 |

**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** | NO |
| **Whole building electric power factor achieved by power factor correction** | <0.9 |

1- Gas boiler - combi for heating and HW in kitchen and Acc WC

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 0.92 | - | - | - | - |
| **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** | | | | | NO |

* 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.

1- SYST0000-DHW

| | Water heating efficiency | Storage loss factor [kWh/litre per day] |
|---|---|---|
| **This building** | Hot water provided by HVAC system | - |
| **Standard value** | N/A | N/A |

2- SYST0003-DHW

| | Water heating efficiency | Storage loss factor [kWh/litre per day] |
|---|---|---|
| **This building** | 1 | 0.015 |
| **Standard value** | 0.9* | N/A |

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

**Local mechanical ventilation, exhaust, and terminal units**

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

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ID of system type** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | | |
| **Standard value** | 0.3 | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 | **Zone** | **Standard** |
| WC | 0.3 | - | - | - | - | - | - | - | - | - | N/A |
| Kitchen | 0.3 | - | - | - | - | - | - | - | - | - | N/A |
| Acc WC | 0.3 | - | - | - | - | - | - | - | - | - | 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 | |
| School hall | 70 | - | - | 544 |
| WC | - | 70 | - | 71 |

| General lighting and display lighting | Luminous efficacy [lm/W] | | | |
|---|---|---|---|---|
| Zone name | Luminaire | Lamp | Display lamp | General lighting [W] |
| Standard value | 60 | 60 | 22 | |
| Store | 70 | - | - | 20 |
| Rear corridor | - | 70 | - | 24 |
| Entrance lobby | - | 70 | - | 30 |
| Kitchen | - | 70 | - | 245 |
| Acc WC | - | 70 | - | 39 |
| Cleaners Store | 70 | - | - | 6 |

## 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? |
|---|---|---|
| School hall | NO (-32.4%) | NO |

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

Separate submission

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

Separate submission

## EPBD (Recast): Consideration of alternative energy systems

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

# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

| | Actual | Notional |
|---|---|---|
| Area [m²] | 155.2 | 155.2 |
| External area [m²] | 476.5 | 476.5 |
| Weather | LON | LON |
| Infiltration [m³/hm²@ 50Pa] | 4 | 5 |
| Average conductance [W/K] | 158.93 | 187.08 |
| Average U-value [W/m²K] | 0.33 | 0.39 |
| Alpha value* [%] | 22.25 | 17.81 |

* 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 | 34.51 | 34.79 |
| Cooling | 0 | 0 |
| Auxiliary | 4.57 | 4.72 |
| Lighting | 7.67 | 8.85 |
| Hot water | 1.67 | 1.69 |
| Equipment* | 16.61 | 16.61 |
| **TOTAL**** | **48.42** | **50.05** |

* 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] | 162.52 | 195.2 |
| Primary energy* [kWh/m²] | 81.73 | 85.13 |
| Total emissions [kg/m²] | 14.2 | 14.7 |

* 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 | 102 | 60.5 | 34.5 | 0 | 4.6 | 0.82 | 0 | 0.92 | 0 |
| | Notional | 102.6 | 92.6 | 34.8 | 0 | 4.7 | 0.82 | 0 | ---- | ---- |

## Key to terms

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

# Key Features

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

**Building fabric**

| **Element** | **$U_{i\text{-}Typ}$** | **$U_{i\text{-}Min}$** | **Surface where the minimum value occurs*** |
|---|---|---|---|
| Wall | 0.23 | 0.26 | "SC000001_W1" |
| Floor | 0.2 | 0.22 | "SC000001_F" |
| Roof | 0.15 | 0.18 | "SC000001_C" |
| Windows, roof windows, and rooflights | 1.5 | 1.3 | "SC000001_C_O0" |
| Personnel doors | 1.5 | - | "No external personnel doors" |
| Vehicle access & similar large doors | 1.5 | - | "No external vehicle access doors" |
| High usage entrance doors | 1.5 | - | "No external high usage entrance doors" |

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = 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 | 4 |

# APPENDIX B

# BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

**Project name**

## Hampton Pre-prep School Extension

As designed

**Date:** Mon Nov 23 17:13:45 2020

## Administrative information

### Building Details

**Address:** Address 1, Address 2, London, Postcode

### Certification tool

**Calculation engine:** SBEM

**Calculation engine version:** v5.6.b.0

**Interface to calculation engine:** Virtual Environment

**Interface to calculation engine version:** v7.0.13

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

### Certifier details

**Name:** Name

**Telephone number:** Phone

**Address:** Street Address, City, Postcode

## 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 | 14.7 |
| Target $CO_2$ emission rate (TER), $kgCO_2/m^2$.annum | 14.7 |
| Building $CO_2$ emission rate (BER), $kgCO_2/m^2$.annum | 4.5 |
| 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 | 0.26 | 0.26 | "SC000001_W1" |
| Floor | 0.25 | 0.22 | 0.22 | "SC000001_F" |
| Roof | 0.25 | 0.18 | 0.18 | "SC000001_C" |
| Windows***, roof windows, and rooflights | 2.2 | 1.68 | 1.8 | "SC000001_W2_O0" |
| Personnel doors | 2.2 | - | - | "No external personnel doors" |
| Vehicle access & similar large doors | 1.5 | - | - | "No external vehicle access doors" |
| High usage entrance doors | 3.5 | - | - | "No external high usage entrance doors" |

$U_{a\text{-}Limit}$ = 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 |
|---|---|---|
| m³/(h.m²) at 50 Pa | 10 | 4 |

**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** | NO |
| **Whole building electric power factor achieved by power factor correction** | <0.9 |

1- Gas boiler - combi for heating and HW in kitchen and Acc WC

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 0.92 | - | - | - | - |
| **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** | | | | | NO |
| * 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. | | | | | |

1- SYST0000-DHW

| | Water heating efficiency | Storage loss factor [kWh/litre per day] |
|---|---|---|
| **This building** | Hot water provided by HVAC system | - |
| **Standard value** | N/A | N/A |

2- SYST0003-DHW

| | Water heating efficiency | Storage loss factor [kWh/litre per day] |
|---|---|---|
| **This building** | 1 | 0.015 |
| **Standard value** | 0.9* | N/A |
| * Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73. | | |

**Local mechanical ventilation, exhaust, and terminal units**

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

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ID of system type** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | | |
| **Standard value** | 0.3 | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 | **Zone** | **Standard** |
| WC | 0.3 | - | - | - | - | - | - | - | - | - | N/A |
| Kitchen | 0.3 | - | - | - | - | - | - | - | - | - | N/A |
| Acc WC | 0.3 | - | - | - | - | - | - | - | - | - | N/A |

**General lighting and display lighting**

| Zone name | Luminous efficacy [lm/W] Luminaire | Lamp | Display lamp | General lighting [W] |
|---|---|---|---|---|
| **Standard value** | 60 | 60 | 22 | |
| School hall | 70 | - | - | 544 |
| WC | - | 70 | - | 71 |

| General lighting and display lighting | Luminous efficacy [lm/W] | | | |
|---|---|---|---|---|
| Zone name | Luminaire | Lamp | Display lamp | General lighting [W] |
| Standard value | 60 | 60 | 22 | |
| Store | 70 | - | - | 20 |
| Rear corridor | - | 70 | - | 24 |
| Entrance lobby | - | 70 | - | 30 |
| Kitchen | - | 70 | - | 245 |
| Acc WC | - | 70 | - | 39 |
| Cleaners Store | 70 | - | - | 6 |

## 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? |
|---|---|---|
| School hall | NO (-32.4%) | NO |

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

Separate submission

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

Separate submission

## EPBD (Recast): Consideration of alternative energy systems

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

# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

| | Actual | Notional |
|---|---|---|
| Area [m²] | 155.2 | 155.2 |
| External area [m²] | 476.5 | 476.5 |
| Weather | LON | LON |
| Infiltration [m³/hm²@ 50Pa] | 4 | 5 |
| Average conductance [W/K] | 158.93 | 187.08 |
| Average U-value [W/m²K] | 0.33 | 0.39 |
| Alpha value* [%] | 22.25 | 17.81 |

* 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 | 34.51 | 34.79 |
| Cooling | 0 | 0 |
| Auxiliary | 4.57 | 4.72 |
| Lighting | 7.67 | 8.85 |
| Hot water | 1.67 | 1.69 |
| Equipment* | 16.61 | 16.61 |
| **TOTAL**** | **48.42** | **50.05** |

* 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 | 18.68 | 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] | 162.52 | 195.2 |
| Primary energy* [kWh/m²] | 81.73 | 85.13 |
| Total emissions [kg/m²] | 4.5 | 14.7 |

* 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 | 102 | 60.5 | 34.5 | 0 | 4.6 | 0.82 | 0 | 0.92 | 0 |
| | Notional | 102.6 | 92.6 | 34.8 | 0 | 4.7 | 0.82 | 0 | ---- | ---- |

### Key to terms

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

## Key Features

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

**Building fabric**

| **Element** | **$U_{i\text{-}Typ}$** | **$U_{i\text{-}Min}$** | **Surface where the minimum value occurs*** |
|---|---|---|---|
| Wall | 0.23 | 0.26 | "SC000001_W1" |
| Floor | 0.2 | 0.22 | "SC000001_F" |
| Roof | 0.15 | 0.18 | "SC000001_C" |
| Windows, roof windows, and rooflights | 1.5 | 1.3 | "SC000001_C_O0" |
| Personnel doors | 1.5 | - | "No external personnel doors" |
| Vehicle access & similar large doors | 1.5 | - | "No external vehicle access doors" |
| High usage entrance doors | 1.5 | - | "No external high usage entrance doors" |

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]　　$U_{i\text{-}Min}$ = 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 | 4 |

# APPENDIX C

**Low and Zero Carbon Technologies Not Feasible for the Site**

## Solar Thermal Panels

Solar hot water systems (SHW) use the energy radiated by the sun and convert it into useful heat in the form of hot water.

Heat is transferred and stored in a central thermal store. The solar panel system would ideally supply approximately 45-55% of the development's hot water requirement; the remainder of energy required for hot water would be supplied by the gas boilers.

Solar thermal panels are ideal for buildings with a highly insulated building envelope as the energy demand for heating water is relatively high in comparison to space heating demand.

Solar thermal panels are most efficient when evacuated tube technology is used. This leads to bulky and visually less pleasing system that will be aesthetically more intrusive.

The roof of the proposed school hall is flat and therefore the collectors would have to be mounted on frames tilted at least 30 degrees facing south, south-west or south-east leading to an optimum hot water output.

Solar thermal panels could be specified to compliment the proposed gas heating strategy but would require a large hot water storage tank located in the cupboard with long circulation pipes providing hot water to the kitchen. This would lead to additional losses from the system.

A SHW system alone would not reduce $CO_2$ emissions by 35% as required by the London Plan Policy 5.2 and therefore an additional technology would have to be incorporated into the design of the building, compromising on space and increasing the overall cost of the construction.

For these reasons a solar hot water system is not recommended for the site.

## Gas CHP (Combined Heat and Power)

A conventionally fuelled CHP system would utilise a prime mover such as a diesel engine or gas turbine to drive an electrical generator. The heat generated by the prime mover during this process would be utilised in a community heating network.

Gas CHP systems are energy efficient and considered as low carbon technologies. For CHP to be viable, it must run almost continuously and thus requires a permanent heat demand (hence its suitability for swimming pools, hospitals etc).

The proposed development would not fully utilise the energy generated by CHP engine and therefore would result in inefficient running of the system.

Air quality issues resulting from operation of a gas CHP system would also have to be addressed and increase of associated NOx emissions would have to be mitigated.

It is therefore not recommended that gas fired-CHP be considered for this site.

## Bio-fuels

Bio-fuels have the potential to contribute to the reduction of CO2 emissions of various developments by using this fuel within a boiler or CHP plant. Biofuels are considered to have low or zero CO2 intensities as theoretically the CO2 released when these fuels are combusted is no greater than the CO2 that has been absorbed from the atmosphere when the plants grew.

However, there are a number of issues which must be considered with this type of fuel in urban locations:

- Potential air quality impacts with combusting bio-fuels in urban areas, in particular elevated NOx emissions and particulates and must be addressed.
- Transporting this type of fuel increases lorry movements into and out of London, affecting congestion and transport emissions. The relatively rapid degradation of biodiesel would require appropriately sized on-site storage tanks with regular fuel deliveries.
- Importantly, the actual bio-diesel $CO_2$ intensity cannot be guaranteed due to variations in fuel stock supply, demand, the energy input processing the fuel and $CO_2$ emissions due to growing, harvesting and processing the base fuel.
- Biofuel availability is currently uncertain due to unknown future supply and demand. Whilst an increase in demand for larger developments may stimulate the supply

chain, availability could change with variation in demand. Transport is likely to have the most significant impact on the biofuel industry over emerging building demand.

- Socio-economic issues from growing and harvesting feedstock, with potential impacts on food production, particularly for biodiesel that is imported. Solid biofuels have a lesser impact in this area.
- On-site fuel storage requirements requiring additional space, along with regular access to the on-site fuel storage area.
- Increased plant maintenance is generally required, adding to costs and plant down-time.

Consequently, biofuels for combustion within a boiler are not appropriate for the scheme.

## Wind Turbines

Although a wind turbine could be sized to meet the requirements of this development, there are numerous factors that would discount its suitability in this setting. Typically wind turbines perform poorly in urban environments as surrounding buildings and features dissipate much of the useful energy of the wind before it can be extracted by the turbine. The tower would also require a large amount of free space for the erecting and periodic maintenance of the turbine. This is likely to be an issue with this site.

Environmental concerns such as noise and shadow flicker are also problematic in populated areas. While modern turbines have low levels of noise generation, even at high rotational speeds, the noise generated may still be an issue for local residents, particularly given the close proximity of the turbine. Given the dense urban setting of this development, shadow flicker is likely to be a problem for the residents of the proposed development. A wind turbine would not be a viable option for this development.