Method
Consulting

Intelligent engineering,
sustainable buildings

Imperial Hotel, New Plant Facilities and Hotel Accommodation Building

# Energy Statement

July 2019

# Document History

This document has been revised and issued as below:

| Revision | Date | Description | Created by | Approved by |
|---|---|---|---|---|
| P01 | 01/07/19 | Preliminary Issue | MBH | TXK |
| P02 | 04/07/19 | Minor Amendments | MBH | TXK |
| P03 | 15/08/19 | Updated incorporating Council Comments | DXN | TXK |
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# 1 Executive summary

The modelling shows that by using a Be Lean approach with enhanced fabric-efficiency and passive measures together with the existing efficient gas-fired CHP and boiler systems at the hotel, the predicted regulated emissions are reduced by 15.6% compared to the base case.

Options for renewable energy were explored. An 80m$^2$ PV array could be installed on the roof of the proposed plant facilities and hotel accommodation building but this would be heavily shaded by adjacent buildings. This would result in a predicted reduction of regulated $CO_2$ emissions of 17.8% compared to the based case (including the 15.6% already accounted for by passive measures and the CHP). The reduction in $CO_2$ emissions from PV is 2.7%.

However, to achieve this reduction the PV array would be highly inefficient because it is heavily shaded by adjacent buildings. Therefore, it is not proposed to proceed with the PV array on the basis that it would be inefficient and a poor use of resources.

# 2 Introduction

Method Consulting has been appointed to produce an Energy Statement as part of the planning application for the proposed remodelling and extension of the Imperial Hotel to provide a new plant facilities and hotel accommodation building.

This report outlines the sustainable features to be incorporated into the design of the development to improve the overall environmental performance through both good building design and the implementation of renewable technologies.

This report only covers the proposed remodelling and extension of the hotel by the provision of a new plant facility and hotel accommodation building.

# 3 Planning Policies & Building Regulations

## 3.1 Building Regulations Approved Document L2A

As per the Approved Document L2A, energy efficiency calculations are required to assess the predicted CO2 emissions and compare these to a notional building. In order to comply with Part L2A the 'actual building' should have a Building Emissions Rate (BER) less than that of the notional building's Target Emission Rate (TER).

## 3.2 Camden Local Plan

The Camden Local Plan sets out policies for all developments to follow. The following policy has been considered as the basis for this report:

### *3.2.1 Policy CC1 Climate Change Mitigation*

The Council requires all developments to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation. This will be done via the following steps:

- Promotion of zero carbon developments and all developments to reduce carbon dioxide emissions through following the steps in the energy hierarchy.
- All major developments to demonstrate how London Plan targets for carbon dioxide emissions have been met.
- Support and encourage sensitive energy efficiency improvements to existing building.

- All major developments are required to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.
- Major developments will be required to install appropriate monitoring equipment to ensure the Council can monitor the effectiveness of renewable and low carbon technologies.

Developments in Camden are expected to minimise energy use and $CO_2$ emissions in operation through the application of the energy hierarchy:

1. Be Lean – use less energy
2. Be Clean – supply energy efficiently
3. Be Green – use renewable energy

Consistent with the above energy hierarchy, developments of more than 500sqm of any gross internal floorspace are expected to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation, unless it can be demonstrated that such provision is not feasible.

## 3.3 London Plan

Since the building is not a major development, it is not referable to the London Plan. However, Camden Council requires the building to follow some aspects of the London Plan, which is reflected in the Camden Local Plan.

## 3.4 Establishing Baseline $CO_2$ Emissions

Dynamic Part L2A simulations have been carried out using the approved software IES Virtual Environment version 2019.0.1.0.

Images of the constructed model are shown below:

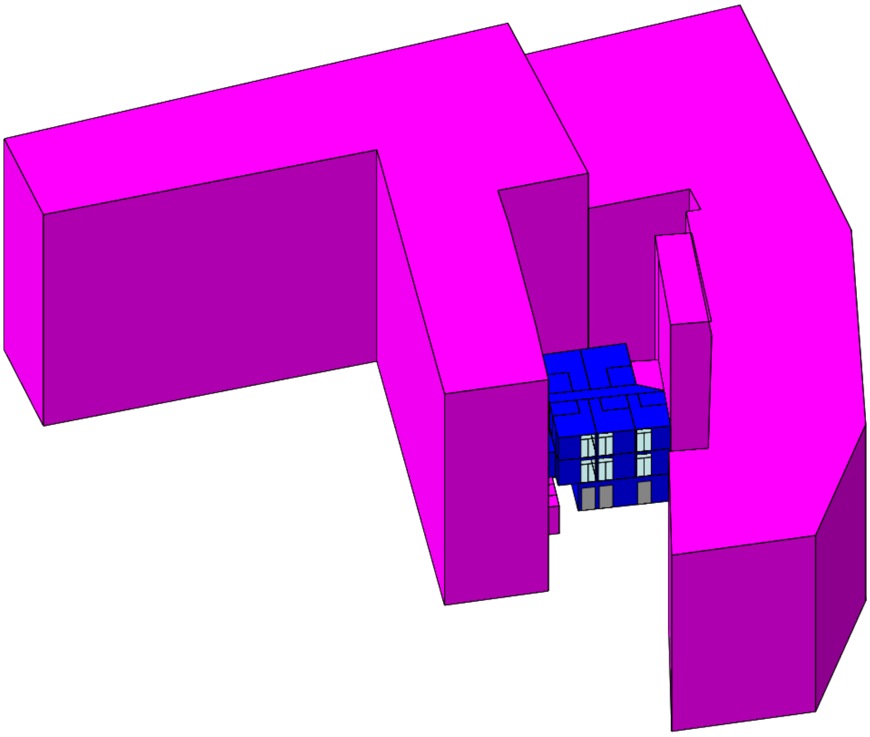


*Figure 1: IES virtual environment model of New Plant Facilities and Hotel Accommodation Building at the Imperial Hotel*

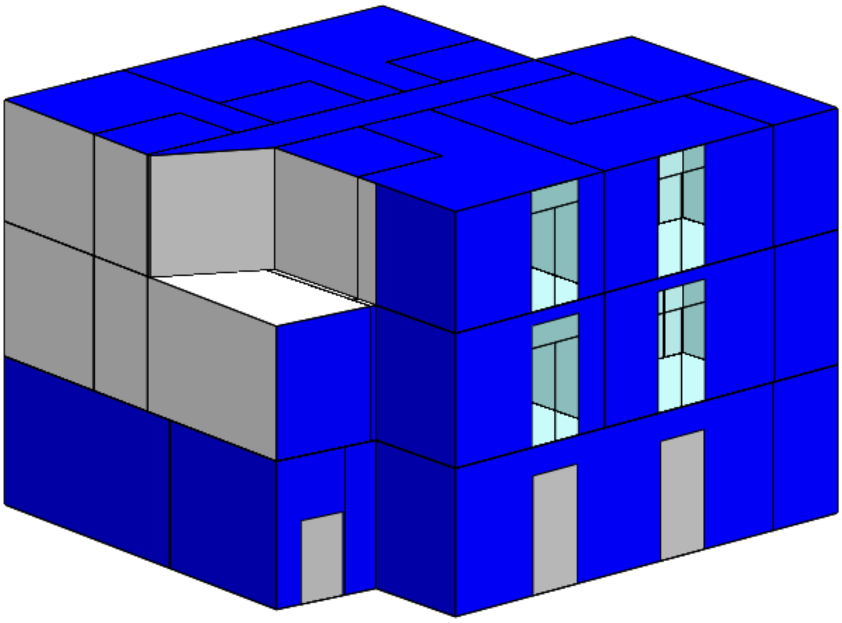


*Figure 2: IES virtual environment model of New Plant Facilities and Hotel Accommodation Building at the Imperial Hotel*

The proposed extension is shown in blue and the existing building is shown in pink.

### 3.4.1 *Base case scenario*

In order to establish the baseline carbon emissions for the development, the methodology described above has been used to model a 'base case scenario' for the development, which is taken as the Building Regulations Part L notional building for each element.

The assumptions for the base case models are detailed in the following section and Appendix A.

#### *(a) Results: Base case energy consumption and $CO_2$ emissions*

From the preliminary BRUKL modelling carried out, the base case scenario is expected to give the following energy consumption and $CO_2$ emissions for the site.

*Table 1: Base case regulated and un-regulated energy consumption and CO2 emissions*

| | Energy Consumption ($kWh/m^2/year$) | $CO_2$ emissions ($kgCO_2/m^2/year$) |
|---|---|---|
| **Base case (regulated)** | 184.80 | 48.20 |
| **Base case (un-regulated)** | 127.21 | 66.00 |
| **Base case (total regulated and un-regulated)** | 312.01 | 114.20 |

## 3.5 Demand Reduction (Be Lean)

In order to ensure that the sustainable aspirations of the development are met, the design team are aiming to provide a high-performance shell for all elements. The proposed building fabric will improve on the requirements of Part L of the Building Regulations 2013. The target U-values are listed in the tables below.

*Table 2: Limiting, notional building and target U values and air permeability*

| Element | Limiting 2013 U-value ($W/m^2/K$) | Notional building U-value ($W/m^2/K$) | Target U-value ($W/m^2/K$) | % improvement on Notional |
|---|---|---|---|---|
| **Ground Floor** | 0.25 | 0.22 | 0.22 | 0% |
| **External Walls** | 0.35 | 0.26 | 0.18 | 30.7% |
| **Roof** | 0.25 | 0.18 | 0.15 | 16.7% |
| **Windows (Double glazed)** | 2.2 | 1.6 | 1.2 | 25% |
| **Doors** | 2.2 | 2.2 | 2.2 | 0% |

| | Limiting ($m^3/h/m^2$) | Notional ($m^3/h/m^2$) | Target ($m^3/h/m^2$) | |
|---|---|---|---|---|
| **Air Permeability** | 10 | 3/5 | 3 | - |

### 3.5.1 *System Description (Building Services)*

The hotel bedrooms are heated and cooled via local fan coil units. The heating is provided by a gas boiler with an efficiency of 95.8%. The cooling is provided by a central 490kW chiller with a cooling efficiency of 2.56 and a seasonal efficiency of 4.27.

Hot water is heated via a gas boiler, with associated storage and distribution systems. The DHW circulation pipework is set at an assumed 8 W/m to reduce energy losses. Ventilation is provided via an Air Handling Unit (AHU).

The lighting in all is to be provided via LED fittings, with an assumed minimum efficacy of 100 lumens/Watt and a light output ratio of 100%.

Please see Appendix A for a more detailed description of the building services.

### 3.5.2 *Results: Energy consumption and $CO_2$ emissions after passive design measures*

From the preliminary BRUKL modelling, the passive design measures are expected to improve energy consumption and $CO_2$ emissions.

In line with Policy CC1's requirement to minimise energy requirements a 'be lean, be clean, be green' philosophy has been applied, with a fabric first approach. High level of insulation and low U-values are being targeted.

*Table 3: Base case regulated and un-regulated energy consumption and $CO_2$ emissions*

| | Energy Consumption ($kWh/m^2/year$) | $CO_2$ emissions ($kgCO_2/m^2/year$) |
|---|---|---|
| **Base case (regulated)** | 184.80 | 48.20 |
| **Passive design case (regulated)** | 183.04 | 46.70 |
| **Passive design case (un-regulated)** | 127.21 | 66.00 |
| **Passive design case (total regulated and un-regulated)** | 310.25 | 112.70 |
| **% improvement compared to Base case model (regulated)** | 0.9% | 3.11% |

## 3.6 Heating Infrastructure (Be Clean)

The review of low and zero carbon technologies carried out for the scheme (see the following section) concludes that photovoltaic panels would be the most appropriate way to achieve a 20% reduction in carbon emissions for this development.

### *3.6.1 District Heating*

As per policy CC1 of the Camden Local Plan, connection to an energy network is not required unless particular circumstances make it viable. As there is already a site wide heat network fuelled by the site's CHP and gas systems this is not proposed to be replaced and the benefit that this would bring would be negligible.

### *3.6.2 Combined Heat and Power*

The building has two existing gas-fired CHP machines of 110kWe (~170kWth) each. These meet the heating baseload for the building and are appropriately sized. It is not proposed to alter or add to the existing CHP installation.

*Table 4: Comparison of the predicted annual energy consumption and $CO_2$ emissions for the passive design case and CHP models*

| | Energy Consumption ($kWh/m^2/year$) | $CO_2$ emissions ($kgCO_2/m^2/year$) |
|---|---|---|
| **Predicted – Passive design (regulated)** | 183.04 | 46.70 |
| **Predicted – Passive design (regulated & un-regulated))** | 310.25 | 112.70 |
| **Predicted – CHP (regulated)** | 163.72 | 40.70 |
| **Predicted – CHP (regulated & un-regulated)** | 290.93 | 106.70 |
| **% improvement compared to passive design model (regulated)** | 10.55% | 12.85% |

## 3.7 Low and Zero Carbon Technologies for Energy Production (Be Green)

This section will aim to investigate and determine the most appropriate LZC technology for the development in order to comply with the requirements of CC1 as described earlier in this report.

### 3.7.1 *Photovoltaics*

Solar energy can be converted to electricity using the photo-electric effect. Simply, photovoltaic (PV) cells use the energy from the sun to induce a current in a circuit. The cells are encapsulated between a sheet of toughened glass at the front and a moisture sealing membrane on the back to make them weatherproof.

In the UK, PV panels are usually installed on roofs of buildings. The optimum position is facing south with a tilt angle of around 30°. PV cells can be purchased in the form of Building Integrated PV (BIPV) products such as roof tiles and glazing products and, as such, is potentially the easiest of all renewable energy technologies to embed into the built environment.

#### *(a) Suitability of photovoltaics for the proposed development*

The new plant facilities and hotel accommodation building is proposed in a courtyard location where it is surrounded on all sides by existing buildings forming the Imperial Hotel and the adjacent President Hotel. These existing buildings are considerably higher than the proposed plant facilities and hotel accommodation building (approximately between 10m and 15m higher) and thus this means that the proposed roof of the plant facilities and hotel accommodation block is over-shadowed for long periods of time during the year.

Our initial assessment suggests that, although photovoltaics would be feasible (a PV array could be installed on the roof of the new plant facilities and hotel accommodation building) the installation would not be an effective use of resources due to heavy shading from adjacent hotels and the simple payback from PV would be relatively long because of the shading.

In order to explore the option of installing PV, 80m$^2$ of photovoltaic panels with an efficiency of 0.165 could be mounted on the roof of the building as calculated from the drawings. A southerly orientation and a 30$^o$ tilt are assumed in the modelling software. We assumed that the PV panels are heavily shaded and include a 10% shading factor (90% shading) to take into account the shading. All other assumptions are as in the Energy Efficient model.

Adding the PV theoretically reduces the $CO_2$ emissions and energy consumption of the development to a reasonable extent, as shown in table 5 below.

The PV array results in a 2.7% reduction in regulated $CO_2$ emissions (over the CHP model) and a 1.03% reduction in regulated and un-regulated $CO_2$ emissions.

*Table 5: Comparison of predicted energy consumption and $CO_2$ emissions for passive design, CHP & PV models*

| | Energy Consumption ($kWh/m^2/year$) | $CO_2$ emissions ($kgCO_2/m^2/year$) |
|---|---|---|
| **Predicted – Base case (regulated)** | 184.80 | 48.20 |
| **Predicted – Base case (regulated & un-regulated))** | 312.01 | 114.20 |
| **Predicted – Passive design (regulated)** | 183.04 | 46.70 |
| **Predicted – Passive design (regulated & un-regulated))** | 310.25 | 112.70 |
| **Predicted –CHP (regulated)** | 163.72 | 40.70 |
| **Predicted – CHP (regulated & un-regulated)** | 290.93 | 106.70 |
| **Predicted –CHP & PV (regulated)** | 161.61 | 39.60 |
| **Predicted – CHP & PV (regulated & un-regulated)** | 288.82 | 105.60 |
| **% improvement compared to base case model (regulated)** | 12.55% | 17.84% |
| **% improvement compared to base case model (regulated & un-regulated)** | 7.43% | 7.53% |
| **% improvement compared to passive design model (regulated)** | 11.71% | 15.20% |
| **% improvement compared to passive design model (regulated & un-regulated)** | 6.91% | 6.30% |
| **% improvement compared to CHP model (regulated)** | 1.29% | 2.70% |
| **% improvement compared to CHP model (regulated & un-regulated)** | 0.73% | 1.03% |

The PV could be connected to the national grid meaning any spare electricity generated (and not used by the building) could be exported when not in use. It is considered that there would be no land use or noise implications from a PV array and if installed discreetly, could not be seen from street level so is unlikely to cause a planning or aesthetic issue.

The table below summarises the estimated costs associated with a PV array of 13.2kWp based on the following assumptions:

- The PV array requires 6.5m$^2$/kWp.
- The cost of electricity is 15p/kWh.
- The calculation accounts for the cost of installing a new PV inverter after 10 years (i.e. once during the lifetime of the PV array). This cost is spread across the lifetime of the array and is subtracted from the annual cost saving.

*Table 6: Simple payback calculation for proposed PV array*

| Area of PV | Capital Cost | Annual energy generated (kWh) | Annual Carbon savings (kg) | Annual cost saving | Simple Payback (years) | £/kg$CO_2$ saved |
|---|---|---|---|---|---|---|
| 80m$^2$ | £15,840 | 1,207.8 | 626.9 | £181.2 | 87.4 | £25.2 |

A factor has also been applied to the annual energy generated and annual carbon savings figures to take account of performance degradation and maintenance requirements throughout the life of the PV array.

This shows that the simple payback of the PV array is much higher than would normally be expected because of the shading factor which reduces the electrical output of the PV array.

This is based on the following assumed PV specification:

*Table 7: Assumed PV specification*

| PV Specification | |
|---|---|
| Module Nominal Efficiency | 16.5% |
| Area | 80m$^2$ |
| Orientation | 145° (Clockwise from North- In line with building) |
| Inclination | 30° |
| Shading Factor | 0.1 (Heavily Shaded) |
| Electrical Conversion Efficiency | 95% |

### *3.7.2 Solar hot water heating*

There are two common types of solar collector that are used to provide hot water and space heating in domestic and commercial situations: flat plate collectors and evacuated tube collectors.

In flat plate collectors the working fluid (typically a water/glycol mixture) is directly heated as it circulates through pipework within the collector. The absorber plate and associated pipe work usually sits below a glass cover within a heavily insulated enclosure to reduce heat loss.

Evacuated tube collectors increase the efficiency of the system by enclosing the absorber plate in a near vacuum. This dramatically reduces the heat loss by convection from the absorber surface. The fabrication of the glass tube is expensive and leads to a collector that will perform better, but at higher cost. Flat plate collectors are generally used on residential buildings and evacuated tube collectors on larger commercial buildings.

***(a) Suitability of solar hot water heating for the proposed development***

Initial investigations suggest that the incorporation of solar thermal would not sufficiently reduce carbon emissions to meet the 20% reduction required. In addition, solar water heating arrays are typically more costly than traditional PV panels and would likely require additional back-up systems due to the high peak loads. A further factor reducing the effectiveness of solar thermal water heating is the overshading of the roof of the building. As such, they are not considered appropriate to the development and have been discounted from the analysis.

### *3.7.3 Biomass Heating*

Biomass refers to burning natural, vegetative matter to produce heat. This heat can be used both to temper the building, and to meet the hot water requirements. The fuel used for the boiler is typically wood, which comes in the form of either chips or pellets. The $CO_2$ released when burning this matter is equivalent to the $CO_2$ the trees have absorbed in their lifetime. Thus, the whole process becomes almost carbon neutral. The only additional emissions will be from processing and transportation of the fuel.

Biomass, like any solid fuel, requires storage on site and, to minimise the frequency of deliveries, significant space and associated access for delivery needs to be allowed for within the site layout. Wood pellets have a higher energy density and a more consistent size, shape and moisture content, so are better suited to smaller boiler installations and where fuel delivery access is restricted.

Currently the cost of woodchips is slightly cheaper than the cost of natural gas, whereas the cost of wood pellets is similar to that of oil. However, the price of natural gas and oil has been very volatile in recent years and for many customers has doubled in price since 2002. In contrast, the price of wood fuel has been much more stable, and it is thought that this is likely to remain the case in the medium to long term.

***(a) Suitability of biomass for the proposed development***

Initial investigations suggest that a biomass heating system is not well suited to this site as a biomass boiler installation would require a large area for the boilers, fuel storage, fuel handling and delivery space for lorries which is not available. In addition, the management of deliveries for and storage of fuel represents a high maintenance commitment for the Client, which is not considered desirable. For these reasons, the technology has been discounted from the analysis.

### *3.7.4 Heat pumps*

A heat pump uses the same ‘vapour compression’ technology that is used in a domestic refrigerator, but the cycle is reversed to provide heating and/or cooling to internal spaces. A heat pump uses electricity to transfer heat from one source to another, rather than generating heat, with most of the energy coming from the ambient ground or water to which it is connected. The coefficient of performance (COP) is the ratio of the heat output to the electricity input. With most modern equipment, the Seasonal COP will typically range from 3 to 5, i.e. for 1 kW of electrical input up to 5 kW of heating or cooling can be achieved.

It should be noted that because of the higher $CO_2$ emissions associated with the grid electricity supply, COPs must be better than 2.5 before there is any reduction in $CO_2$ emissions compared to heating via gas fired condensing boilers. However, if the electricity is generated from renewable energy sources, heat pumps can be part of a carbon neutral servicing strategy providing both heating and cooling to buildings.

Heat pumps are characterised depending on the source of the heat and the sink used for the heat. In the heating mode, energy can be extracted from the air, water or the ground and delivered to the space via fan powered air supply or a water circuit (such as underfloor heating). It should be noted that high COPs are generally only obtained when the flow temperature of the heating circuit to the building is relatively low, so they are often used with underfloor heating.

#### *(a) Suitability of heat pumps for the proposed development*

Air-source heat pumps would require space for external condensing units, relatively close to the development (to minimise refrigerant pipework lengths). Because of the proposed layout there is no space for local condensing units for air-source heat pumps near the development. In addition there is a desire to minimise the visual impact of the building and condensing units at roof level which would be visible from the other rooms and neighbouring buildings are not considered desirable.

The existing building is heated by efficient existing CHP machines and gas boilers and it is proposed to extend the existing low temperature hot water installation to cover the development. This then allows the extension to make best use of the efficient CHP and gas-boiler system.

Air-source heat pumps have therefore been discounted from the analysis.

### *3.7.5 Wind turbines*

Wind turbines use energy from the wind to produce electricity. This electricity can be used on site or sold back to the national grid. The suitability of installing wind turbines is largely dependent on local wind speeds. Accurately estimating the energy available from wind at a specific site is a complex task and requires knowledge of the long-term wind speeds at height, taking into account climatic variations, the effect of topological features and ground friction factors. Average wind speeds of 7 m/s or above are required for large scale wind turbines, although average speeds in the region of 4-6m/s can be sufficient to make smaller turbines viable.

Turbines are rated by the power generated at a specific wind speed. At very low wind speeds turbines do not operate. When they reach their critical cut-in wind speed they generate at a lower level than the rating, and finally once the rated wind speed is reached the turbine is designed to maintain a fairly constant power output. As a turbine is not generating all the time, and sometimes at part load, a good approximation of annual output is 20-30% of that expected if the turbine was operating continuously at its rated level throughout the year. This percentage is known as the capacity factor.

*(a) Suitability of a wind turbine for the proposed development*

Initial investigations suggest that the site is not well suited to a wind turbine, due to the urban location and associated local planning issues. For these reasons, the technology has been discounted from the analysis.

## 3.8 Assessment of the percentage emissions reduction

### *3.8.1 Methodology*

The Part L2A NCM methodology has been used to assess the $CO_2$ reductions from the renewable technologies.

### *3.8.2 IES modelling*

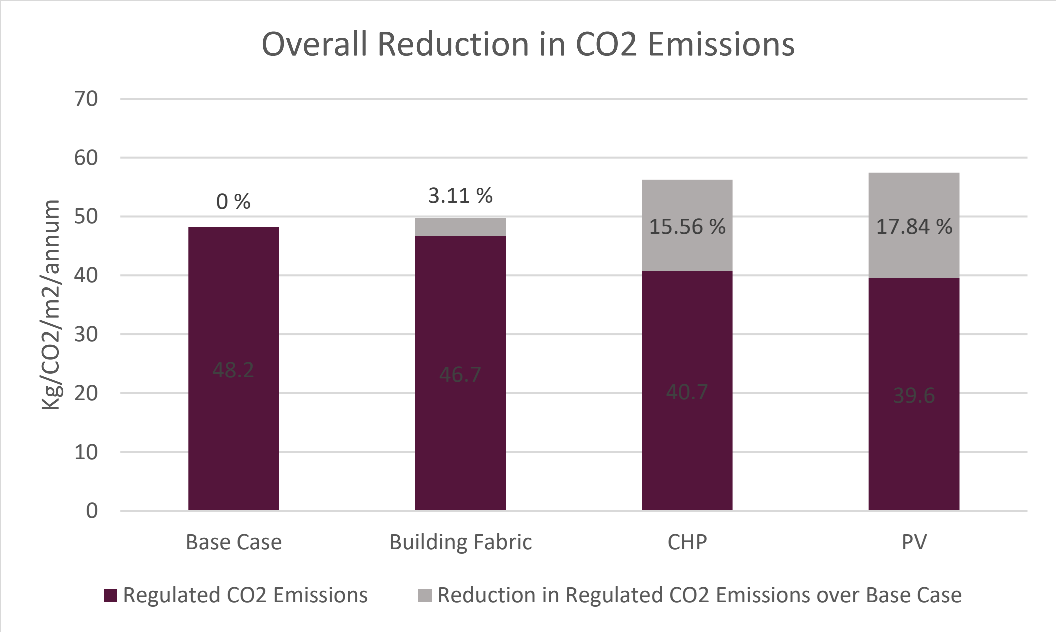
The building has been fully modelled using IES in order to demonstrate the building complies with the Building Regulations Part L. The output from this is the BRUKL document and this is attached to this report.

This modelling process and the BRUKL then gives us an accurate estimate of the energy consumption and $CO_2$ emissions from the building. We have used this data to demonstrate that the proposed renewable energy sources will provide 22.4% of the regulated energy requirements generated by the development.

*Table 8: $CO_2$ Savings*

| **Calculation of $CO_2$ savings (Regulated only)** | |
|---|---|
| Notional Building $CO_2$ emissions per $m^2$ (TER) (from BRUKL page 1 (TER) | 48.2 kg CO2/m2/annum (a) |
| Total residual $CO_2$ emissions per $m^2$ after passive design measures and energy efficient plant (BER without energy from PV savings = g | 46.7 kg CO2/m2/annum (b) |
| Energy production from CHP (from BRUKL page 6) | 20.81 kWh/m2/annum (c) |
| $CO_2$ savings per $m^2$ from CHP | 6.0 kg CO2/m2/annum (d) |
| Energy production from PV (from BRUKL page 14) | 2.11 kWh/m2/annum (e) |
| $CO_2$ saving per kWh generated from PV | 0.519 kg CO2/m2/annum (f) |

| | |
|---|---|
| Therefore, $CO_2$ savings per $m^2$ from PV array (i.e. e x f) | 1.1 kg CO2/m2/annum (g) |
| $CO_2$ savings from on-site renewables expressed as a percentage of the residual $CO_2$ including CHP | 2.70 % (h) |
| $CO_2$ emissions per $m^2$ after passive design measures, efficient plant measures & renewable energy provision (BER from Page 1) | 39.6 $CO_2$/m2/annum (i) |




The renewable energy sources (PV array) achieve a 2.7% reduction in regulated $CO_2$ emissions, which does not meet the Camden Local Plan Policy CC1 requirements (a 20% reduction in $CO_2$ from on-site renewable energy generation).

The use of PV for this development is not recommended as the roof is heavily shaded causing the array to work at approximately 10% of its potential, and therefore PV is not considered cost effective nor an efficient use of resources.

Energy efficiency measures included in the proposals include the use of high-performance building fabric, low glazing g-values and high efficiency systems to optimise the building and reduce the energy loads.

## 3.9 Energy Monitoring

The building will be installed with a full energy metering system, for monitoring and targeting, in compliance with TM39. The meters will be linked to the building management system so that meter readings are automatically recorded, and they can then be easily analysed for monitoring and targeting with the aim of reducing energy consumption.

This is in line with the requirements of policy CC1, which requires equipment to monitor the effectiveness of renewable and low carbon technologies.

# 4 Appendix

## 4.1 Appendix A – M&E systems descriptions for base case and proposed building model

### *(a) Heating and cooling*

*Table 9: Assumed PV specification*

| | Limiting value | Proposed building | Comments |
|---|---|---|---|
| **Fuel and system type** | N/A | Air Handling Unit with gas boiler and Chiller | Efficiency 95.8%<br>Cooling seasonal efficiency 4.27<br>Heat recovery of 85% |
| **Carbon emission factor ($kgCO_2/kWh$)** | N/A | 0.216 | AHU CEN Leakage Class L1 |
| **Emitters** | N/A | Indoor fan coil units | |

*Table 6: Heating system description for proposed building*

### *(b) Controls*

*Table 10: Assumed PV specification*

| | Proposed building | Comments |
|---|---|---|
| **Central time controls** | Yes | |
| **Local Time Controls (by room)** | Yes | |
| **Local Thermostatic Controls (by room, e.g. TRVs)** | Yes | |
| **Optimum start/stop** | Yes | |
| **Weather compensation** | Yes | |
| **Pump speed control** | Variable speed differential sensor across pump | |
| **Energy meters connected to BMS to alert users to high consumption** | Yes | |

*Table 9: Controls description for proposed building*

### *(c) Ventilation*

*Table 11: Ventilation system description for proposed building*

| Ventilation System Type | Limiting value | | Proposed building | |
|---|---|---|---|---|
| | SFP (W/l/s) | Heat Recovery Efficiency (%) | SFP (W/l/s) | Heat Recovery Efficiency (%) |
| AHU heating and cooling | 1.9 | 73% | 1.6 | 85% |
| FCU | 0.5 | N/A | 0.33 | N/A |

### *(d) Hot Water*

*Table 12: Hot water system description for proposed building*

| | Limiting value | Proposed building | Comments |
|---|---|---|---|
| **Fuel and system type** | N/A | Buffer vessel with LTHW boiler | 95.8% efficiency |
| **Carbon emission factor (kg.$CO_2$/kWh)** | N/A | 0.216 | |
| **Water Cylinder Capacity (litres)** | N/A | 400 litres | Storage Losses – 0.023 kW/l/day |
| **Circulation Loop?** | N/A | Yes | 135m. Pipework losses of 8W/m. |

### *(e) Lighting*

*Table 13: Lighting system description for proposed building*

| Area | Limiting | | Proposed building | | Comments |
|---|---|---|---|---|---|
| | Luminaire Efficacy (l/W) | LOR | Luminaire Efficacy (l/W) | LOR | |
| All spaces | The ***luminaire efficacy*** must be at least 60 l/W | | 100 | 100% | |

### *(f) Lighting Controls*

*Table 14: Lighting controls description for proposed building*

| Area | Limiting | Proposed | Comments |
|---|---|---|---|
| | Control | Control | |
| Circulation areas | Dimming for spaces with windows | Presence Detection and timer (auto-on-off) | |
| Bedrooms and WCs | Dimming for spaces with windows | Absence Detection and timer (man-on-auto-off) | |

## 4.2 Appendix B – Baseline/ Passive Design case BRUKL

# BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

**Project name**

# 1183LIH - Imperial Hotel Super Plant REV P1

As designed

**Date:** Thu Aug 15 08:44:55 2019

## Administrative information

### Building Details

**Address:** 61-66 Russell Square, London, WC1B 5BB

### Certification tool

**Calculation engine:** Apache

**Calculation engine version:** 7.0.12

**Interface to calculation engine:** IES Virtual Environment

**Interface to calculation engine version:** 7.0.12

**BRUKL compliance check version:** v5.6.a.1

### Owner Details

**Name:**

**Telephone number:**

**Address:** , ,

### Certifier details

**Name:** Method Consulting LLP

**Telephone number:** 01793822044

**Address:** Berkeley house, Hunts Rise, South Marston Park, Swindon, SN3 4TG

## 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 | 48.2 |
| Target $CO_2$ emission rate (TER), $kgCO_2/m^2$.annum | 48.2 |
| Building $CO_2$ emission rate (BER), $kgCO_2/m^2$.annum | 46.7 |
| 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 | 0.18 | 0.18 | 0F000002:Surf[0] |
| Floor | 0.25 | 0.22 | 0.22 | 0F000002:Surf[9] |
| Roof | 0.25 | 0.15 | 0.15 | 1F00000B:Surf[6] |
| Windows***, roof windows, and rooflights | 2.2 | 1.2 | 1.2 | 1F00000D:Surf[0] |
| Personnel doors | 2.2 | 2.2 | 2.2 | 0F000002:Surf[4] |
| Vehicle access & similar large doors | 1.5 | - | - | No Vehicle access doors in building |
| High usage entrance doors | 3.5 | - | - | No High usage entrance doors in building |

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

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

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

## Building services

**The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.**

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

1- Fan Coil

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 0.96 | 2.56 | 0 | 1.6 | 0.85 |
| **Standard value** | 0.91* | 2.55 | N/A | 1.6^ | 0.5 |
| **Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system** | YES | | | | |

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

"No HWS in project, or hot water is provided by HVAC system"

### 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** |
| 1F - Bedroom 1 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 1 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 2 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 2 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 3 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 3 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 4 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 4 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 5 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 5 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 10 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 10 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 6 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 6 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 7 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 7 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ID of system type | A | B | C | D | E | F | G | H | I | | |
| Standard value | 0.3 | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 | Zone | Standard |
| 2F - Bedroom 8 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 8 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 9 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 9 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 | |
| 0F - Plant | 100 | - | - | 481 |
| 0F - President Fire Escape | - | 100 | - | 27 |
| 0F - Stair | - | 100 | - | 36 |
| 0F - Storage | 100 | - | - | 11 |
| 1F - Bedroom 1 | - | 100 | - | 32 |
| 1F - Bedroom 1 WC | - | 100 | - | 29 |
| 1F - Bedroom 2 | - | 100 | - | 33 |
| 1F - Bedroom 2 WC | - | 100 | - | 29 |
| 1F - Bedroom 3 | - | 100 | - | 33 |
| 1F - Bedroom 3 WC | - | 100 | - | 30 |
| 1F - Bedroom 4 | - | 100 | - | 42 |
| 1F - Bedroom 4 WC | - | 100 | - | 36 |
| 1F - Bedroom 5 | - | 100 | - | 42 |
| 1F - Bedroom 5 WC | - | 100 | - | 36 |
| 1F - Corridor | - | 100 | - | 35 |
| 1F - President Fire Escape | - | 100 | - | 33 |
| 1F - Stair | - | 100 | - | 54 |
| 2F - Bedroom 10 | - | 100 | - | 40 |
| 2F - Bedroom 10 WC | - | 100 | - | 32 |
| 2F - Bedroom 6 | - | 100 | - | 29 |
| 2F - Bedroom 6 WC | - | 100 | - | 26 |
| 2F - Bedroom 7 | - | 100 | - | 31 |
| 2F - Bedroom 7 WC | - | 100 | - | 27 |
| 2F - Bedroom 8 | - | 100 | - | 31 |
| 2F - Bedroom 8 WC | - | 100 | - | 27 |
| 2F - Bedroom 9 | - | 100 | - | 40 |
| 2F - Bedroom 9 WC | - | 100 | - | 32 |
| 2F - Corridor | - | 100 | - | 47 |
| 2F - Stair | - | 100 | - | 30 |

## 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? |
|---|---|---|
| 1F - Bedroom 1 | NO (-77%) | NO |
| 1F - Bedroom 1 WC | N/A | N/A |

| Zone | Solar gain limit exceeded? (%) | Internal blinds used? |
|---|---|---|
| 1F - Bedroom 2 | NO (-81.8%) | NO |
| 1F - Bedroom 2 WC | N/A | N/A |
| 1F - Bedroom 3 | NO (-87.4%) | NO |
| 1F - Bedroom 3 WC | N/A | N/A |
| 1F - Bedroom 4 | NO (-95.8%) | NO |
| 1F - Bedroom 4 WC | N/A | N/A |
| 1F - Bedroom 5 | NO (-93.9%) | NO |
| 1F - Bedroom 5 WC | N/A | N/A |
| 2F - Bedroom 10 | NO (-93.7%) | NO |
| 2F - Bedroom 10 WC | N/A | N/A |
| 2F - Bedroom 6 | NO (-76.5%) | NO |
| 2F - Bedroom 6 WC | N/A | N/A |
| 2F - Bedroom 7 | NO (-81.3%) | NO |
| 2F - Bedroom 7 WC | N/A | N/A |
| 2F - Bedroom 8 | NO (-90.6%) | NO |
| 2F - Bedroom 8 WC | N/A | N/A |
| 2F - Bedroom 9 | NO (-95.5%) | NO |
| 2F - Bedroom 9 WC | N/A | N/A |

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

Separate submission

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

Separate submission

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

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

# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

| | Actual | Notional |
|---|---|---|
| Area [m$^2$] | 572.4 | 572.4 |
| External area [m$^2$] | 827.6 | 827.6 |
| Weather | LON | LON |
| Infiltration [m$^3$/hm$^2$@ 50Pa] | 3 | 3 |
| Average conductance [W/K] | 257.04 | 384.86 |
| Average U-value [W/m$^2$K] | 0.31 | 0.47 |
| Alpha value* [%] | 10 | 10 |

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

## Building Use

| % Area | Building Type |
|---|---|
| | A1/A2 Retail/Financial and Professional services |
| | A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways |
| | B1 Offices and Workshop businesses |
| | B2 to B7 General Industrial and Special Industrial Groups |
| | B8 Storage or Distribution |
| **100** | **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 |
| | 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/m$^2$]

| | Actual | Notional |
|---|---|---|
| Heating | 5.03 | 13.75 |
| Cooling | 5.97 | 4.23 |
| Auxiliary | 14.4 | 15.94 |
| Lighting | 4.26 | 8.39 |
| Hot water | 153.38 | 142.5 |
| Equipment* | 127.21 | 127.21 |
| **TOTAL**** | **183.04** | **184.8** |

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

## Energy Production by Technology [kWh/m$^2$]

| | Actual | Notional |
|---|---|---|
| Photovoltaic systems | 0 | 0 |
| Wind turbines | 0 | 0 |
| CHP generators | 0 | 0 |
| Solar thermal systems | 0 | 0 |

## Energy & $CO_2$ Emissions Summary

| | Actual | Notional |
|---|---|---|
| Heating + cooling demand [MJ/m$^2$] | 88.16 | 100.33 |
| Primary energy* [kWh/m$^2$] | 266.99 | 276.09 |
| Total emissions [kg/m$^2$] | 46.7 | 48.2 |

* 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] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity** | | | | | | | | | | |
| | **Actual** | 30.6 | 141.4 | 9.8 | 11.7 | 26.7 | 0.87 | 3.37 | 0.96 | 4.27 |
| | **Notional** | 83.3 | 112.5 | 26.8 | 8.2 | 31.1 | 0.86 | 3.79 | ---- | ---- |
| **[ST] No Heating or Cooling** | | | | | | | | | | |
| | **Actual** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Notional** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ---- | ---- |

## Key to terms

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

# Key Features

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

**Building fabric**

| **Element** | **$U_{i-Typ}$** | **$U_{i-Min}$** | **Surface where the minimum value occurs*** |
|---|---|---|---|
| Wall | 0.23 | 0.18 | 0F000002:Surf[0] |
| Floor | 0.2 | 0.22 | 0F000002:Surf[9] |
| Roof | 0.15 | 0.15 | 1F00000B:Surf[6] |
| Windows, roof windows, and rooflights | 1.5 | 1.2 | 1F00000D:Surf[0] |
| Personnel doors | 1.5 | 2.2 | 0F000002:Surf[4] |
| Vehicle access & similar large doors | 1.5 | - | No Vehicle access doors in building |
| High usage entrance doors | 1.5 | - | No High usage entrance doors in building |

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

$U_{i-Min}$ = Minimum individual element U-values [W/(m²K)]

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

| **Air Permeability** | **Typical value** | **This building** |
|---|---|---|
| $m^3/(h.m^2)$ at 50 Pa | 5 | 3 |

## 4.3 Appendix C – BRUKL with CHP

# BRUKL Output Document

## Compliance with England Building Regulations Part L 2013

**Project name**

# 1183LIH - Imperial Hotel Super Plant REV P1

As designed

**Date:** Thu Aug 15 09:06:43 2019

## Administrative information

### Building Details

**Address:** 61-66 Russell Square, London, WC1B 5BB

### Certification tool

**Calculation engine:** Apache

**Calculation engine version:** 7.0.12

**Interface to calculation engine:** IES Virtual Environment

**Interface to calculation engine version:** 7.0.12

**BRUKL compliance check version:** v5.6.a.1

### Owner Details

**Name:**

**Telephone number:**

**Address:** , ,

### Certifier details

**Name:** Method Consulting LLP

**Telephone number:** 01793822044

**Address:** Berkeley house, Hunts Rise, South Marston Park, Swindon, SN3 4TG

## 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 | 48.2 |
| Target $CO_2$ emission rate (TER), $kgCO_2/m^2$.annum | 48.2 |
| Building $CO_2$ emission rate (BER), $kgCO_2/m^2$.annum | 40.7 |
| 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 | 0.18 | 0.18 | 0F000002:Surf[0] |
| Floor | 0.25 | 0.22 | 0.22 | 0F000002:Surf[9] |
| Roof | 0.25 | 0.15 | 0.15 | 1F00000B:Surf[6] |
| Windows***, roof windows, and rooflights | 2.2 | 1.2 | 1.2 | 1F00000D:Surf[0] |
| Personnel doors | 2.2 | 2.2 | 2.2 | 0F000002:Surf[4] |
| Vehicle access & similar large doors | 1.5 | - | - | No Vehicle access doors in building |
| High usage entrance doors | 3.5 | - | - | No High usage entrance doors in building |

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

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

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

## Building services

**The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.**

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

1- Fan Coil

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 0.96 | 2.56 | 0 | 1.6 | 0.85 |
| **Standard value** | 0.91* | 2.55 | N/A | 1.6^ | 0.5 |
| **Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system** | | | | | YES |

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

"No HWS in project, or hot water is provided by HVAC system"

1- CHECK2-CHP

| | CHPQA quality index | CHP electrical efficiency |
|---|---|---|
| **This building** | 105 | 0.34 |
| **Standard value** | 105 | 0.2 |

### 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** |
| 1F - Bedroom 1 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 1 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 2 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 2 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 3 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 3 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 4 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 4 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 5 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 5 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 10 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 10 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ID of system type** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | | |
| **Standard value** | 0.3 | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 | **Zone** | **Standard** |
| 2F - Bedroom 6 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 6 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 7 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 7 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 8 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 8 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 9 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 9 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 | |
| 0F - Plant | 100 | - | - | 481 |
| 0F - President Fire Escape | - | 100 | - | 27 |
| 0F - Stair | - | 100 | - | 36 |
| 0F - Storage | 100 | - | - | 11 |
| 1F - Bedroom 1 | - | 100 | - | 32 |
| 1F - Bedroom 1 WC | - | 100 | - | 29 |
| 1F - Bedroom 2 | - | 100 | - | 33 |
| 1F - Bedroom 2 WC | - | 100 | - | 29 |
| 1F - Bedroom 3 | - | 100 | - | 33 |
| 1F - Bedroom 3 WC | - | 100 | - | 30 |
| 1F - Bedroom 4 | - | 100 | - | 42 |
| 1F - Bedroom 4 WC | - | 100 | - | 36 |
| 1F - Bedroom 5 | - | 100 | - | 42 |
| 1F - Bedroom 5 WC | - | 100 | - | 36 |
| 1F - Corridor | - | 100 | - | 35 |
| 1F - President Fire Escape | - | 100 | - | 33 |
| 1F - Stair | - | 100 | - | 54 |
| 2F - Bedroom 10 | - | 100 | - | 40 |
| 2F - Bedroom 10 WC | - | 100 | - | 32 |
| 2F - Bedroom 6 | - | 100 | - | 29 |
| 2F - Bedroom 6 WC | - | 100 | - | 26 |
| 2F - Bedroom 7 | - | 100 | - | 31 |
| 2F - Bedroom 7 WC | - | 100 | - | 27 |
| 2F - Bedroom 8 | - | 100 | - | 31 |
| 2F - Bedroom 8 WC | - | 100 | - | 27 |
| 2F - Bedroom 9 | - | 100 | - | 40 |
| 2F - Bedroom 9 WC | - | 100 | - | 32 |
| 2F - Corridor | - | 100 | - | 47 |
| 2F - Stair | - | 100 | - | 30 |

## 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? |
|---|---|---|
| 1F - Bedroom 1 | NO (-77%) | NO |
| 1F - Bedroom 1 WC | N/A | N/A |
| 1F - Bedroom 2 | NO (-81.8%) | NO |
| 1F - Bedroom 2 WC | N/A | N/A |
| 1F - Bedroom 3 | NO (-87.4%) | NO |
| 1F - Bedroom 3 WC | N/A | N/A |
| 1F - Bedroom 4 | NO (-95.8%) | NO |
| 1F - Bedroom 4 WC | N/A | N/A |
| 1F - Bedroom 5 | NO (-93.9%) | NO |
| 1F - Bedroom 5 WC | N/A | N/A |
| 2F - Bedroom 10 | NO (-93.7%) | NO |
| 2F - Bedroom 10 WC | N/A | N/A |
| 2F - Bedroom 6 | NO (-76.5%) | NO |
| 2F - Bedroom 6 WC | N/A | N/A |
| 2F - Bedroom 7 | NO (-81.3%) | NO |
| 2F - Bedroom 7 WC | N/A | N/A |
| 2F - Bedroom 8 | NO (-90.6%) | NO |
| 2F - Bedroom 8 WC | N/A | N/A |
| 2F - Bedroom 9 | NO (-95.5%) | NO |
| 2F - Bedroom 9 WC | N/A | N/A |

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

Separate submission

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

Separate submission

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

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

# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

| | Actual | Notional |
|---|---|---|
| Area [$m^2$] | 572.4 | 572.4 |
| External area [$m^2$] | 827.6 | 827.6 |
| Weather | LON | LON |
| Infiltration [$m^3/hm^2$@ 50Pa] | 3 | 3 |
| Average conductance [W/K] | 257.04 | 384.86 |
| Average U-value [$W/m^2K$] | 0.31 | 0.47 |
| Alpha value* [%] | 10 | 10 |

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

## Building Use

| % Area | Building Type |
|---|---|
| | A1/A2 Retail/Financial and Professional services |
| | A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways |
| | B1 Offices and Workshop businesses |
| | B2 to B7 General Industrial and Special Industrial Groups |
| | B8 Storage or Distribution |
| **100** | **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 |
| | 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 [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Heating | 5.47 | 13.75 |
| Cooling | 5.97 | 4.23 |
| Auxiliary | 14.4 | 15.94 |
| Lighting | 4.26 | 8.39 |
| Hot water | 175.24 | 142.5 |
| Equipment* | 127.21 | 127.21 |
| **TOTAL**** | **184.53** | **184.8** |

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

## Energy Production by Technology [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Photovoltaic systems | 0 | 0 |
| Wind turbines | 0 | 0 |
| CHP generators | 20.81 | 0 |
| Solar thermal systems | 0 | 0 |

## Energy & $CO_2$ Emissions Summary

| | Actual | Notional |
|---|---|---|
| Heating + cooling demand [$MJ/m^2$] | 88.16 | 100.33 |
| Primary energy* [$kWh/m^2$] | 230.33 | 276.09 |
| Total emissions [$kg/m^2$] | 40.7 | 48.2 |

* 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] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity** | | | | | | | | | | |
| | **Actual** | 30.6 | 141.4 | 8.4 | 11.7 | 26.7 | 0.87 | 3.37 | 0.96 | 4.27 |
| | **Notional** | 83.3 | 112.5 | 26.8 | 8.2 | 31.1 | 0.86 | 3.79 | ---- | ---- |
| **[ST] No Heating or Cooling** | | | | | | | | | | |
| | **Actual** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Notional** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ---- | ---- |

## Key to terms

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

# 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 | 0.18 | 0F000002:Surf[0] |
| Floor | 0.2 | 0.22 | 0F000002:Surf[9] |
| Roof | 0.15 | 0.15 | 1F00000B:Surf[6] |
| Windows, roof windows, and rooflights | 1.5 | 1.2 | 1F00000D:Surf[0] |
| Personnel doors | 1.5 | 2.2 | 0F000002:Surf[4] |
| Vehicle access & similar large doors | 1.5 | - | No Vehicle access doors in building |
| High usage entrance doors | 1.5 | - | No High usage entrance doors in building |

$U_{i\text{-}Typ}$ = 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 | 3 |

## 4.4 Appendix D – BRUKL with PV

# BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

**Project name**

# 1183LIH - Imperial Hotel Super Plant REV P1

As designed

**Date:** Thu Aug 15 09:10:46 2019

## Administrative information

### Building Details

**Address:** 61-66 Russell Square, London, WC1B 5BB

### Certification tool

**Calculation engine:** Apache

**Calculation engine version:** 7.0.12

**Interface to calculation engine:** IES Virtual Environment

**Interface to calculation engine version:** 7.0.12

**BRUKL compliance check version:** v5.6.a.1

### Owner Details

**Name:**

**Telephone number:**

**Address:** , ,

### Certifier details

**Name:** Method Consulting LLP

**Telephone number:** 01793822044

**Address:** Berkeley house, Hunts Rise, South Marston Park, Swindon, SN3 4TG

## 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 | 48.2 |
| Target $CO_2$ emission rate (TER), $kgCO_2/m^2$.annum | 48.2 |
| Building $CO_2$ emission rate (BER), $kgCO_2/m^2$.annum | 39.6 |
| 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 | 0.18 | 0.18 | 0F000002:Surf[0] |
| Floor | 0.25 | 0.22 | 0.22 | 0F000002:Surf[9] |
| Roof | 0.25 | 0.15 | 0.15 | 1F00000B:Surf[6] |
| Windows***, roof windows, and rooflights | 2.2 | 1.2 | 1.2 | 1F00000D:Surf[0] |
| Personnel doors | 2.2 | 2.2 | 2.2 | 0F000002:Surf[4] |
| Vehicle access & similar large doors | 1.5 | - | - | No Vehicle access doors in building |
| High usage entrance doors | 3.5 | - | - | No High usage entrance doors in building |

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

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

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

## Building services

**The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.**

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

1- Fan Coil

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 0.96 | 2.56 | 0 | 1.6 | 0.85 |
| **Standard value** | 0.91* | 2.55 | N/A | 1.6^ | 0.5 |
| **Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system** | | | | | YES |

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

"No HWS in project, or hot water is provided by HVAC system"

1- CHECK2-CHP

| | CHPQA quality index | CHP electrical efficiency |
|---|---|---|
| **This building** | 105 | 0.34 |
| **Standard value** | 105 | 0.2 |

### 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** |
| 1F - Bedroom 1 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 1 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 2 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 2 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 3 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 3 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 4 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 4 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 5 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 1F - Bedroom 5 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 10 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 10 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ID of system type | A | B | C | D | E | F | G | H | I | | |
| Standard value | 0.3 | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 | Zone | Standard |
| 2F - Bedroom 6 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 6 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 7 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 7 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 8 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 8 WC | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 9 | - | - | - | - | - | - | - | 0.3 | - | - | N/A |
| 2F - Bedroom 9 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 | |
| 0F - Plant | 100 | - | - | 481 |
| 0F - President Fire Escape | - | 100 | - | 27 |
| 0F - Stair | - | 100 | - | 36 |
| 0F - Storage | 100 | - | - | 11 |
| 1F - Bedroom 1 | - | 100 | - | 32 |
| 1F - Bedroom 1 WC | - | 100 | - | 29 |
| 1F - Bedroom 2 | - | 100 | - | 33 |
| 1F - Bedroom 2 WC | - | 100 | - | 29 |
| 1F - Bedroom 3 | - | 100 | - | 33 |
| 1F - Bedroom 3 WC | - | 100 | - | 30 |
| 1F - Bedroom 4 | - | 100 | - | 42 |
| 1F - Bedroom 4 WC | - | 100 | - | 36 |
| 1F - Bedroom 5 | - | 100 | - | 42 |
| 1F - Bedroom 5 WC | - | 100 | - | 36 |
| 1F - Corridor | - | 100 | - | 35 |
| 1F - President Fire Escape | - | 100 | - | 33 |
| 1F - Stair | - | 100 | - | 54 |
| 2F - Bedroom 10 | - | 100 | - | 40 |
| 2F - Bedroom 10 WC | - | 100 | - | 32 |
| 2F - Bedroom 6 | - | 100 | - | 29 |
| 2F - Bedroom 6 WC | - | 100 | - | 26 |
| 2F - Bedroom 7 | - | 100 | - | 31 |
| 2F - Bedroom 7 WC | - | 100 | - | 27 |
| 2F - Bedroom 8 | - | 100 | - | 31 |
| 2F - Bedroom 8 WC | - | 100 | - | 27 |
| 2F - Bedroom 9 | - | 100 | - | 40 |
| 2F - Bedroom 9 WC | - | 100 | - | 32 |
| 2F - Corridor | - | 100 | - | 47 |
| 2F - Stair | - | 100 | - | 30 |

## 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? |
|---|---|---|
| 1F - Bedroom 1 | NO (-77%) | NO |
| 1F - Bedroom 1 WC | N/A | N/A |
| 1F - Bedroom 2 | NO (-81.8%) | NO |
| 1F - Bedroom 2 WC | N/A | N/A |
| 1F - Bedroom 3 | NO (-87.4%) | NO |
| 1F - Bedroom 3 WC | N/A | N/A |
| 1F - Bedroom 4 | NO (-95.8%) | NO |
| 1F - Bedroom 4 WC | N/A | N/A |
| 1F - Bedroom 5 | NO (-93.9%) | NO |
| 1F - Bedroom 5 WC | N/A | N/A |
| 2F - Bedroom 10 | NO (-93.7%) | NO |
| 2F - Bedroom 10 WC | N/A | N/A |
| 2F - Bedroom 6 | NO (-76.5%) | NO |
| 2F - Bedroom 6 WC | N/A | N/A |
| 2F - Bedroom 7 | NO (-81.3%) | NO |
| 2F - Bedroom 7 WC | N/A | N/A |
| 2F - Bedroom 8 | NO (-90.6%) | NO |
| 2F - Bedroom 8 WC | N/A | N/A |
| 2F - Bedroom 9 | NO (-95.5%) | NO |
| 2F - Bedroom 9 WC | N/A | N/A |

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

Separate submission

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

Separate submission

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

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

# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

| | Actual | Notional |
|---|---|---|
| Area [$m^2$] | 572.4 | 572.4 |
| External area [$m^2$] | 827.6 | 827.6 |
| Weather | LON | LON |
| Infiltration [$m^3/hm^2$@ 50Pa] | 3 | 3 |
| Average conductance [W/K] | 257.04 | 384.86 |
| Average U-value [$W/m^2K$] | 0.31 | 0.47 |
| Alpha value* [%] | 10 | 10 |

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

## Building Use

| % Area | Building Type |
|---|---|
| | A1/A2 Retail/Financial and Professional services |
| | A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways |
| | B1 Offices and Workshop businesses |
| | B2 to B7 General Industrial and Special Industrial Groups |
| | B8 Storage or Distribution |
| **100** | **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 |
| | 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 [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Heating | 5.47 | 13.75 |
| Cooling | 5.97 | 4.23 |
| Auxiliary | 14.4 | 15.94 |
| Lighting | 4.26 | 8.39 |
| Hot water | 175.24 | 142.5 |
| Equipment* | 127.21 | 127.21 |
| **TOTAL**** | **184.53** | **184.8** |

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

## Energy Production by Technology [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Photovoltaic systems | 2.11 | 0 |
| Wind turbines | 0 | 0 |
| CHP generators | 20.81 | 0 |
| Solar thermal systems | 0 | 0 |

## Energy & $CO_2$ Emissions Summary

| | Actual | Notional |
|---|---|---|
| Heating + cooling demand [$MJ/m^2$] | 88.16 | 100.33 |
| Primary energy* [$kWh/m^2$] | 230.33 | 276.09 |
| Total emissions [$kg/m^2$] | 39.6 | 48.2 |

* 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] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity** | | | | | | | | | | |
| | **Actual** | 30.6 | 141.4 | 8.4 | 11.7 | 26.7 | 0.87 | 3.37 | 0.96 | 4.27 |
| | **Notional** | 83.3 | 112.5 | 26.8 | 8.2 | 31.1 | 0.86 | 3.79 | ---- | ---- |
| **[ST] No Heating or Cooling** | | | | | | | | | | |
| | **Actual** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Notional** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ---- | ---- |

## Key to terms

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

# 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 | 0.18 | 0F000002:Surf[0] |
| Floor | 0.2 | 0.22 | 0F000002:Surf[9] |
| Roof | 0.15 | 0.15 | 1F00000B:Surf[6] |
| Windows, roof windows, and rooflights | 1.5 | 1.2 | 1F00000D:Surf[0] |
| Personnel doors | 1.5 | 2.2 | 0F000002:Surf[4] |
| Vehicle access & similar large doors | 1.5 | - | No Vehicle access doors in building |
| High usage entrance doors | 1.5 | - | No High usage entrance doors in building |

$U_{i\text{-}Typ}$ = 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 | 3 |

Method Consulting
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