Environmental Sustainability Plan

Building B5

King's Cross Central
General Partner Ltd

October 2014

King's Cross

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KING'S CROSS CENTRAL
BUILDING B5

Environmental Sustainability Plan

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CONTENTS

REVISION STATUS

Issue	Scope of Revision	Date	Prepared By	Checked By
01	Draft For Comment	July 2014	RDB	AJD
02	For Planning	September 2014	RDB	AJD

GLOSSARY

AD	Approved Documents (Building Regulations)
AHU	Air Handling Unit
BER	Building Emission Rate
BREEAM	Building Research Establishment Environmental Assessment Method
CHP	Combined Heat & Power Generation
CCHP	Combined Cooling, Heat & Power Generation (Tri-Generation)
CO_2	Carbon Dioxide
DE	District Energy
DHW	Domestic Hot Water
ESCO	Energy Service Company
GREEN GUIDE	The Building Research Establishments Green Guide to Specification (3rd Edition)
GLA	Greater London Authority
LTHW	Low Temperature, Hot Water
MSCB	Multi Service Chilled Beams
PV	Photovoltaic Cells/Panels
S106	Deed of Planning Obligations Pursuant to Section 106 of the Town and Country Planning Act 1990
TER	Target Emission Rate
TIMSA	Thermal Insulation Manufacturers and Suppliers Association
HVAC	Heating, Ventilation & Air-Conditioning
Part L2	This refers to 'Approved Document L2A' of the building regulations which sets down the minimum performance and energy efficient measures which will have to be achieved by the King's Cross Central Zone B buildings.
Lean	The efficient use of energy by the Building Services equipment within the building domain.
Clean	The efficient supply of energy (Heat, Power, Cooling, etc.) for the building domain.
Green	The use of renewable technologies to supply energy (Heat, Power, Cooling, etc.)

1. INTRODUCTION

This Environmental Sustainability Plan is submitted in respect of a revised Reserved Matters submission for Building B5 including the B5 basement. It describes the strategies that have been included within the design of Building B5 in order to satisfy the planning conditions of the King's Cross Central ('KXC') outline planning permission (ref. 2004/2307/P) dated 22 December 2006 (the 'Outline Planning Permission') and obligations in the associated Section 106 Agreement related to sustainability. In particular, it seeks to address Planning Condition 17 and each of the six sub-sections listed in the same condition, giving details of the strategies adopted and demonstrating that the building achieves a very high standard of sustainability for a building of this scale in an urban environment. Additionally, reference is made to the actions taken to comply with Planning Condition 45 and the relevant obligations from the Section 106 agreement, namely those contained in Section AA, Section Y and Section Z.

Servicing facilities for Building B5 will be provided in the basement, primarily within the building footprint but also extending into the B5/B6 'Finger', which connects to the service roadway of the Zone B, part of the B0 Basement. Reserved Matters approval for the Zone B B0 Basement was approved in 2011 (with ref. 2011/4743/P.)

This Plan should be read in the context of the other plans and documents forming the B5 submission, including the Urban Design Report, the Planning Compliance Report and BREEAM pre-assessment, the latter being included within this document in Appendix A.

2. EXECUTIVE SUMMARY

Building B5 lies in the southern part of the KXC site in Development Zone B. It is one of three separate buildings on the northern edge of the zone and is bound by Goods Way to the north and Pancras Square to the south. The building is predominantly office use, with ground floor retail/restaurant/café uses. The building is serviced by the shared Zone B basement which is accessed via Pancras Road. A full description of the building and the basement are provided in the Urban Design Report, included with this submission.

Building B5 will achieve a very high standard of sustainability. The building has been registered since concept design stage under the BREEAM Offices 2011 scheme and will achieve a minimum rating of 'EXCELLENT', with an aspiration to achieve 'OUTSTANDING'.

The combination of energy efficient measures, the sourcing of heat and power from the low-carbon district energy system and the installation of photovoltaic arrays result in an overall annual carbon reduction in excess of 40% relative to the 2010 Part L target emission rate (TER).

In summary, the main environmental and sustainability measures that are proposed include but are not limited to, the following:

Condition 17(a) Energy efficiency measures

- An enhanced building envelope thermal performance through the specification of 'better-than' Part-L minimum limiting parameters for fabric U-values and air permeability.
- The adoption of effective passive design techniques such as optimising façade solar performance to respond to orientation and any benefits from natural sources of shading (for example, by Buildings B3 and B6) to minimise direct solar gain whilst ensuring good levels of natural daylight within the occupied areas.
- An emphasis on building services system operational efficiencies and a comprehensive metering strategy enabling interrogation of electrical, gas and water usage.
- The installation of an intelligent 'building management system' to monitor and control the building's energy performance and comfort conditions.
- The installation of ultra high efficency chillers with a seasonal efficency ratio greater than 5 to satisfy the building's cooling load.
- The installation of energy efficient lighting with a high efficacy and intelligent controls, including presence detection and daylight dimming to greatly reduce the electrcial consumption of the artificial lighting installation.

Condition 17(b) Reduction in carbon emissions

- Excluding the contribution of the low-carbon district energy system, the achievement of carbon emissions 21.8% lower than Part L of the Building Regulations 2010 through the use of good passive building design, energy efficient system selection and intelligent control methodologies.

Condition 17(c): Provision of Green / Brown roofs

- The provision of a landscaped roof garden, which will include 628m^2 of green roof, incorporates a mix of species sympathetic to the local environment. A suitable qualified Ecologist will detail the species mix to ensure the enhancement of ecological value to the area.
- The inclusion of terraces to the north and south facades at levels 2-10 shall enable incoming tenants to further enhance these spaces with planters.

Condition 17(d): Energy supply

- The connection of Building B5 to the district energy supply system to allow it to take advantage of the low-carbon benefits associated with combined heat and power. The district energy system will meet all of the heating and hot water demand for the building. It will also generate electrical power which will be fed into the National Grid, thereby offsetting a significant percentage of the building's demand.
- The use of a low-carbon energy supply and the aforementioned passive design measures, energy efficient systems selection and intelligent controls result in Building B5 achieving an overall reduction in CO_2 of 41.8% against the Part L 2010 TER.

Condition 17(e): BREEAM Rating

- As stated above, an initial Bespoke BREEAM pre-assessment has been carried out and has identified that the building design has an indicative score of 73.44%, representing an 'Excellent' BREEAM rating. The project team has also identified those credits which will be targeted with an aspiration to achieve an 'Outstanding' BREEAM rating.

Condition 45: Drainage

- The surface water discharge peak flows for Building B5 are 150l/s and 9.4l/s for surface water and foul water, respectively. The site-wide drainage networks have been designed on this basis, using SUDS principles to provide an overall peak flow reduction of 10% (based on a 1 in 30 year storm). Building B5 has been designed so that the above discharges will not be exceeded and that the site-wide maximum discharge to the existing combined sewer will not exceed 2292 l/s.

S106 - Section AA: Water

- The specification of rainwater harvesting and greywater recycling for the flushing of WC's and sanitary supply shut-off valves to reduce demand for mains water.
- The installation of low water use sanitaryware fittings (in conjunction with the rainwater harvesting and greywater recycling systems) to reduce the internal water use, resulting in a total consumption figure of less than 6.5 litres/person/day.

S106 - Section Y: Construction materials and waste

- The minimisation of packaging used to protect construction materials and assemblies in transportation. Any packaging will be returned wherever possible to be re-used. In addition, to minimise site wastage at the construction phase, prefabrication off-site will be utilised wherever possible.
- In addition to Section 106 requirements, the project contractor (BAM) has its own corporate construction targets which will be applied to the proposed development.
- The targeting of maximum credits under the BREEAM for Offices 2011 assessment for 'Man 3 - Construction site impacts, which includes monitoring and reducing resource use and its waste production.
- An early appraisal of the likely construction materials and their embodied energies has been undertaken. Materials with low levels of environmental impact will be specified wherever practicable. In addition, to minimise site wastage at the construction phase, prefabrication will be utilised whenever possible.

S106 - Section Z: Waste

- The circulation of a simple 'user' guide to occupants, including information on waste and recycling.
- The allocation of a sizeable waste store for Building B5 in the basement service area to allow for the future separation of waste and recyclable materials.

3. RESPONSE TO PLANNING CONDITIONS

3.1 CONDITION 17(a) – ENERGY EFFICIENT MEASURES

"The Environmental Sustainability Plan shall explain how the proposed building design realises opportunities to include design and technology energy efficiency measures."

3.1.1 Overview

Building B5 has been designed with energy efficiency being one of the key drivers from the outset.

Whilst the offsetting of electrical energy and the heating supplies to each building will be provided via the low-carbon KXC Energy Centre, the project team recognise the need to reduce energy consumption demand of both the building and its users through the application of the following design methodologies:

Passive Design - The use of the building structure (thermal mass) and the development of the façade systems to respond to their orientation and relation to sun angles to minimise cooling loads and artificial lighting energy demand.

Active Design - The specification of energy efficient equipment (for example, intelligent and high efficacy lighting systems, variable speed pumping etc.) all linked and monitored via the Building Energy Management System, to reduce energy consumption when the building is in use.

By embracing passive and active design, Building B5 will also be 'future-proofed' to ensure it is adaptable to climate change and the future operational needs of the tenant, and is capable of accommodating future low/zero carbon technologies.

3.1.2 Passive Design

3.1.2.1 Physical Form of the Buildings

Building B5 lies in the southern part of the KXC site in Development Zone B. It is predominantly office use, with some retail/restaurant/café uses at ground level.

The building will be serviced by a common basement which will extend across the entirety of Development Zone B and will be accessed via a single entrance/exit ramp off Pancras Road. Dedicated service areas, plant, cycle and car parking facilities for Building B5 will be provided within the footprint of the building, at basement levels.

Building B5 will overlook Pancras Square to the south, which forms the centrepiece to Zone B, and will overlook the Camley Street Natural Park to the North West, Canal Square to the North East, with the Regent's Canal and the Eastern Goods Yard beyond this to the north. The secondary streets between Building B5 and the Buildings B3 & B6 to the West and East respectively, provide connections between Goods Way and Pancras Square.

Site Context

Figure 3.1 below highlights the location and orientation of Building B5 (outlined with blue dashed line) in the context of the KXC illustrative scheme.

3.1.2.2 Façade Design

The building's façades have been developed through detailed thermal modelling analysis using industry-recognised dynamic simulation software to optimise the percentage of glazing in conjunction with solar and light transmittance performance to ensure good levels of natural daylight penetration whilst limiting solar gain and heat loss. High performance building fabrics with low U-values and the specification of low air-leakage rates will be used to minimise uncontrolled heat losses and gains. Extensive computational analysis has been carried out to optimise the benefits from the structural thermal mass and high levels of insulation, selection of thermal and solar-control glass, the depth of reveals, inclusion of external brise soleil as well as the proportions of glazing and opaque façade elements.

The Building B5 façade performance figures will look to comply with or exceed the Part-L Limiting Fabric Parameters as stated within the Building Regulations Part-L2 2013.

It should be noted that the basement does not include any external facades.

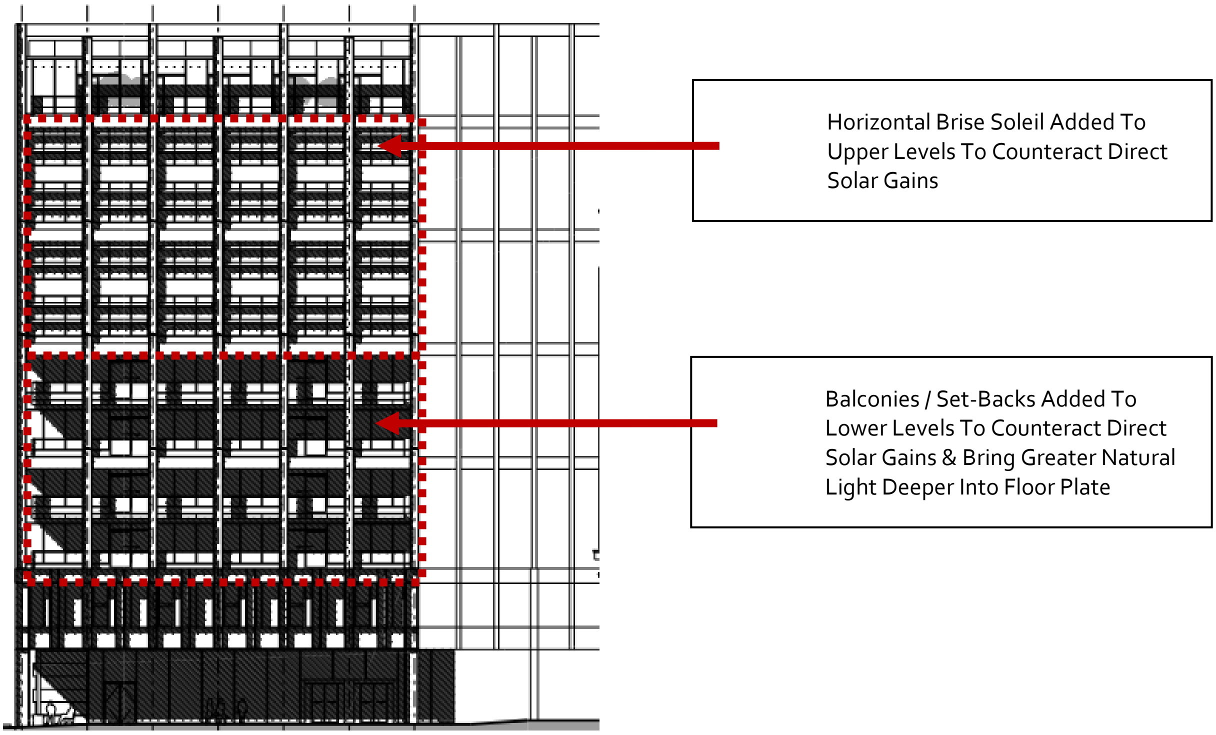


Figure 3.2 – Southern Elevation

Figure 3.3 – Eastern Elevation

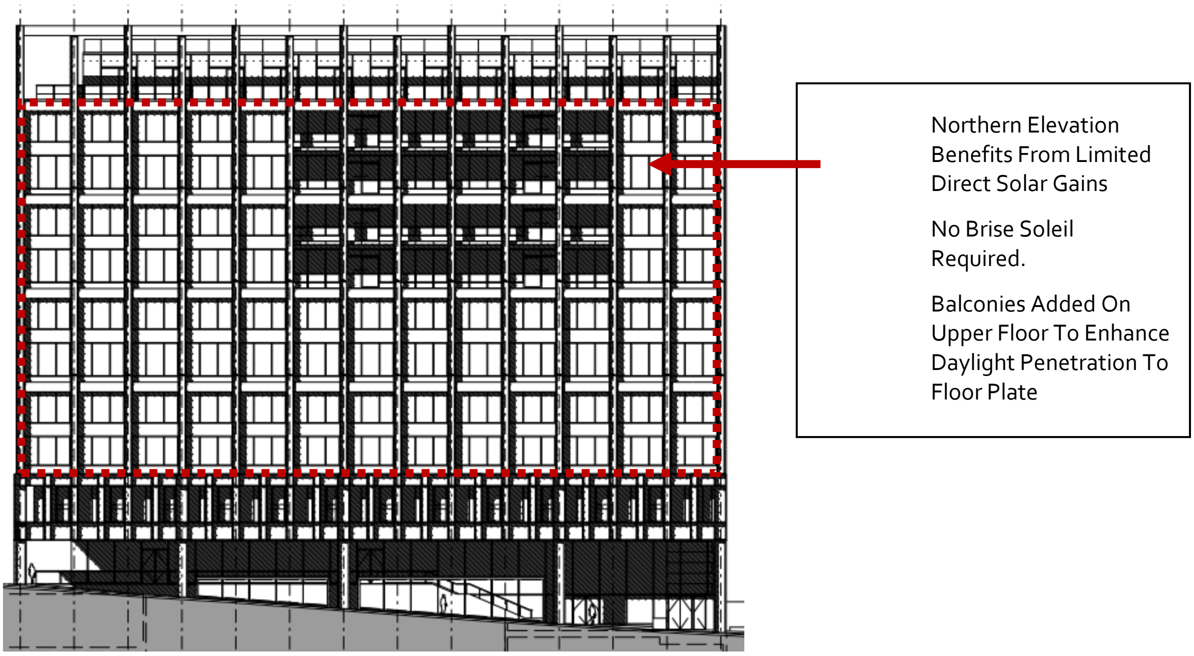


Figure 3.4 – Northern Elevation

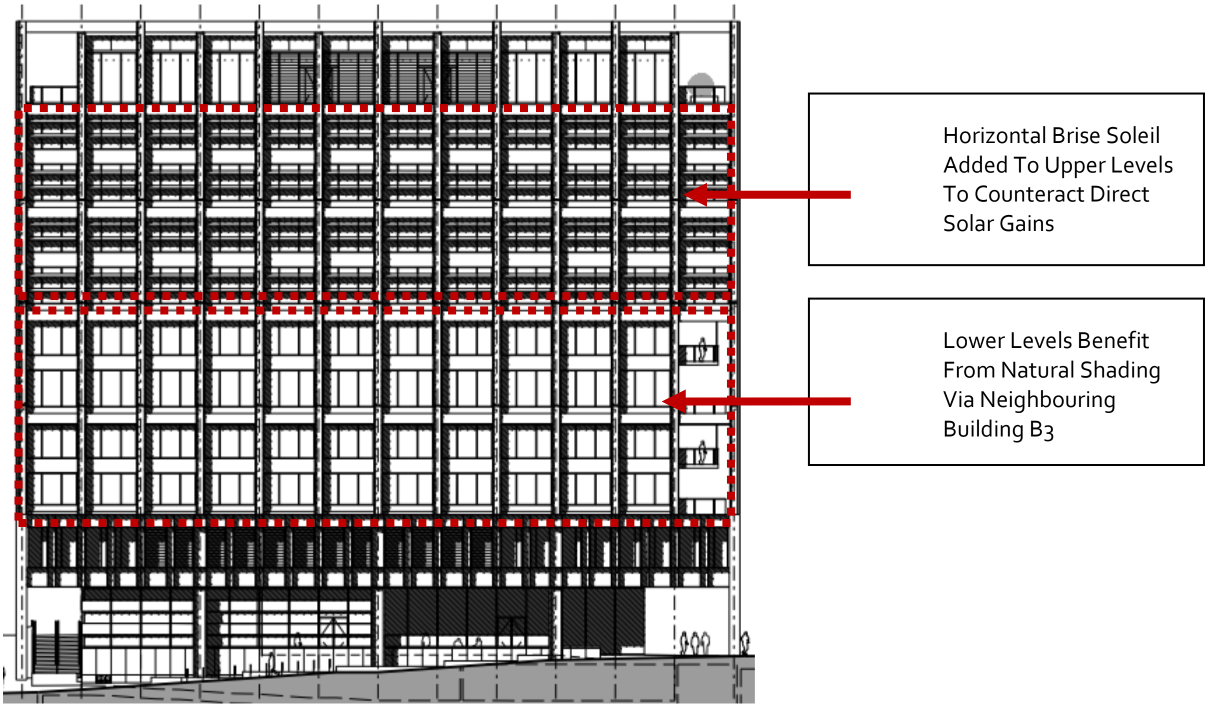


Figure 3.5 – Western Elevation

The project team has acknowledged from the outset that the glazing performance specification for this building in terms of solar, thermal and light transmittance is a key driver to minimise energy usage. Two of the four facades, the east and west, will have neighbouring buildings of similar height shading the majority of these facades. The north facade will have an abundance of natural light available, but limited solar gain, whereas the south facade will have to counteract direct solar gains in the peak mid-day hours. Hence the correct balance of glazing performance, set-backs and external brise soleil are proposed. The design allows tenants to install internal blinds as part of their fit-out for glare control which will be more important during the winter months due to the inherent low sun angles. These blinds will also assist in reducing further solar gains but as they are under the control of occupants, they have not been included in thermal simulations.

The percentage of glazing on the north façade, where little direct solar gain exists, has been maximised to create transparency, views out and increased levels of natural daylight into the occupied areas.

The east, west and south facades have been developed with external brise soleil added to the upper levels to counteract direct solar gain. The lower floors on the east and west facades benefit from natural shading given the proximity and location of Buildings B3 and B6. The lower floors on the south facade have incorporated external terraces to provide breakout space for building users, but these also provide horizontal shading to the office accommodation, which counteract solar gain from the high sun angles.

The percentage of and the solar performance of the glazing on the upper levels has been specified to maximise the opportunity for very good levels of natural light. This slight increase in the percentage of glazed area on the upper levels acknowledges and responds to the reduced floor plate depths, enabling significant reductions in the need for artificial lighting throughout the day.

The depth of the building floor plate exceeds the effective maximum for natural ventilation. Hence, energy efficient mechanical ventilation systems have been specified to maintain desired internal comfort conditions. Details on these systems are provided later in Section 3.1.3 of this document.

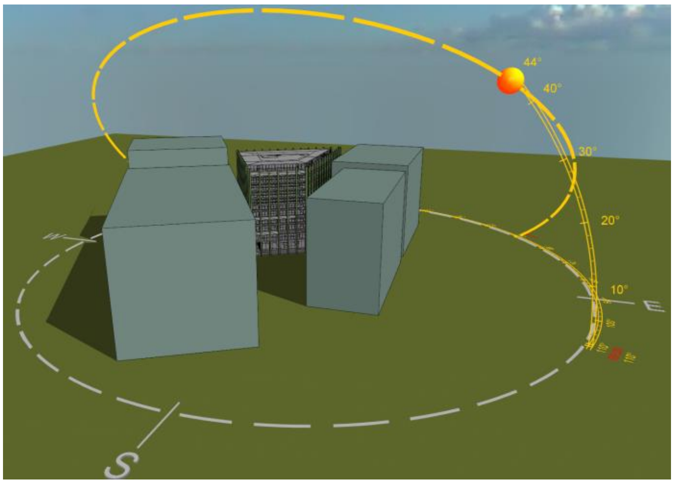


Figure 3.6 - Building B5 – Sun Angle at 09:00hrs (July 1st)

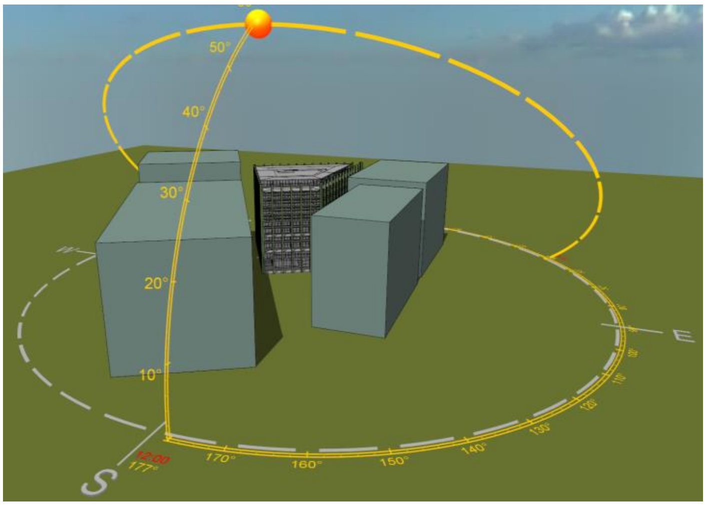


Figure 3.7 – Building B5 – Sun Angle at 12:00hrs (July 1st)

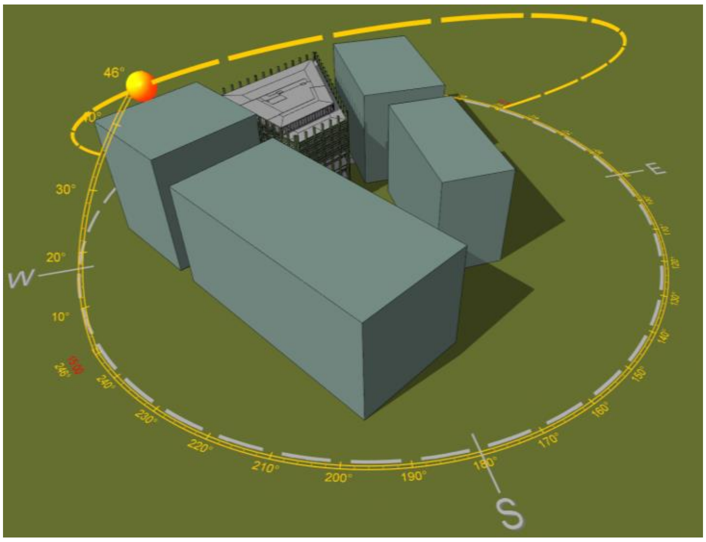


Figure 3.8. – Building B5 – Sun Angle at 15:00hrs (July 1st)

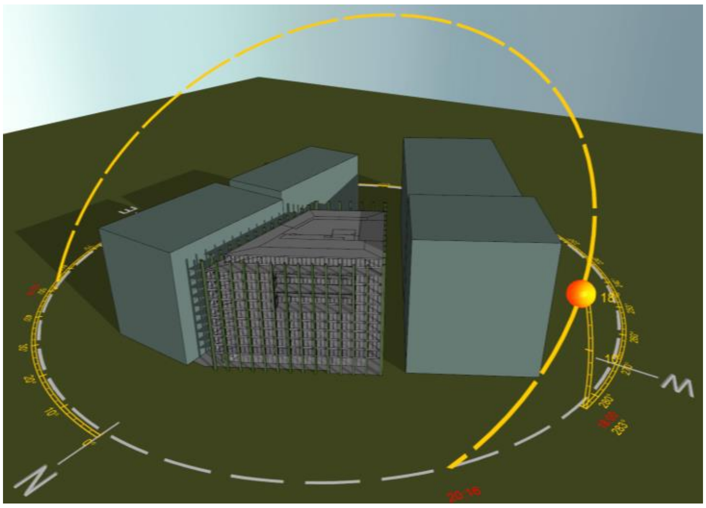


Figure 3.9. – Building B5 – Sun Angle at 18:00hrs (July 1st)

3.1.2.3 Natural Daylight

As stated previously the external facades have been optimised to minimise direct solar gains whilst maximising daylight provision into the occupied areas.

Cut outs to form balconies on the north and south facades between levels 2-10 have enhanced the levels of daylight penetration into their respective office floors. As well as improving occupant comfort by increasing natural daylight provision, this will reduce the dependency on artificial lighting, thus resulting in significant energy savings.

Whilst the lower floors will predominantly be shaded on two sides by buildings B3 & B6, the project team has sought to limit the quantum of structure present on the façade at the double height ground level to enable the internal environment at ground floor the experience a greater benefit from natural light.

3.1.2.4 Scope for Using Thermal Mass

Building B5 has been designed with inherent high thermal mass through the specification of exposed concrete floors in the office areas.

The thermal mass allows the potential to store 'coolth'. Hence overnight, during the warmer months of the year, the buildings will be ventilated with cool, early morning and/or night-time air in a controlled fashion by utilising free cooling via the mechanical ventilation systems. This cool air will purge the day's heat build-up from the concrete floor and soffit slabs. The cooled slabs will then be able to absorb heat from the office space the following day, and offset the peak cooling load. This technique offers the following benefits:

- Reduced peak cooling load
- Reduced annual cooling consumption
- Improved thermal comfort for occupants.

3.1.3 Active Design

3.1.3.1 Building Energy Management System and Metering

A comprehensive Building Energy Management System ('BEMS') will be installed to monitor and report overall energy consumption. The system will highlight any out of range consumption figures and readings, allowing a preventative approach through interrogation and resolution of potential problems.

Metering of energy usage on all floors allows building owners / occupiers to view and interrogate where potential energy savings can be made throughout their buildings.

3.1.3.2 Ventilation

Displacement ventilation is proposed to provide comfort cooling and ventilation to the office floors. This method of ventilation (illustrated in Figure 3.10) supplies all the air necessary for cooling via the central air handling plant, with the air then introduced directly into the occupied area. Cooled supply air is delivered at low level via a pressurised floor void and enters into the occupied area at low velocities via floor grilles to cause minimal induction and mixing. Large volumes of fresh air are inherent with this type of ventilation system resulting in a high level of occupant comfort and indoor air quality.

The supply air creates a reservoir of cool air flow at low levels. Convection from heat sources (e.g. people, equipment) creates vertical air motion. This convection allows the air to rise, pulling the cool supply air up with it, moving contaminants and heat away from the occupied zone up into the upper zone away from occupants. At high level, return air grilles will extract the contaminated air. This strategy maintains thermal comfort conditions within the occupied zone and the convection motion removes contaminants, meaning that the air quality is generally superior to that achieved with mixing room air distribution.

Since the conditioned air is supplied directly into the occupied space, supply air temperatures must be higher than mixing systems (> 18 °C) to avoid cold draughts being experienced by the occupants. Hence, the supply air temperature will be closer to the actual room temperature, delivered at low velocities and with consideration given to the location of supply diffusers/floor grilles in relation to furniture layouts to maximise occupant comfort.

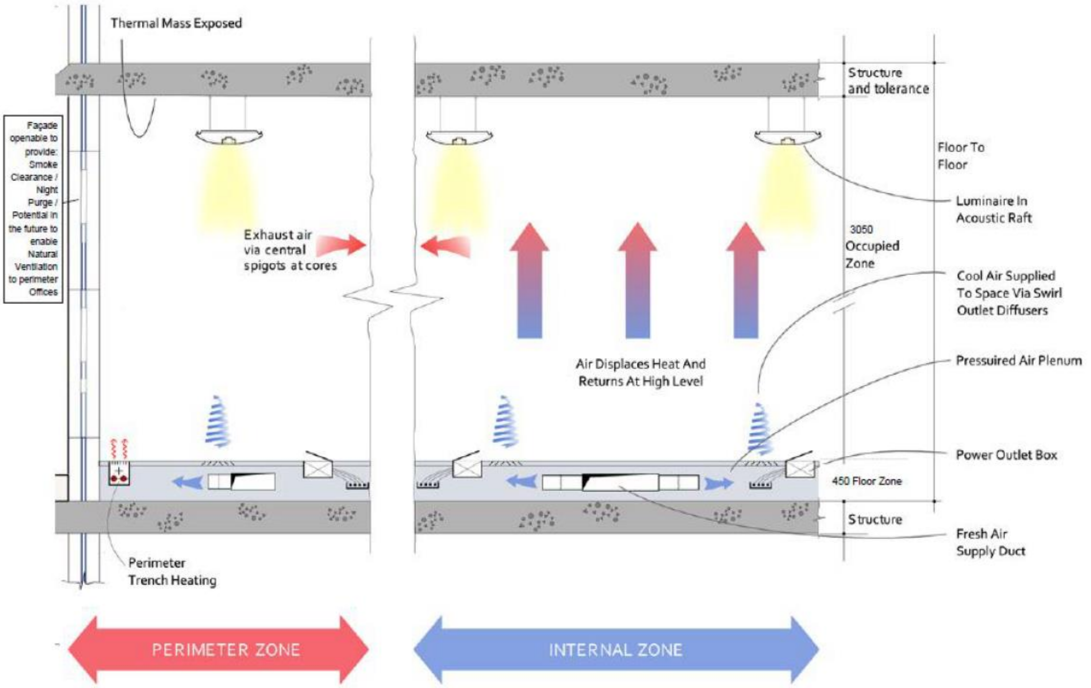


Figure 3.10 Displacement Ventilation Principles

Displacement ventilation offers good energy efficiency potential compared to other fresh air services strategies such as fan coil units or chilled beam installations. As mentioned above, due to the large quantities of air supplied and returned via the central air handling plant there is significant energy saving potential to transfer the heat from the return air path into the incoming supply air path. This will be done via an efficient thermal transfer media (e.g. thermal wheels – see Section 'Heat Recovery Systems' & Figure 3.11).

Since the temperature of the supply air for a displacement ventilation system is generally higher than a fan coil or chilled beam installation, less cooling is required to condition the incoming supply air prior to being supplied into the occupied areas. As cooling will be provided via electricity through efficient air-cooled chillers, and any heating will be provided via the low carbon district energy system, the carbon emissions inherent with this type of services strategy will be very low.

In addition, all the conditioning of incoming and outgoing air occurs entirely within the central air handling plant, hence displacement ventilation is deemed a low maintenance system as access, filter cleaning and inspections can generally take place within the central plant areas. In contrast, fan coil unit or active chilled beam installations tend to require maintenance on-floor.

3.1.3.3 Heat Recovery Systems

The energy required to heat or cool the incoming fresh air supply to the office space will be significantly reduced by using a heat recovery system. The heat recovery systems will utilise the thermal properties of the return air to transfer 'free' heat/coolth to the incoming fresh air supply. These will be controlled so as to minimise the demand for any heating and cooling of the fresh air supply.

Thermal wheels will be specified as the heat recovery medium. Thermal wheels continuously rotate allowing the storage of heat from the return air path (> 24°C) to transfer to the incoming air stream (see Figure 3.11 below). In winter the warmer return air will combine with the cooler outdoor air to raise the supply air temperature, thus reducing the amount of energy required to heat the incoming air to the required design conditions. In summer, the opposite occurs, with the incoming air stream likely to be of a higher temperature than the return air. In this case a transfer of coolth results in a reduction of energy required to cool the air to design conditions. These systems provide the highest heat recovery efficiency available and will significantly reduce the building's overall heating and cooling demand.

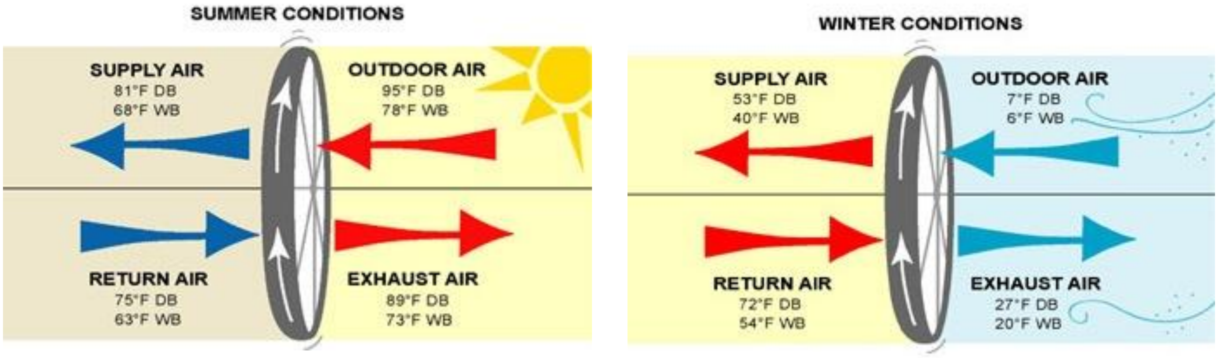


Figure 3.11: Thermal Wheel Explanation: Source – http://greenlineblog.com/what-is-an-enthalpy-wheel/

3.1.3.4 Scope for Intelligent and High Efficacy Lighting Systems

The specification of the lighting types and spacing of the fittings will generally be limited to provide an intensity of 300-400 lux on the working plane using high efficacy lamps, thereby limiting the energy used to power the lighting, and the cooling required to off-set the lighting heat gain. High frequency ballasts will be used to improve occupant well being and energy efficiency, by preventing flickering. The nett lettable office lighting installation will generally comply with CIBSE LG7. A tenant fit-out guide will be produced which will highlight the potential benefits and payback potential should the tenant wish to install LED lighting in their meeting rooms or even throughout the entire office area itself.

All lighting in office and toilet areas will be controlled by presence/movement detectors (PIRs) which will monitor occupancy and switch off the lights when the area is vacant for a sustained length of time. Further to this, lighting in perimeter office areas will include intelligent dimming that monitors daylight and adjusts the lighting intensity accordingly. Lighting in communal/lobby areas will include timed control to ensure switching off to reduce energy consumption.

3.1.3.5 Power Factor Correction

Power factor correction, to 0.95 or greater, will be provided, thus improving the efficiency of the electrical supply.

Many items of equipment within a building cause a lagging power factor, a good example being a motor. This lagging power factor is inefficient because it means more energy is required to produce the power consumed. For example a motor consumes 1kW of electrical power whilst running, at unity power factor (PF=1) this requires 1kVA of apparent power to be supplied to it. If the power factor is reduced to 0.8 then 1.25kVA needs to be supplied to get the required output

3.1.3.6 Heating

All the building heating demand will be provided from the low carbon KXC Energy Centre, therefore negating the need for boilers. The building will make use of the low carbon heat to serve the central air handling units to heat the incoming air and the trench heaters which will heat the perimeter zones of the office accommodation and the building reception to offset any heat loss. The low carbon heating supply will also serve the domestic hot water load for the showers within the basement areas as well as the hot water supply to the office wash hand basins. Similarly the retail tenants will also be provided with a heat exchanger to enable them to connect to the KXC Energy Centre.

3.1.3.7 Chilled Water

A life cycle costing and operational life cycle analysis has been undertaken by the project team to assess the benefits of either an air-cooled chiller installation or a water cooled chiller installation to satisfy the building cooling load.

The results of the study showed that a water cooled chiller installation offers the greatest LCC benefit due to the efficiencies >6.0. (266% improvement over the Part-L2 requirements). A water cooled chiller installation has been specified for Building B5 following the results of the study.

Variable speed pumping will be used throughout the building to respond to variations in the annual building cooling load demand and thereby maximise the energy efficiency potential of the specified system.

High Efficiency Variable Speed Drives

The fans and pumps will be specified with inverter drives and variable speed controllers. By varying the fan and pump speeds for the chilled water, low temperature hot water and ventilation systems in order to match the building heating and cooling load profiles as monitored and controlled via the intelligent Building Management System; fan and pump energy consumption is considerably reduced.

3.1.3.8 Climate Change Adaptability & Future Flexibility

As described earlier, Displacement Ventilation inherently has large volumes of fresh air resulting in a high level of occupant comfort and indoor air quality. These fresh air volumes are distributed throughout the building and therefore offers future flexibility for the installation of supplementary systems should there be the need to increase additional heating or cooling.

The zoning of the proposed Displacement Ventilation mechanical system will separate internal and perimeter zones (shown in Figure 3.12). Zoning the floor plate in this way will allow greater control to respond to any variations in occupancy, casual gains and solar gains throughout a typical day. The zoned environments will be closely monitored via temperature and carbon dioxide sensors allowing the BMS tocontrol the internal conditions and ensure plant operates at appropriate efficiencies.

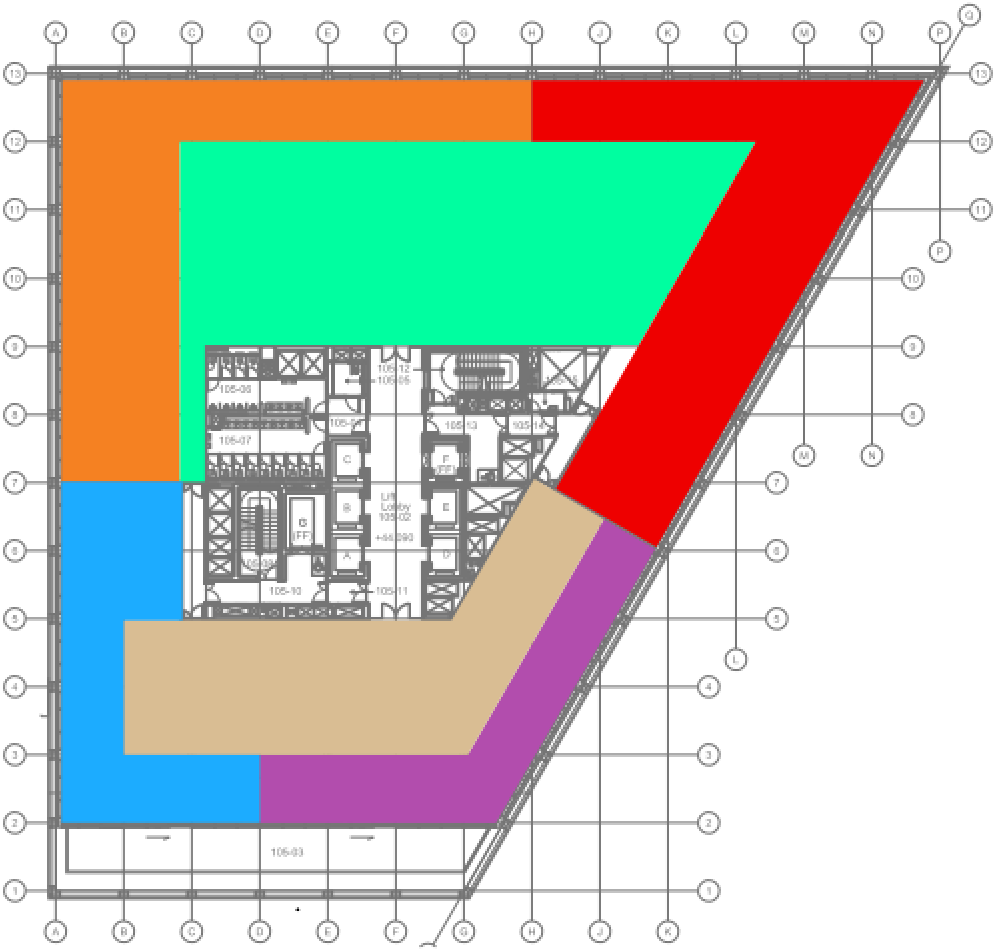


Figure 3.12 – Diagram of Typical Floor Highlighting The Zonal Control Zones

3.2 CONDITION 17(b) REDUCTION IN CARBON EMISSIONS

"The Environmental Sustainability Plan shall explain the reduction in carbon emissions achieved through building design and technology measures, compared with the emissions permitted under the national Building Regulations prevailing at the time the application for the approval of reserved matters is submitted."

3.2.1 Overview

Building B5 is primarily a new-build office building and therefore falls within the remit of Building Regulations Document L2A (ADL2A). A dynamic simulation model (DSM) software package, fully accredited for Level 5 Part L/EPC by the DCLG, has been used under the supervision of a licensed energy assessor (LCEA) to assess regulated carbon dioxide emissions. Section 5 of this Plan sets out the assumptions, methodology and results of the Target Emission Rate (TER)/Building Emission Rate (BER) calculations in more detail.

A full three-dimensional thermal model was created in 'IES' from the architect's drawings.

The Building Regulations Part-L2 compliance is demonstrated by utilising these models and inputting the Part-L minimum set values for building fabric U-values, plant efficiencies and operational parameters to determine a notional (or benchmark) building emission. To comply, each building will have to show carbon emissions which are lower than the notional building figure. This notional building figure is known as the 'Target Emission Rate' (TER).

Once calculated, the actual emission rate of the building and its systems is referred to as the 'Building Emission Rate' (BER).

The KXC S106 Agreement targets each new building to achieve carbon emissions at least 5% lower than Part-L of the prevailing Building Regulations (i.e Building Regulations 2010) using good passive design and energy efficiency measures only such as those set out in Section 4.1. On the basis of these measures alone (i.e.disregarding the carbon savings that will be achieved by utilising the low carbon district energy system and any renewables), the carbon emissions for Building B5 are expected to be 18.28 kg CO_2 /m^2. This represents a 21.8% reduction over the Part-L2 TER. Consequently the building exceeds the target 5% reduction set by the S106 Agreement, before taking into account the carbon savings resulting from the KXC Energy Centre.

Similarly, taking into account building design and technology measures only, a comparison with the Econ 19 Good Practice 'Business as Usual' benchmark identified in the KXC Energy Assessment and referred to in the S106 Agreement, shows that the CO_2 emissions are reduced by 66%. [1]

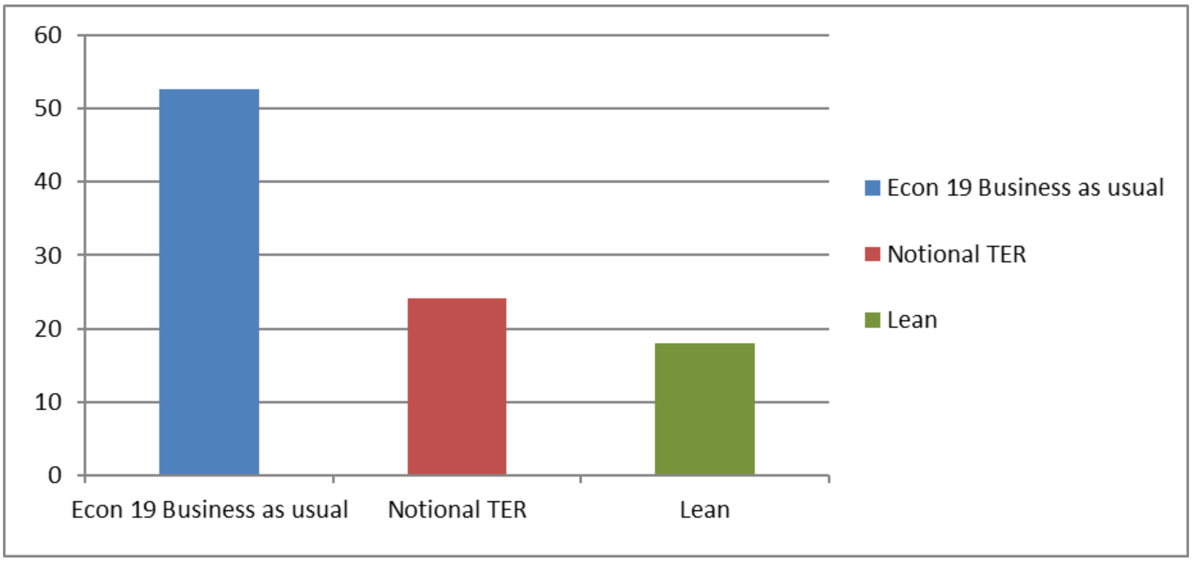


Figure 3.13 Part-L Assessment of proposed 'lean' design measures for Building B5

[1] *ECON 19 COMPARISON NOTE: Econ 19 is not directly comparable to Part-L2. Econ 19 includes for process loads such as catering facilities, data rooms etc. consumed within the building whereas Part-L2 does not. Therefore, the Econ 19 targets stated within this report have been adjusted by removing this portion of emissions. In this way, Econ 19 has been made as comparable as possible for the purposes of this Plan to Part-L2.*

3.3 CONDITION 17(c): PROVISION FOR GREEN AND/OR BROWN ROOFS

"The Environmental Sustainability Plan shall explain the specification for any green and / or brown roof."

The KXC Outline Planning Permission does not, within the Parameter Plans, define Zone B as a priority location for green and/or brown roofs. Nonetheless, it is proposed that a landscaped roof garden, of 628m² in area[1], will be provided on Building B5.

RPS has provided ecology advice on the types of species which will be planted within the landscaped roof garden. RPS will also write a five year bio-diversity action plan which will detail how the various species are to be maintained.

Consideration will be given to the arrangement and selection of ecology to ensure that the roof garden has spatial heterogeneity and thus supports diverse microhabitats, for example through the provision of varied depths, mounding features and a variety of particle sizes.

In addition to the roof garden, a series of terraces at various levels, are provided as amenity space for occupants. These areas provide the opportunity for additional container planting by the tenants.

The ecological enhancement and biodiversity arising from the provision of these roof and terrace are recognised within the building's BREEAM assessment, as detailed in Section 6 of this report.

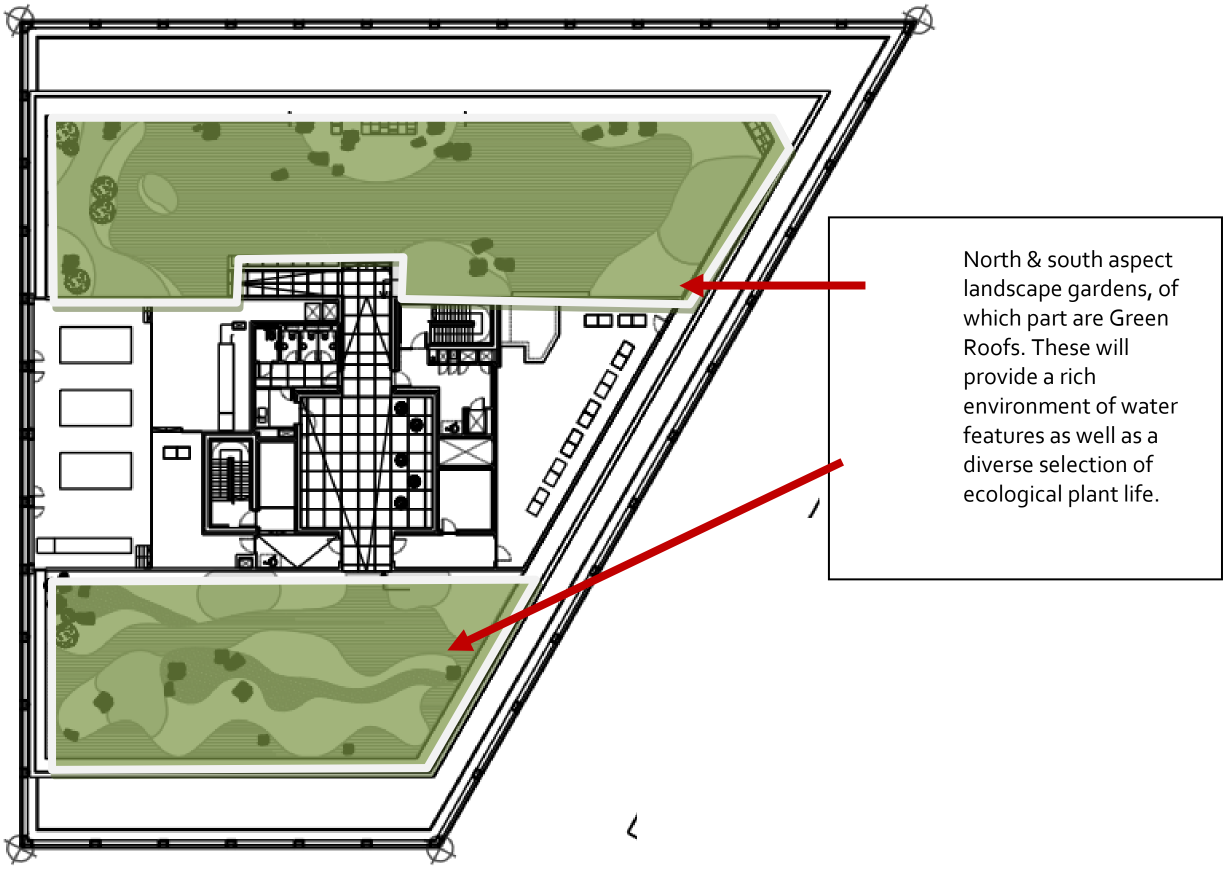


Figure 3.14: Building B5 Roof Plan

[1] The term 'green roof' is defined in the Revised Development Specification (2005) as both intensive ornamental roof gardens and extensive roofs with more naturalistic plantings or self-established vegetation. The term 'brown roof' refers to roof areas where ruderal vegetation (vegetation associated with disturbed sites) is allowed to colonise low fertility substrates like those found in the rubble of demolished buildings.

3.4 CONDITION 17(d): REDUCTION IN CARBON EMISSIONS

"The Environmental Sustainability Plan shall explain how energy shall be supplied to the building, highlighting:

(i). How the building relates to the site-wide strategy for district heating incorporating tri-generation from distributed combined heat and power;

(ii). How the building relates to the strategy for using bio-fuel boilers to supplement the energy supplied through the district heating system;

(iii). The assessment of the cost-effectiveness and reliability of the supply chain and bio-fuels;

(iv). Any other measures to incorporate renewables.

3.4.1 Overview

The T1 Energy Centre has already been approved and constructed. The necessary heat and power distribution infrastructure is being installed across the King's Cross Central site to enable the connection of each new building to the district heating system. The thermal energy thus supplied to Building B5 will be used to provide all of its space heating and hot water demands. The combined heat and power (CHP) engines to be installed within the T1 Energy Centre will also generate electrical power (to be fed into the National Grid), which will offset a significant percentage of the buildings' demand. Building B5 will be able to benefit from the domestic hot water load generated by the cyclist showers and office wash hand basin hot water demand.

The showers and wash hand basin heating demand, which is supplied via the low carbon district energy system, significantly contributes to the overall savings in carbon emissions for the building against the Part-L2 target emission rate. The notional building used within the Part-L2 to compare the Building B5 design efficiencies, would typically utilised localised electric heating to serve these showers and wash hand basins.

Due to the good thermal performance of the façade of Building B5, which is achieved through the specification of insulated solid external walls; double glazing with an U-value inclusive of mullions and framing of 2.0W/m²K or lower; and the specification of a low infiltration rate; there will be limited heat losses through the façade.

When fully fitted, it is anticipated that the T1 Energy Centre will include the following principal items.

• 3 No. 1.8MWth gas fired CHP

• A thermal store, integral to the CHP operating hours strategy

• 3 No. 9MWth gas boilers

These items will be installed on a phased basis as more buildings are constructed within the King's Cross Central development, and the heating and electrical loads reach critical mass, in order to meet peak demands and optimise efficiency.

KCCLP and its partners have now established the Energy Services Company (ESCo) to run the district heating, and remain committed to completing the works on site to install utilities and district heating infrastructure, for example within Goods Way and the Boulevard.

As outlined in previously submitted (and approved) Environmental Sustainability Plans, future provision has been made within the KXC development for the inclusion of biomass boilers. At this time, a robust commercial case to support the inclusion of biomass cannot yet be made, however, this position continues to be actively monitored. The scope for a secondary energy centre within Plot T2 could provide for their inclusion later, subject to procurement of an appropriate fuel source in line with clause 20(a) of Section X of the Section 106 Agreement.

The carbon emission calculations used within this report have assumed that, in total, 66.2% of the thermal energy used across the KXC site will be produced by CHP with the remainder provided by gas-fired boilers.

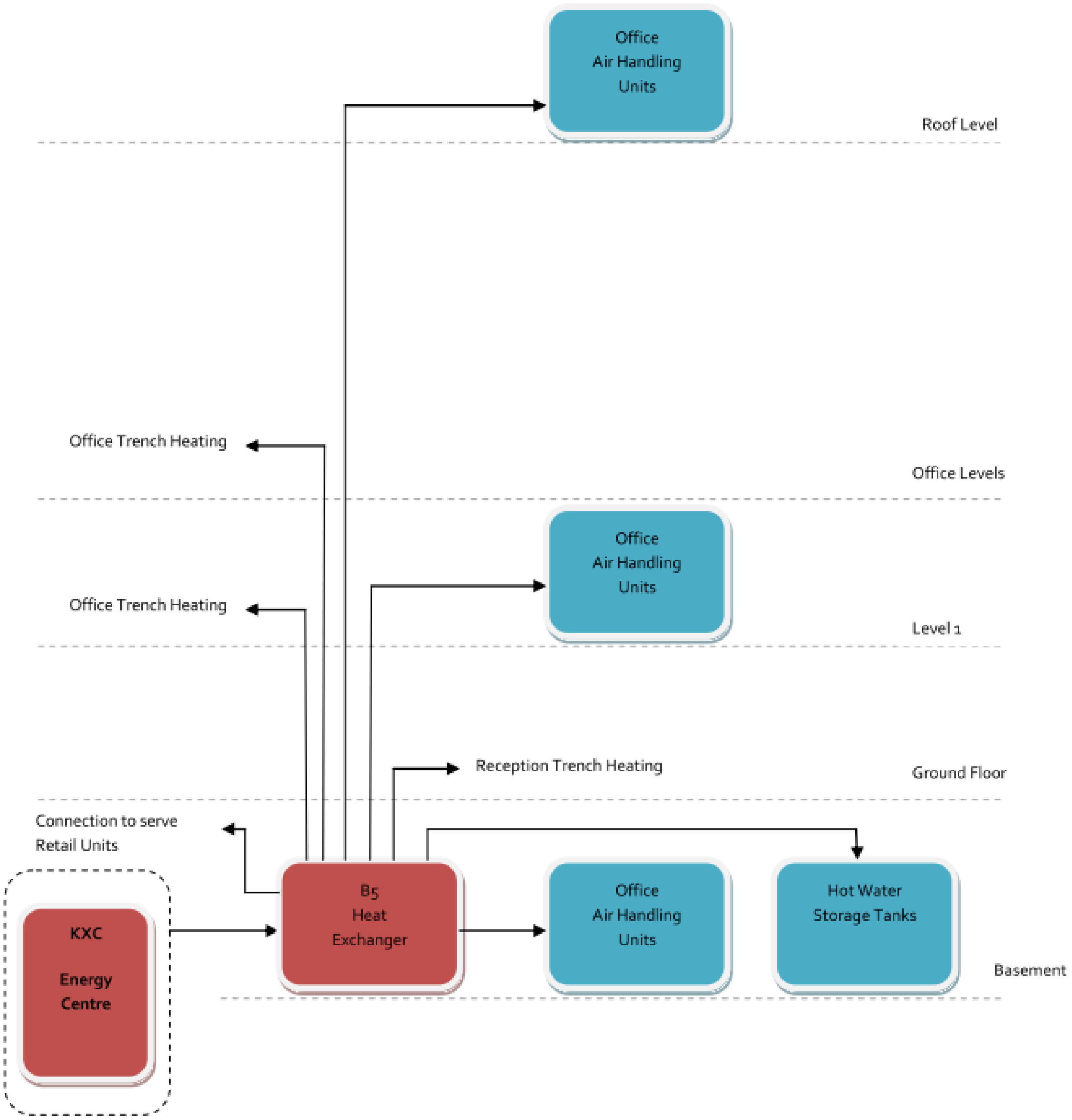


Figure 3.15 - The strategy for heating for Building B5 is shown above

3.4.2 CO_2 Savings Arising From the KXC Energy Centre

Figure 3.16 shows the CO_2 savings that could be expected from connecting Building B5 to the KXC Energy Centre.

The utilisation of low carbon heating to serve the building heating and hot water demand, and the offset electrical power from the KXC Energy Centre will add about 25 percentage points to the 21.8% savings against Part L achieved by the passive design measures described previously. This equates to an additional reduction in CO_2 emissions from 18.28kgCO_2/m^2 to 13.61kgCO_2/m^2 and a combined improvement of 41.8% lower than the Part L 2010 target of 23.4kgCO_2/m^2 or 73% compared to ECON 19 – Good Practice. (adapted as per Section 3.2 to enable comparison with Part L).

Incorporating biomass boilers would see a further, but relatively small reduction in CO_2 emissions.

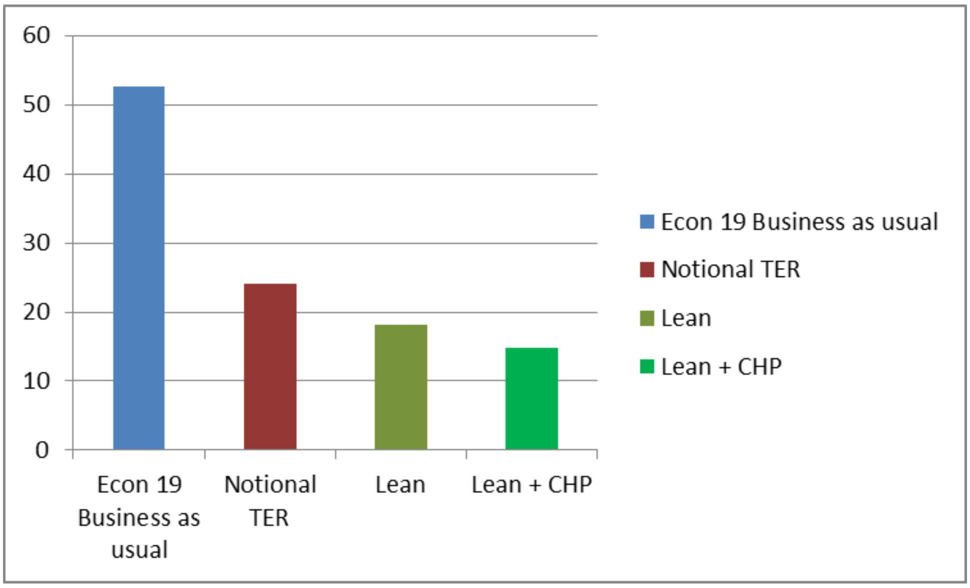


Figure 3.16: Building B5 CO_2 Savings Due to Energy Centre

3.4.3 Renewables

The opportunities for exploiting renewable technology on Building B5 were thoroughly considered during the design process. A range of technologies were examined, even though the September 2005 Energy Assessment did not highlight Building B5 as an appropriate building within the site for the application of renewables. The technologies considered included the preferred on-site renewable technologies (wind turbines, solar water heating, ground source (bore hole) cooling and photovoltaic generation) described in the same assessment.

In summary, the review, had the following outcomes:

- Wind turbines – Though outside the priority zone for wind turbines set by parameter Plan KXC021, the feasibility of the application of wind turbines to the buildings was assessed. Given the buildings' location within the St. Paul's viewing corridor and the King's Cross St. Pancras Conservation Area and their proximity to the listed St. Pancras and King's Cross Stations, it was considered that wind turbines would be incongruous in long and short range views and therefore would not be appropriate. In addition, the roof on Building B5 has been allocated for ecological enhancement (green roof) and plant, meaning that insufficient space would be available to allow for the installation and maintenance of turbines.
- Solar hot water – Domestic hot water demand for an office building is relatively small and a solar-powered system would provide only a modest renewables contribution. Furthermore the designs for Building B5 and the basement have been progressed to make full use of the KXC Energy Centre, as this is the lowest carbon solution. The only major hot water load is in the basement to serve the showers and the standing losses of the pipework running from the roof to the basement would make the system inefficient.
- Ground source heat pumps – Ground source heat pumps ('GSHP') are best suited to buildings with roughly equal summer cooling and winter heating requirements, so that across a year the heat extracted and returned to the ground has a neutral thermal polluting effect in the ground. Typically they can serve air-conditioned buildings up to around 4 storeys from the ground floor. Given the height of Building is 11 storeys, it is considered that the size of the building is not conducive to GSHP. Further, the use of heat from the KXC Energy Centre means that the buildings and the basement will not be able to offer a balanced heating and cooling application, as preferred by the Environment Agency, and therefore a GSHP would not be able to achieve the carbon savings that will be achieved by using the Energy Centre. The use of the district heating system offers the lowest carbon solution for the site and hence the ground source scheme will not be pursued further.
- Photovoltaics – Photovoltaics are still relatively inefficient. Their need for appropriate availability and angling towards the sun restricts their locations at roof level. Furthermore, adequate access for cleaning and maintenance is also needed. Given the desire to accommodate a roof garden which enhances the ecology and aids in occupant well-being and satisfaction within their work environment, the location of photovoltaics would need to be compromised. This would also lead to further inefficiencies in electrical generation from the PV cells.

  The conclusion is that the most effective application of low carbon and renewable technology is the connection and utilisation of the low carbon district heating network. Given the carbon savings in excess of 40% against the Part-L2 TER with the passive and active measures as defined earlier in this document, the enhancement of the local wildlife and ecology is felt to take precedence over the limited benefit an installation of photovoltaics would generate. Hence, no photovoltaics will be specified on Building B5.

3.5 CONDITION 17(e) BREEAM RATING

"The Environmental Sustainability Plan shall explain how the proposed building has been designed to achieve a BREEAM rating of 'Very Good' or better."

3.5.1 Overview

BREEAM is a recognised methodology to drive improvement in the sustainability performance of buildings. The standards set by BREEAM are being used to maximise the effectiveness of the issue-specific strategies, including energy, water and waste, addressed in this Plan. The project team is fully committed to go beyond the planning objective for a 'Very Good' rating by securing an 'Excellent' rating with an aspiration to achieve 'Outstanding' for Building B5.

The team has taken a holistic approach to every aspect of the building's design utilising passive and active design methodologies to ensure that a truly sustainable building is produced. The key design features covering energy, water and resource efficiencies, together with supplier and construction management and commissioning practice, all discussed in other sections of this Plan, fully embrace sustainability best practice and will contribute to delivering a high BREEAM rating.

A BREEAM Pre-Assessment has been carried out using the BREEAM New Construction 2011 scheme.

The Pre-Assessments predict that an 'Excellent' rating (minimum BREEAM score of 70%) will be achieved under BREEAM Offices 2011. The project team have also assigned target credits to strive for the 'Outstanding' rating, but this will also rely on how the building is used by incoming tenants. The full list of credits which are being targeted can be seen within the Pre-Assessment Report in Section 6, but are also summarised in Figure 3.17.

It should be noted that the assessments are provisional on the basis that all of the documentary evidence required for a formal assessment (in the form of tender documents and drawings etc) is not yet available at this planning stage. Full evidence will be gathered in due course at the detailed design stages as the projects progress.

3.5.2 Building B5: BREEAM Assessment

The provisional assessment tool for BREEAM Offices 2011 predicts an overall score of 73.44% for Building B5, which equates to an 'Excellent' rating. The assessment highlights the credits sought. Full details are provided in Section 6 of this document.

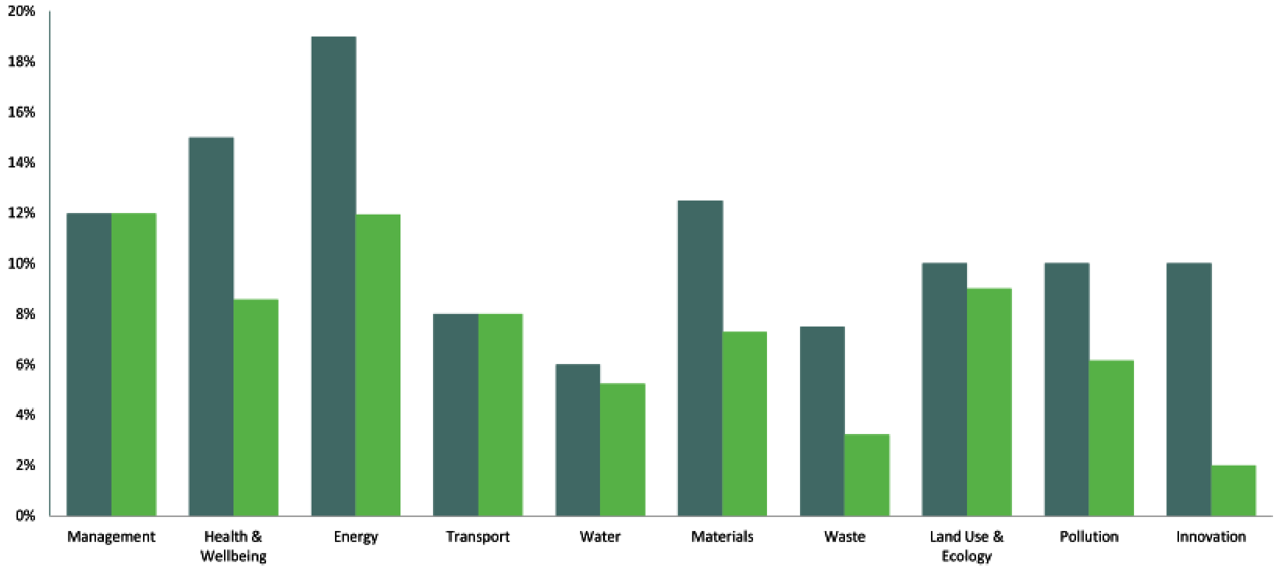
BREEAM®

BREEAM 2011 New Construction Assessment Report: Building and Project Details

Overall Building Performance

Building name	Kings Cross Buidling B5
BREEAM rating	Excellent
Total Score	73.44%
Min. standards level achieved	Outstanding level

Building Performance by Environment Section



Environmental Section	No. credits available	No. credits Achieved	% credits achieved	Section Weighting	Section Score
Management	22	22	100.00%	12.0%	12.00%
Health & Wellbeing	14	8	57.14%	15.0%	8.57%
Energy	27	17	62.96%	19.0%	11.96%
Transport	9	9	100.00%	8.0%	8.00%
Water	8	7	87.50%	6.0%	5.25%
Materials	12	7	58.33%	12.5%	7.29%
Waste	7	3	42.86%	7.5%	3.21%
Land Use & Ecology	10	9	90.00%	10.0%	9.00%
Pollution	13	8	61.54%	10.0%	6.15%
Innovation	10	2	20.00%	10.0%	2.00%

Figure 3.17 – Table 1 - Credit summary allocation & score for Building B5 under BREEAM Offices 2011

3.6 CONDITION 17(f)

"The Environmental Sustainability Plan shall explain the incorporation of bird boxes, bat roosts and other wildlife features on the building."

Building B5 will make a positive contribution towards fulfilling objectives set out in the London Biodiversity Action Plan.

Building B5 includes approximately 865m² landscaped roof garden, as described in Section 3.3. This will provide habitat for insects and birds, including species such as the Black Redstart and Swallows.

Although predominantly hard landscaped, the terraces provided at the various levels of the building on the north, and south facades are likely to feature raised containers for shrub planting. The design of these spaces will make a further, albeit small, contribution to the ecological enhancement of the site. External lighting for these areas will be designed to be sympathetic to the wildlife populations.

Bird and bat boxes will be incorporated during construction of the building to provide nesting habitats and shelter.

A five year bio-diversity action plan will be prepared by an Ecologist from RPS. The reportwill make recommendations to further enhance diversity of wildlife as well as plant species. KCCLP will adhere to these recommendations and appoint Broadgate Estates to manage and maintain the ecology on-site.

3.7 CONDITION 45

"The new drainage infrastructure within the site shall be designed to achieve a combined (storm and foul) peak discharge to the existing combined sewer of 2,292 l/s or less."

3.7.1 Site wide drainage infrastructure

The figure of 2292 l/s in the wording to Condition 45 describes the maximum peak (storm and foul) discharge which is permissible for the site as a whole to discharge to the existing combined sewers. The peak discharge will be split between the Camden Sewer and York Way Sewer (for areas north of the Regent's Canal) and the Camley Sewer / Fleet Sewer (for the areas south of the Regent's Canal).

The cumulative peak discharge from the many building plots and areas of infrastructure will exceed 2292 l/s under certain weather conditions. In these instances, the site wide drainage infrastructure, including online and offline attenuation (see below), will attenuate peak flows discharging from individual plots, adopted highway and public realm, enabling cumulative peak flows to be reduced to 2292 l/s or less.

The site wide surface and foul water disposal strategy can be summarised as follows:

- To provide separate surface and foul water networks, combining only at the final manhole prior to connection into the existing Thames Water sewerage network;
- To provide online attenuation (for example oversized pipe work) and offline attenuation (for example proprietary modular underground storage systems / tanks) to buffer peak flows generated within the site down to the agreed discharge rates into the existing Thames Water sewerage network;
- To ensure that no above ground flooding occurs during the worst case 1 in 30 year storm event;
- To ensure that no internal building flooding occurs during the worst case 1 in 100 year (+20%) storm event;
- To accord with PPS 25 and Sewers For Adoption 6th Edition;
- To discharge at various locations into the sewerage network; and
- To design the above infrastructure such that combined surface and foul water flows do not exceed 2292 l/s during a 1 in 30 storm event.

The site wide drainage infrastructure at King's Cross Central can be described in terms of three drainage infrastructure areas, incorporating both building plots and infrastructure/public realm. These are described below.

Drainage Infrastructure Area	Plot developments	Infrastructure / Public Realm
Eastern Goods Yard	The Granary Complex, Q1, Q2, R1, R2, R3, R4, R5, S1, S2, T1, T2, J1, H1, K1, K2, K3, K4 and 50% of I1)	Transit Street, Wharf Road, Goods Street, Granary Square, Cubitt Park and Handyside Park
Southern Area Infrastructure	A1, A2, A3, A4, A5, B1, B2, B3, B4, B5, Building B6, D1, D2, F1 and V1	The Boulevard, Goods Way, Station Square and Pancras Square
Remainder of the Northern Area including the Triangle Site	M1, M2, N1, N2, P1, P2, S3, S4, S5, T3, T4, T5, T6 and W1	Canal Street and Cubitt Square

Table 1 Drainage Infrastructure Areas

Table 2 identifies the assumed peak foul and surface water flows from each of the building plots in the Southern Area (of which Building B5 forms part) which underpins the design of the site-wide infrastructure. The foul water figures are based on CIRIA 177 Variable Peaking Factor and the assumed foul water discharges from various land uses identified in Table 4. The surface water peak flows are based on a 1 in 30 year storm. It should be noted that it is most unlikely that the foul and surface water peak discharges from each individual plot will coincide with each other.

Generally, foul water discharges represent small but consistent flows subject to diurnal patterns. For example, residential properties will exhibit two peaks within their diurnal flow pattern, one in the morning and one in the early evening. Surface water discharges, on the other hand exhibit extreme variations in flow, directly related to rainfall intensity.

The surface water discharge from each plot development will have its own unique hydrograph (identifying the variation between flow and time – the peak of which only lasting for a few minutes in most cases). Each one of these peaks (within the hydrographs) combine within the main drainage infrastructure at different points in time during the storm event creating an averaged flow within the pipe network. These flows will discharge into the Thames Water network via flow hydraulic controls at the downstream end of each network. These hydraulic controls limit the discharges to a combined maximum of 2292l/s. Where the plot development discharges combine to produce flows in excess of the maximum allowable discharge, water will be held within the drainage infrastructure which has been specifically sized to accommodate these flows.

	Assumed Peak Flows (l/s) for plots in the Southern Area	
Plot reference	**Surface Water (1 in 30 year event)**	**Foul Water**
A1	68	5.1
A2	94	7.7
A3	122	9.1
A4	155	10.6
A5	193	11.4
B1	118	5.5
B2	63	3.5
B3	263	17
B4	112	6.7
Building B5	150	9.4
B6	130	9.9
D1	40	0.5
E1	48	1.9
F1	45	2.4
V1	59	0.1
Totals	**1660**	**100.8**

Table 2 – Peak Surface and Foul Water Flows

Land Use	Demand Options	Discharge to Sewer (l/day/hd)	l/s/head	Operational Hours	Population Density (m2 per person)
Residential	-	152	0.0023457	18	36.2
Student Accommodation	-	152	0.0023457	18	19.5
Retail	Large Retail	26.6	0.0009236	8	40
Food/Drink	Customer/day 2hr sittings	28.5	0.0009896	8	1.4
Education	General	19	0.0006597	8	10
Business	Without Canteen	41	0.0014236	8	12
Hotel		133	0.0046181	8	20
Leisure	Sports club	142.5	0.0049479	8	40

Table 3: Foul water discharges from various land uses

3.7.2 Drainage Infrastructure

The drainage networks around the King's Cross Central development are being designed on SUDS principles providing an overall peak flow reduction of 10% (based on a 1 in 30 year storm).

Thames Water has approved in principle surface water discharges for four direct connections. The approved surface water discharge for Building B5 is 150l/s. Further, the foul water flow 9.4l/s for Building B5. The figures in Tables 2&3 do not include for any public realm areas.

4. SECTION AA: ENVIRONMENTAL SUSTAINABILITY – WATER

Section AA of the Section 106 agreement places an obligation to use reasonable endeavours:

- *to incorporate within the detailed design water efficiency measures such that the design secures at least 40% of the potable water consumption credits available under the BREEAM methodology which represents a reduction of approximately 20-30% against typical water consumption;*
- *to incorporate one or more of groundwater abstraction, grey-water and black-water recycling and rainwater harvesting as alternative water supplies to meet 5% or more of the non-potable water needs; and*
- *to ensure that the design for the treatment of storm water run-off incorporates, where practicable, filtration, attenuation and other techniques that is consistent with current best practice on SUDS, to control the timing and volume of flows.*

4.1.1 Water Efficiency

Building B5 will achieve very high standards of water efficiency through an approach that combines alternative supply via rainwater collection and recycling, with internal water efficiency through design. The design teams have used the BREEAM criteria as their benchmark in driving down potable water consumption for the building.

Water efficiency measures will include 'auto shut-off' on all toilet areas, dual flush WCs and urinals. Together with rainwater harvesting, the incorporation of this sanitaryware will reduce the water consumption from the BREEAM baseline figure of 7.0m^3 per person per year, down to 3.35m^3 per person per year. This indicates a >50% improvement on the BREEAM baseline figure.

It is also the intention of the project team to capture and re-use the grey-water from the basement showers and office level wash hand basins to reduce the overall water usage even further.

4.1.2 Alternative Water Supplies

A combination of grey-water and rainwater harvesting is to be installed. Rainwater will be collected from roof areas (excluding green roof areas) and stored in rainwater tanks in the basement. Grey-water from the basement showers will also be collected in tanks within the basement. The water will be filtered prior to entering the tanks. A booster pump will be used to deliver the water for the flushing of water closets and urinals. It is estimated that potable water consumption for flushing will be reduced by about 25% as a result of these water recycling measures.

4.1.3 Sustainable Urban Drainage

Surface water drainage methods that take account of quantity, quality and amenity issues are collectively referred to as Sustainable Urban Drainage Systems ('SUDS'). SUDS will be integrated wherever possible into the design of Building B5 to affect source control and storm water retention/infiltration, provide permeable surfaces and encourage evapo-transpiration. These SUDS controls have been located as close as possible to the rainwater source, providing attenuation of the runoff.

The public realm between Buildings B3 and B5 and Building B6 and Building B5 (revised details of which are submitted as part of the Building B5 reserved matters submission), incorporates planted beds and tree pits. These features will make a contribution (albeit small) to reducing the peak flow and the total volume discharged into the combined sewer by attenuating or detaining rainfall and on warmer days, by encouraging evapo-transpiration. As described above, water harvesting tanks will be provided in Building B5's basement area to collect surface water run-off from the roof. This water will be used to either flush toilets and/or to water plants on the tree terrace, thereby reducing potable water consumption.

4.2 SECTION Y: CONSTRUCTION MATERIALS & WASTE

As Section Y of the S.106 Agreement imposes obligations to:

- *implement the Construction Materials and Purchasing Strategy;*
- *apply the Construction Materials and Purchasing Strategy to agreeing specifications and targets in contracts with contractors, designers and suppliers of services in relation to construction; and*
- *use reasonable endeavours:*
  - I. *to minimise packaging waste associated with the delivery of construction materials;*
  - II. *to produce topsoil and subsoil that uses subsoil and crushed rubble from the site combined with organic material for use in areas of landscaping; and*
  - III. *to achieve the Construction Targets.*

4.2.1 Construction Materials and Purchasing Strategy

The project teams intend that best practice will be followed, and surpassed wherever practicable, in order to maximise resource efficiency. The Construction Materials and Purchasing Strategy will be adopted, while careful planning and effective control will ensure that waste during the construction phase is minimised

4.2.2 Packaging Waste

Packaging used to protect construction materials and assemblies in transportation will be kept to a minimum and wherever possible returned to be re-used.

4.2.3 Soil

The Earthworks and Remediation Plan, approved in 2011 as part of the Revised Reserved Matters Approval for Development Zone B Basement (ref. 2010/0870/P), addresses the nature and quantity of arisings and the arrangements for their re-use or disposal as appropriate.

Due to the brownfield nature of the site, there are no natural topsoil or subsoil resources on site. A Topsoil Manufacture Feasibility Study has been undertaken by Tim O'Hare Associates to assess the suitability of site-won clay fill from the KXC site as a constituent of manufactured topsoil, rather than importing material onto site for landscaping use. Due to the density, plasticity and poor drainage qualities associated with clay fill, the study concludes that manufactured topsoil derived from this material would not be suitable for use in permanent landscaping schemes such as brown or green roofs (which require a light weight substrate) or planted beds/tree pits in the secondary streets. As such, it is recommended that imported organic material is used in these areas.

4.2.4 Construction Targets

A BREEAM rating of 'Outstanding' will be the principal driver for the team's endeavours to achieve the best possible performance against the Construction Targets. BREEAM credits cover the Green Guide rating of the major building elements, the provision of floor coverings in offices, the environmental impacts of paints and varnishes, the use of recycled aggregate, the responsible sourcing of materials and the global warming potential of insulants, all matters addressed by the Construction Targets.

At this early stage the exact degree to which all the Construction Targets will be achieved cannot yet be determined, because the precise specifications and quantities of many of the materials have not yet been finalised. It has already been confirmed that all timber products within Zone B, and also the temporary timbers used for site works at the construction phase, will be sustainably-sourced through an auditable supply chain and that ozone-depleting substances will not be used.

4.3 SECTION Z: WASTE

Section Z of the S.106 Agreement imposes obligations to:

I. *provide occupiers with Waste Information Packs and use reasonable endeavours to obtain feedback on the success or popularity of the initiatives contained within the Packs;*

II. *use reasonable endeavours to incorporate within the detailed design best practice design solutions that provide for waste segregation and storage areas and to maintain the solutions that are implemented;*

III. *provide and maintain segregated waste containers within the Public Realm areas at suitable locations and in appropriate numbers.*

4.3.1 Waste Information Packs

To encourage the minimisation of waste generated during the operational life of the building, Waste Information Packs will be provided to occupiers, and arrangements will be made to monitor their effectiveness in encouraging waste minimisation.

4.3.2 Design Solutions

Dedicated and sufficient facilities will be provided within the basement service area and within the Facilities Management Suite for the separation, storage and easy handling of waste. The facilities will be available for use by both the commercial and retail occupiers of the buildings, with direct lift connections being provided to basement service areas to allow convenient access to the storage areas and the service yard from which collections will be made. The commitment to aspire to achieve an 'Outstanding' BREEAM rating will ensure that current best practice is followed.

As this submission does not include any areas of Public Realm, part iii above does not apply.

5. PART L2 ANALYSIS

5.1 OVERVIEW

The content of this Appendix is governed by the Building Regulations Part-L2, 2013 and sets out the assumptions, methodology and results of the TER/BER calculations referred to in Section 3.2.1 in detail. This section focuses on three of the five criteria (Criteria 1, 2 and 3) required for compliance at the design stage. Criteria 4 and 5 have not been addressed because the project team have committed to adhering to the best practice guidelines with respect to BREEAM. A 'Building Log Book' and 'User Guide' will be provided, thereby satisfying Criterion 5 in any event. In addition, Criterion 4 covering quality of construction and commissioning will be satisfied as the Contractor will commit to achieving best practice certification under the 'Considerate Constructors Scheme'.

Criterion 1: Target CO 2 emissions rate (TER), requires that the Building CO 2 Emissions Rate (BER) is equal or less than the TER when using pre-determined scenarios and weather data.

Criterion 2: Limits to design flexibility ensure that a minimum level of performance is achieved for the fabric, heating, ventilation and air conditioning (HVAC) systems, and lighting for all buildings and designs.

Criterion 3: Limits to solar gains, assessment to highlight compliance with a reference mean solar gain figure determined through April to September onto an 'East' facing façade with fixed glazing dimensions and solar performance. All facades on Building B5 will need to adhere to the equivalent or less mean solar gain figure predetermined.

The building's Part L2 calculations have been carried out by Grontmij. A registered IES assessor used approved IES Software to carry out the Part L calculation. IES complies with the requirements of the Chartered Institution of Building Services Engineers (CIBSE) AM11 as required by BREEAM.

A full three-dimensional thermal model for the building was created in IES from the architects drawings. Numerous simulations were run to optimise the energy demand and heating and cooling power, by studying various options for the design of the façade, glazing type, the level of thermal insulation in the fabric, the level of thermal mass, etc. Then the type of local and central system was modelled to identify the system with lowest energy consumption. CFD was used to ensure that the proposed ventilation, heating and distribution systems are viable and comfort and indoor air quality is achieved.

5.2 BUILDING CONDITIONS

5.2.1 Design Data Used for Calculations

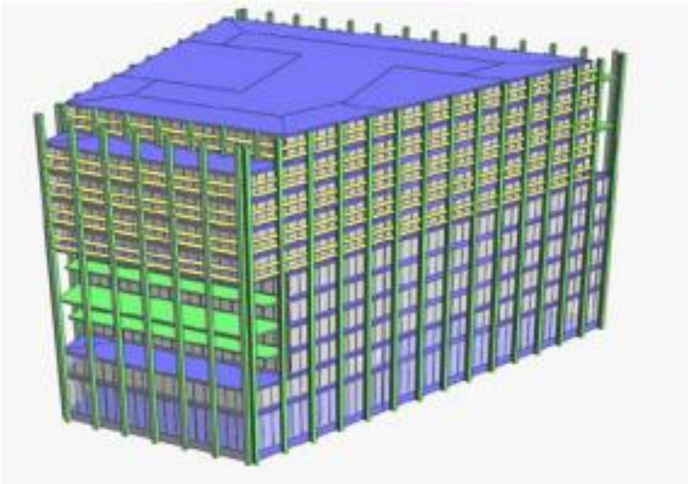


Figure 5.1

3D Model used within the Dynamic IES Modelling simulations

The 3D geometry and building construction materials have been modelled based on the architectural plans and elevations.

The 3D model describes the building, in terms of:

- orientation
- geometry of building form and all associated exposure of surfaces
- material constructions
- windows and glazing.

The 3D geometry has been subdivided into generic zone types as per the National Calculation Method (NCM) requirements.

Operational Parameters

Building loads determine the heating and cooling requirements of a building. Generic zone types have been assigned a default NCM Operational Template, taken from the Activity Database, which defines these loads.

Each of the NCM Operational Templates applies a fixed set of characteristics including:

- operational hours and profile
- occupancy densities and loads
- minimum ventilation rates
- small power loads
- room conditions
- domestic hot water loads.

Solar loads vary daily and depend on seasonal and weather conditions, and will affect loads which are accounted for in the thermal modelling process, such as solar transmission, conduction and building heat transfer. These are represented in the model by virtue of the weather data file.

5.3 CRITERION 1 – TARGET EMISSIONS RATE (TER)

Carbon savings were calculated using the industry-approved software, IES.

5.3.1 Building B5 Compliance with Criterion 1

Using the above data and assumptions the BER for Building B5 was calculated to be 13.61kgCO_2/m^2 per annum. The carbon emissions of the notional building were calculated to be 23.4kgCO_2/m^2 per annum. The building therefore performs better than the TER by approximately 42% and complies with the Criterion 1 of the Building Regulations Part L2A. Figure 5.2 below, shows the data produced by the IES software.

The Final CO_2 Level shown in Figure 5.2 accounts for passive design measures, improved plant efficiency, as well as the additional energy-efficiency due to the KXC Energy Centre.

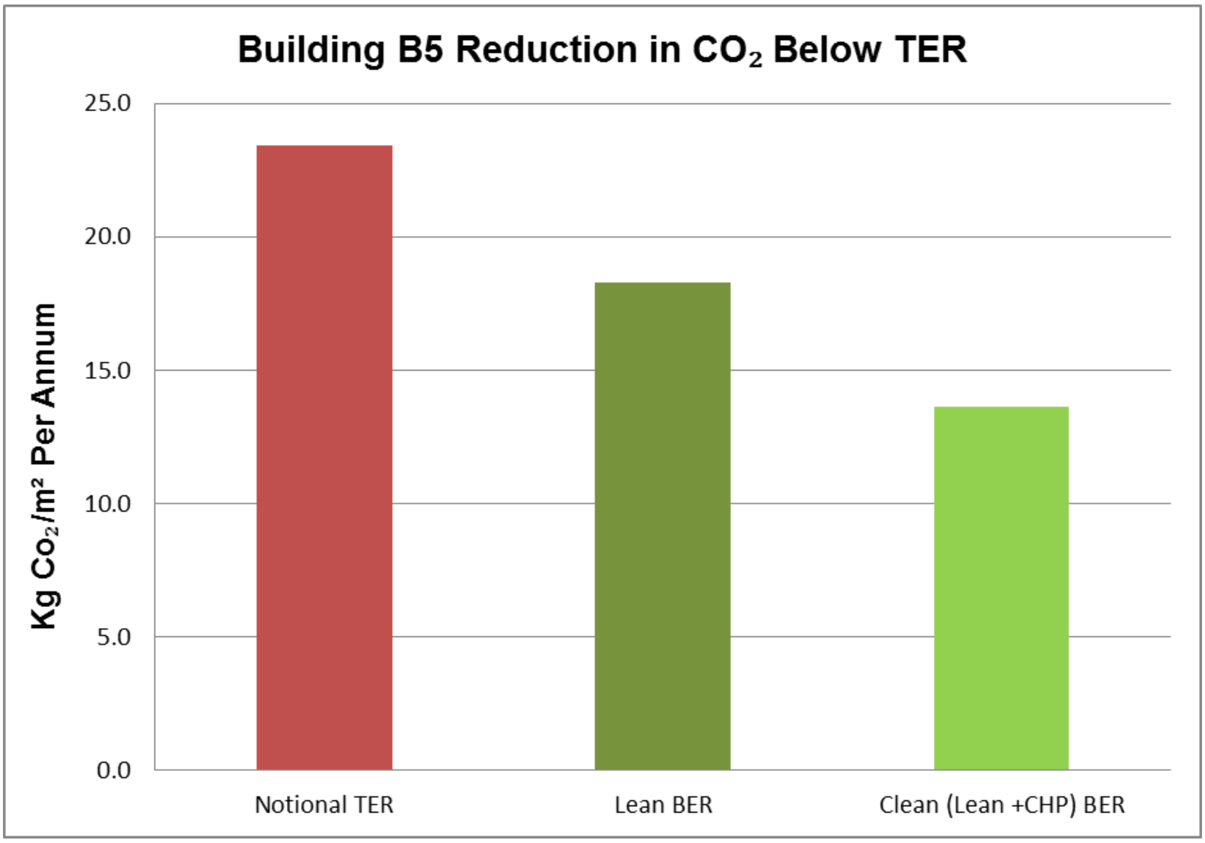


Figure 5.2: Building B5 Reduction in CO_2 Below TER

5.4 CRITERION 2

Limits to design flexibility ensure that a minimum level of performance is achieved for fabric, heating, ventilation and air conditioning (HVAC) systems, and lighting for all buildings and designs.

All fabric, fittings, HVAC systems and lighting have been specified with performance better than or equal to the Part-L2 requirements. Building B5 therefore complies with Criterion 2 of the Building Regulations.

5.5 CRITERION 3

Limits to solar gains, assessment to highlight compliance with a reference mean solar gain figure determined through April to September onto an 'East' facing façade with fixed glazing dimensions and solar performance. All facades on Building B5 will need to adhere to the equivalent or less mean solar gain figure predetermined.

The reference façade is that of a 1m high piece of glazing across the full width of the occupied space. A frame taking up 10% of this window area should also be assumed. The glazing solar performance (g-value) is 0.68.

The façade is East facing. Hence, the solar performance of any façade make-up on any orientation of Building B5 will have to better the mean solar gain figure passing into the occupied area set by this reference façade system.

All of the Building B5 facades, except the South facing entrance façade, show the resulting mean solar gain to be less than the reference glazing system figure. Whilst this space will be conditioned to prevent condensation from occurring on the glazing system, the entrance foyer has been defined as a transient area. The reception area, where an employee will be positioned for large proportions of the working day, is set-back from this glazed façade and therefore not subject to the direct solar gains falling onto this façade and the transient area.

Hence, Grontmij has excluded this area from their calculation of Criterion 3.

Building B5 therefore satisfies Criterion 3 of the Building Regulations Part-L2.

6. BUILDING B5 - BREEAM SCORING MATRIX

6.1 SUMMARY

Grontmij have prepared this document to highlight those credits which have been sought in order for the Building B5 development to achieve an 'Excellent' rating under the BREEAM for Offices 2011 criteria.

The final BREEAM certification report will be produced in line with the credits highlighted within this schedule and sent to the Building Research Establishment for quality assurance checking and accreditation.

Management

BREEAM Ref	Title	Number Of Credits Available	Number Of Credits Sought
Man 01	**Sustainable Procurement**	**8**	**8**
Man 02	**Responsible Construction Practices**	**2**	**2**
Man 03	**Construction Site Impacts**	**5**	**5**
Man 04	**Stakeholder Participation**	**4**	**4**
Man 05	**Life cycle cost and service life planning**	**3**	**3**

Health & Well-Being

BREEAM Ref	Title	Number Of Credits Available	Number Of Credits Sought
Hea 01	**Visual Comfort**	**3**	**1**
Hea 02	**Indoor air quality**	**4**	**3**
Hea 03	**Thermal comfort**	**2**	**1**
Hea 04	**Water Quality**	**1**	**1**
Hea 05	**Acoustic Performance**	**2**	**1**
Hea 06	**Safety & Security**	**2**	**1**

Energy

BREEAM Ref	Title	Number Of Credits Available	Number Of Credits Sought
Ene 01	**Reduction of CO_2 Emissions**	15	10
Ene 02	**Energy Monitoring**	2	2
Ene 03	**External Lighting**	1	0
Ene 04	**Low & Zero Carbon Technologies**	5	3
Ene 06	**Energy Efficient Transportation Systems**	2	2
Ene 08	**Energy Efficient Equipment**	2	0

Transport

BREEAM Ref	Title	Number Of Credits Available	Number Of Credits Sought
Tra 01	**Public Transport**	3	3
Tra 02	**Proximity of Amenities**	1	1
Tra 03	**Cyclist Facilities**	2	2
Tra 04	**Maximum Car Parking Capacity**	2	2
Tra 05	**Travel Plan**	1	1

Water

BREEAM Ref	Title	Number Of Credits Available	Number Of Credits Sought
Wat 01	**Water Consumption**	5	4
Wat 02	**Water Monitoring**	1	1
Wat 03	**Water Leak Detection & Prevention**	2	2
Wat 04	**Water Efficient Equipment**	1	0

Materials

BREEAM Ref	Title	Number Of Credits Available	Number Of Credits Sought
Mat 01	**Life Cycle Impacts**	**5**	**2**
Mat 02	**Hard Landscaping & Boundary Protection**	**1**	**1**
Mat 03	**Responsible Sourcing of Materials**	**3**	**1**
Mat 04	**Insulation**	**2**	**2**
Mat 05	**Designing For Robustness**	**1**	**1**

Waste

BREEAM Ref	Title	Number Of Credits Available	Number Of Credits Sought
Wst 01	**Construction Waste Management**	**4**	**2**
Wst 02	**Recycled Aggregates**	**1**	**0**
Wst 03	**Operational Waste**	**1**	**1**
Wst 04	**Speculative Floor & Ceiling Finishes**	**1**	**0**

Land Use & Ecology

BREEAM Ref	Title	Number Of Credits Available	Number Of Credits Sought
LE 01	**Site Selection**	**2**	**1**
LE 02	**Ecological Value of Site & Protection of Ecological Features**	**1**	**1**
LE 03	**Mitigating Ecological Impact**	**2**	**2**
LE 04	**Enhancing Site Ecology**	**3**	**2**
LE 05	**Long Term Impact On Biodiversity**	**2**	**2**

Pollution

BREEAM Ref	Title	Number Of Credits Available	Number Of Credits Sought
Pol 01	**Impact of Refrigerants**	**3**	**1**
Pol 02	**NO_x Emissions**	**3**	**3**
Pol 03	**Surface Water Run Off**	**5**	**2**
Pol 04	**Reduction of Night Time Light Pollution**	**1**	**1**
Pol 05	**Noise Attenuation**	**1**	**1**

Innovation

BREEAM Ref	Title	Number Of Credits Available	Number Of Credits Sought
Man 01	**Sustainable Procurement**	**1**	**1**
Man 02	**Responsible Construction**	**1**	**1**

6.2 RESULTS

The building design and evidence provided by the project team will result in King's Cross Central Building B5 achieving an 'Excellent' rating, scoring an anticipated 73.44%

RATING / SCORE

PASS	-	≥25 - <40%
GOOD	-	≥40 - <55%
VERY GOOD	-	≥55 - <70%
EXCELLENT	-	≥70 - <85%
OUTSTANDING	-	≥85%

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