



**35 Greyfriars Road
Reading
Berkshire
RG1 1JH**

Energy and Ventilation Strategy

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Mechanical and Electrical Building Services Design Consultants



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1.0 APPLICATION PARTICULARS

Applicant: Croudace Properties Ltd

Site Address: 35 Greyfriars Road, Reading

Description: The project will comprise the comprehensive refurbishment and extension of the existing 3 storey, office building, located on Greyfriars Road in Reading town centre. The redeveloped office will comprise two further floors providing commercial office accommodation, a new external façade, new external plant enclosed upon the new roof level, new external entrance, lift and complete new build toilet cores and circulation.

2.0 EXECUTIVE SUMMARY

This report provides proposals for achieving the policy requirements set by the local authority for reducing energy consumption and employing Low Zero Carbon (LZC) energy sources to meet the following targets:

- BREEAM 2008 Very Good
- 25% reduction in carbon dioxide emissions
- Demonstration of an overall improvement to calculated carbon emissions as a result of the proposed works

The application of general energy efficiency measures prior to consideration of LZC energy sources is crucial to meeting the expectations, as it has a multiple effect of reducing running costs, reducing baseline CO₂ emissions and reducing the absolute size of renewable technologies to be applied. The following energy hierarchy is therefore proposed:

1. *Be Lean: Use less energy*
2. *Be Clean: Supply energy efficiently*
3. *Be Green: Use renewable energy*

In line with the above philosophy, the application of low energy lighting and passive improvements to newly introduced building fabric are proposed. LZC technology will be applied in the form of high efficiency air source heat pumps (VRF).

This provides a 25% improvement on Part L TER for extension areas.

Baseline Carbon Dioxide emissions and Low Zero Carbon (LZC) energy contribution, on which the percentage reduction is based, have been calculated using approved IES VE 2014 Level 5 Dynamic Simulation Part L compliance software which represents the latest calculation tool as required under The Building Regulations Part L2A 2013.

Summary of Proposals and Assumptions

Space Heating Source:	VRF heat recovery heating to office areas
Space Cooling Source:	VRF heat recovery cooling to office areas
Hot water generation:	Electric water heating
Ventilation and cooling:	Mechanical heat recovery ventilation to offices Mechanical extract ventilation to sanitary areas
Insulation:	Enhanced U-Values to all areas of the building in compliance with Part L2A 2013. All glazing to be replaced Insulation introduced to exposed ground floor soffit
Air tightness:	APR = $3.00\text{m}^3 / \text{m}^2\cdot\text{h}$ @ 50pa to all new build areas APR = $10.00\text{m}^3 / \text{m}^2\cdot\text{h}$ @ 50pa to building as a whole
Lighting:	Intelligent control allied with very high efficiency LED fittings
Building Controls	Intelligent digital controls with out of range monitoring and energy and water supply metering.
On site LZC technology:	Air source heat pumps

The above measures allow the entire building to achieve the BREEAM ENE01 score of 8 credits and comply with Building regulations Part L2A 2013

Summary of emissions

TER emissions:	21.5 kgCO₂/m²/annum
BER emissions:	14 kgCO₂/m²/annum
Improvement	35%

3.0 INTRODUCTION

This Energy Strategy is devised to comply with identified policies and regulations where feasible and within the constraints of the project.

This Energy Strategy provides:

- Projected building energy and CO₂ emission performance;
- Proposed levels of passive measures;
- Estimated contributions from all three elements of the hierarchy;
- Approximate sizes of technologies analysed and proposed; and
- Review and justification against local policy requirements
- Comparison with estimated existing building performance calculated using same NCM methodology

This report provides preliminary proposals for achieving the identified expectations for reducing energy consumption to the requirement laid down by local policy and guidance. This in turn contributes to the BREEAM scoring system

This energy strategy has been undertaken to investigate methods of conforming to the policies and regulations that are applicable to this project. Further investigation into opportunities for energy conservation and CO₂ emission reductions are undertaken to improve the environmental performance of the development, assessed against identified aspirations and financial feasibility. The general approach adopted is the following Energy Hierarchy:

1. Use less energy
2. Supply energy efficiently
3. Use renewable energy

It is very important for energy efficiency as well as LZC energy to be considered for the development.

The reduction in carbon dioxide emissions is quantified as a proportion of baseline carbon emissions for the development Target Emissions Rate (TER). Such reductions take into account

energy efficient techniques and technologies such as improved insulation, energy efficient lighting etc., before the inclusion of LZC technologies.

All calculations are based on planning stage information, for strategy purposes and as such are approximate.

Each LZC technology identified has been given an evaluation with regard to application to the development.

The proposal provides a solution that encompasses all items within the hierarchy by means of reduced energy usage and the incorporation of site wide renewables.

The submitted Energy Strategy Report provides:

- Projected building energy and CO₂ emissions performance.
- Proposed levels of passive measures.
- Estimated contributions from all three elements of the hierarchy.
- Approximate sizes of technologies analysed and proposed.

Initial calculations for baseline carbon dioxide emissions and subsequent reduction of carbon emissions due to incorporation of renewable energy technologies are included in this document. This is provided in the form of published data and a Part L2A Level 5 DSM calculation, generated using IESVE 2014 simulation software that complies with the BRE National Calculation Method.

This report also provides a general heating strategy for the site and describes passive measures applied to the building design to minimise energy consumption.

4.0 RELEVANT POLICY

Current regulatory or policy documents that apply are:

- Building Regulations Approved Document L2A and L2B
- National Planning Policy – Delivering Sustainable Development (PPS1), Planning and climate change – supplement (PPS1 supplement) and Renewable energy (PPS22)
- Reading council Policy – see below

Policy CS1- Sustainable Construction and Design

To meet these requirements:

- All new housing is required to meet the most up to date Eco-Homes 'Very Good' as a minimum standard, and all new commercial developments are required to meet the most up to date BREEAM 'Very Good' as a minimum standard;
- All new developments maximise the use of energy efficiency and energy conservation measures in their design, layout and orientation to reduce overall energy demand;
- All developments of more than 10 dwellings or 1000m² floorspace incorporate on-site generation of energy from renewable sources and energy efficient design measures (including the use of CHP where appropriate) to off-set at least 20% of predicted carbon dioxide emissions from the estimated energy usage of the completed and occupied development;

SPD – Revised Sustainable Design and Construction

Current position with regard to Building Regulations

- Recent changes to the Building Regulations mean that the requirement in policy CS1 to 'off-set at least 20% of predicted carbon dioxide emissions' has now been superseded for both residential and non-residential developments. All other parts of policy CS1 are still relevant. For this reason, the requirement to off-set at least 20% of predicted carbon dioxide emissions from the estimated energy usage of the completed and occupied development in adopted policy CS1 is not mentioned further in this SPD.
- The Communities and Local Government Building Regulations 2010 Circular Letter of 28 September 2010 Circular also sets out how carbon reductions will be achieved for both new homes and new non-domestic buildings. It sets out that the target emission rate for

carbon dioxide will achieve an additional improvement of 25% relative to 2006 standards.³ These changes were brought into effect through Part L1A Building Regulations in October 2010 and are reflected in the 'Code for Sustainable Homes, Technical Guide' November 2010. A minimum percentage improvement in dwelling emission rate over target emission rate (a higher standard than that required mandatorily required by Building Regulations) is now only required for Level 4 and above.

5.0 ASSESSMENT OF BASELINE EMISSIONS

5.1 INTRODUCTION

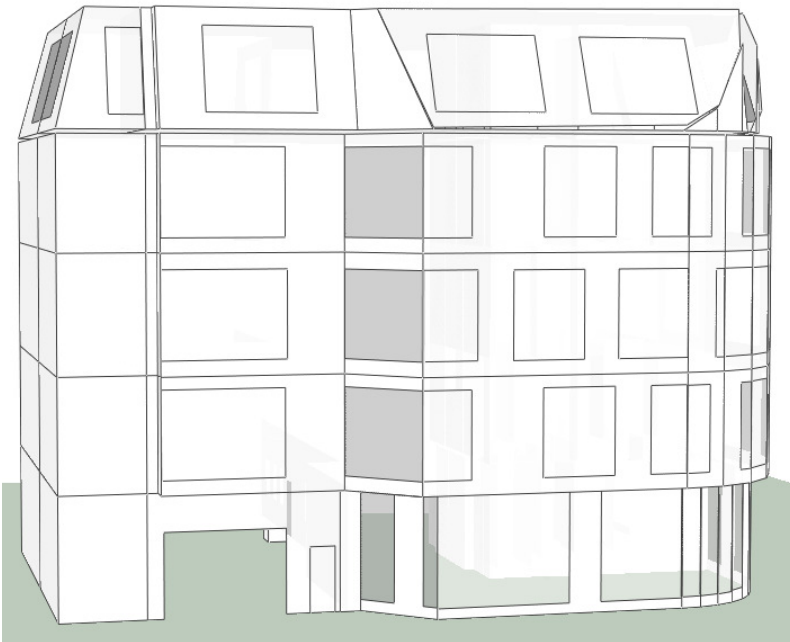
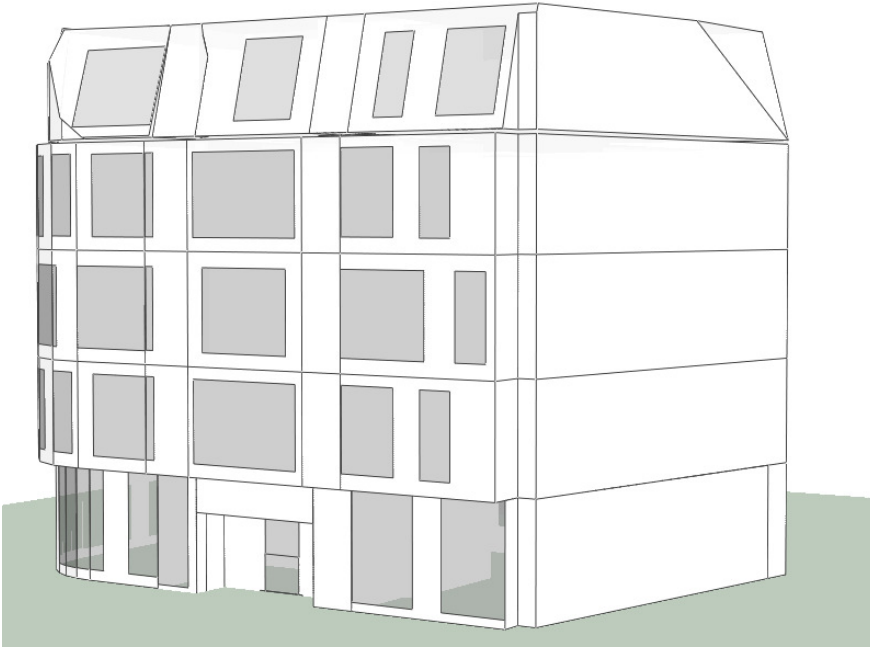
The proposed building design is influenced and assessed using modern Dynamic Simulation Modelling. IESVE 2014 software is used to simulate the performance of the design with respect to cooling and heating loads, lighting efficiency, control methods, passive measures, orientation, solar shading, daylighting, domestic hot water delivery, renewable energy contribution and air tightness to minimise predicted energy usage and carbon dioxide emissions.

The software utilises accurate hourly local weather data to provide a subjective simulation. It can also take into account the unique operational profile of the development with occupancy patterns associated with a very specific site activity, albeit that Building Regulations NCM calculations do not allow this flexibility.

The dynamic simulation model is undertaken at planning energy strategy stage to allow the proposals to be developed in line with identified policy, where feasible, and to permit a holistic approach to energy efficiency whereby architecture is informed by the energy modelling.

The IESVE Software is also be used to generate preliminary Part L2A compliance calculations for new build and existing areas to provide a recognised method of energy consumption prediction in accordance with NCM parameters. The outputs of these calculations are utilised for the assessment of baseline emissions and will be used to ensure that the Building Regulations targets continue to be reflected in the developing design.

The Proposed Building



Carbon Emission Factors

The carbon emission factors that will be used in this assessment are as follows:

Grid Supplied Electricity: 0.519 kgCO₂/kWh

Grid Supplied Natural Gas: 0.216 kgCO₂/kWh

Further factors associated with biofuels or other liquid fuels are utilised as required.

6.0 PASSIVE ENERGY REDUCTIONS (HIERACHY LEVEL 1)

The ethos of this project is to ensure that passive measures are adopted prior to the application of high efficiency or renewable technologies wherever feasible. The measures that have been included in the baseline emissions model are summarised below. All measures are quantified within the BER figures in the executive summary and BRUKL output:

- Thermal Insulation to all new build elements and fabric
- Key existing items to be replaced or upgraded (windows, ground floor and roof)
- Air Tightness to be optimised;
- Maximising Daylighting;
- Passive Solar Gain for heating
- Minimised solar gain for cooling loads (low g-value glazing)

Utilising the thermal model the effectiveness of the proposed measures is assessed with respect to performance, life cycle and capital cost to ensure that a feasible solution is adopted.

6.1 BUILDING FABRIC

The investment in thermal insulation to heated and cooled spaces will result in an improvement in heat losses and hence reduction in annual heating fuel consumption. All windows are based on aluminium frames.

Estimated existing building constructions (1995 Building Regulations)

Building Element	U-Value
External Wall	0.45W/m ² K
Roof	0.25W/m ² K
Ground Floor	0.45W/m ² K
Windows	3.3W/m ² K

New Build constructions required to meet current Building Regulations Part L2:

Building Element	U-Value
External Wall	0.35W/m ² K
Roof	0.25W/m ² K
Ground Floor Exposed floor to perimeter ratio = 0.25	0.25W/m ² K
Windows	2.2W/m ² K

Proposed improved New Build Building Constructions to exceed Building Regulations Part L2 2013:

Building Element	U-Value
New External Walls	0.2 W/m ² K
Existing party walls	0.26 W/m ² K
Roof to all areas	0.15 W/m ² K
Ground Floor upgrade/ground floor exposed soffit	0.2 W/m ² K
Curtain wall glazing	1.2 W/m ² K
Windows	1.2 W/m ² K

Infiltration and air tightness

To achieve the required result all elements of the entire building should be designed to achieve an overall air permeability of $10\text{m}^3/\text{h}/\text{m}^2$ at 50Pa. The new build extension should be designed to achieve a stand-alone air permeability of $3\text{m}^3/\text{h}/\text{m}^2$ at 50Pa.

This is an improvement on the existing building which is estimated to be $20\text{m}^3/\text{h}/\text{m}^2$ at 50Pa.

7.0 EFFICIENT ENERGY DELIVERY (HIERARCHY LEVEL 2)

The energy efficient measures that have been included in the baseline emissions model are summarised below.

- Demand based heating and cooling to occupied spaces
- High efficiency fans
- Heat recovery ventilation to office spaces, effectiveness 65%
- High efficiency lighting achieved by way of high efficiency lighting to all areas with presence detection and photoelectric sensing
- Sub-metering to mechanical plant
- Intelligent thermal controls including warnings on out of range values
- Variable speed drives to all fans, pumps and compressors
- High power factor

7.1 SERVICES STRATEGY

The baseline services strategy is:

Space Heating Source:	VRF heat recovery heating to office areas
Space Cooling Source:	VRF heat recovery cooling to office areas
Hot water generation:	Electric fired water heating
Ventilation:	Mechanical heat recovery ventilation to offices and meeting rooms Mechanical extract ventilation to sanitary areas
Insulation:	Enhanced U-Values to all areas of the building to comply with Part L2A. All glazing to be replaced Insulation introduced to ground floor exposed soffit.
Glazing g-value	0.18
Air tightness:	APR = $3.00\text{m}^3 / \text{m}^2\cdot\text{h}$ @ 50pa to all new build areas APR = $10.00\text{m}^3 / \text{m}^2\cdot\text{h}$ @ 50pa to building as a whole
Lighting:	Intelligent control allied with very high efficiency fittings
Building Controls	Intelligent digital controls with out of range monitoring and energy and water supply metering.
On site LZC technology:	Air source heat pumps

The key efficiency data proposed is:

		Proposed	Existing estimated
Lighting	Office	2.5 w/m2/100 lux	4 w/m2/100 lux
	Core	2.5 w/m2/100 lux	6 w/m2/100 lux
	Plant	2.5 w/m2/100 lux	4 w/m2/100 lux
Heating seasonal efficiency COP		3.84	2.5
Cooling seasonal efficiency EER		3.28	3.1
Ventilation SFP		1.0	3.0
Ventilation heat recovery		85%	50%
HWS efficiency		97%	97%

7.2 DISTRICT HEATING

Due to the need for cooling and the synergy of using a combined heating and cooling system the creation of or connection into a LTHW district heating system is not feasible. The relatively small load associated with this building further supports this approach.

8.0 AVAILABLE LZC ENERGY TECHNOLOGIES (HIERACHY LEVEL 3)

Eight LZC energy technologies have been given high level consideration.

- Wind Turbines
- Photovoltaic Cells
- Ground Source Heating
- Ground Source Cooling
- Air Source Heat Pump Heating and Cooling
- Solar Hot Water (Solar Thermal)
- Biomass Heating
- CHP (Combined heat and Power)

9.0 LZC ENERGY FEASIBILITY

The following table outlines the difference LZC technologies and assesses them in terms of application and feasibility:

LZC Energy Type	Application	Feasibility
Wind Turbine Power	Roof mounted small scale wind turbines for domestic and non-domestic buildings. Wind speeds of 7m/s or above required for large scale therefore high level mounting only option.	Visual electromagnetic and environmental noise impact, and public opposition to such, may have negative effect on planning process. Vibration isolation required for building mounted turbines. Noise may affect natural ventilation feasibility for domestic properties. Wind study required to ensure conditions are correct. Feasibility for large scale not possible due to urban location. Appearance of turbines very problematic. Low wind speeds at location increases number of turbines required. Roof mounted wind turbines would be ineffective as the site is sheltered.
Photo voltaics	PV panels integrated into building fabric, such as cladding, roof surface or brise soleil. Elevations south-east to south-west unshaded.	PV panels can be prone to vandalism. Simple systems requiring little maintenance other than cleaning and repair.
Ground Source Heating	Can be utilised individual systems with central or individual ground loop operation. Particularly suited to underfloor heating. Can preclude the need for gas distribution to individual properties.	Limited space for boreholes. Possible for larger private residential. Very costly More suited to individual systems, additional heating can be required to domestic hot water as typical temperatures are only 50°C Borehole requirements and ground conditions may reduce the amount that could be implemented. Environment Agency Licence may be required.

		Borehole requirements and ground conditions may reduce the amount that could be implemented. Environment Agency Licence may be required.
Air Source Heat Pumps	Particularly suited to water based heating and cooling systems. Particularly suited to underfloor heating. Precludes the need for gas distribution to individual properties.	Significant roof or external compound space required. Conventional heating and cooling delivery plant can still be utilised. Medium capital cost. Sufficient power supply required. Good maintenance support Vast market availability Does not affect local air quality.
Solar Hot Water	Roof mounted solar collectors combined with central/local hot water calorifiers. Gas or electric back up system still required. Solar hot water is not a replacement of such systems.	Roof space availability for solar collectors subject to planning acceptance relating to visual appearance and height. High levels of hot water storage required. Very low summertime load – poor utilisation
Biomass Heating	Wood chips used as primary fuel. Provides space heating and domestic hot water for whole building.	The necessary transportation of wood chips to site and ash from site using road reduces the carbon emission savings available. The proximity of wood chip sources and congested roads adds to the disadvantage. Wood chip and ash storage on site required. Very little space available for this. Back up gas installation required to ensure heat supply in the event of reliability problems or fuel availability problems.
Natural gas CHP	CHP – Combined Heat and Power Heat source for partial space heating and domestic hot water. Electrical output for local use or export	Constant year round base load required to ensure generated heat is utilised and payback periods minimised. Not present.

9.1 Feasibility Matrix

The following matrix scores the LZC technologies in terms of cost, visual impact, space requirements and suitability for application on this development.

1 = poor

5 = excellent

Site suitability rating doubled to provide weighting

Where site application is less than 6 this option must be ruled out due to impracticalities.

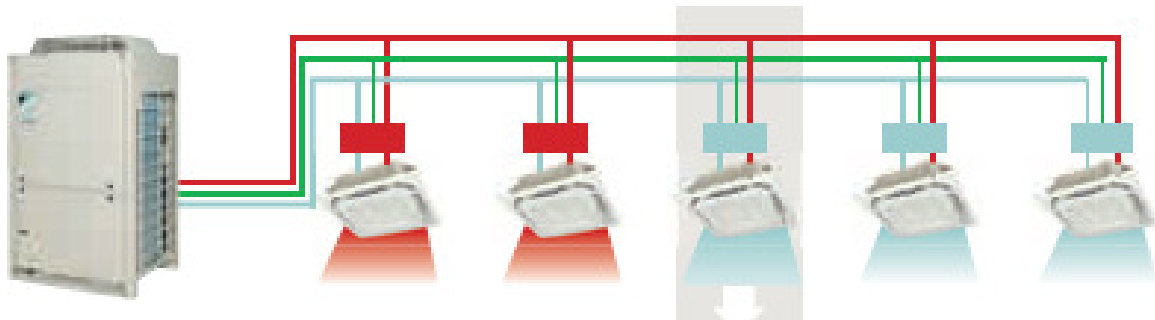
Technology	Cost	Appearance	Roof space	Suitability of Application	Total
Turbines (Tower)	3	1	5	4	N/A
Turbines (Roof Mounted)	3	1	1	4	N/A
Photovoltaics	2	4	2	8	16
Solar Hot Water	2	3	2	2	N/A
Ground Source Heat Pumps	1	5	5	4	N/A
Air Source Heat Pumps	4	2	2	10	18
Natural Gas CHP site wide	1	2	5	2	N/A
Biomass Boiler	4	1	5	2	N/A

9.2 PROPOSED TECHNOLOGIES

9.2.1 Air Source Heating and Cooling

Air-source heat pumps operate by extracting heat/coolth from the external air utilising the vapour compression cycle. Air-source heat pumps are classified as either air-to-air or air-to-water depending on whether the heat distribution system in the building uses air or water.

To suit a heating and cooling strategy the use of packaged VRF (Variable Refrigerant Flow) systems would be utilised. This consists of air to air heat pumps that operate in heating and cooling mode with inherent heat recovery where simultaneous heating and cooling exist.



Coefficient of Performance compared with ground source systems is often inferior due to the less stable temperature of atmospheric air compared with ground temperatures. However air source heat pumps provide a very practical solution where building footprint is limited or use of bore holes impractical. It provides far superior efficiencies to gas/oil fired appliances. ASHP also provides a cost effective solution.



Air source heat pumps in the form of packaged VRF heating and cooling are proposed to provide a significant improvement to the building BER, whilst providing a cost effective and well established heating and cooling method . External plant will be located at the roof top screened enclosure.

VRF provides a more effective solution than the alternative identified technology (PV) due to the following:

- All savings are utilised on site and therefore end user gains benefit (PV relies on electrical export during periods of vacancy which can also result in transmission losses)
- Delivers high efficiencies and hence savings in all seasons and all light conditions. PVs rely on sunlight
- Minimises additional maintenance regimes
- More cost effective due to the inherent need for heating and cooling
- Provides better efficiencies than baseline model systems in all but the most severe external conditions
- Provision of greater carbon savings per sq. m roof space

10.0 CARBON EMISSIONS SUMMARY

TER emissions:	21.5 kgCO₂/m²/annum
BER emissions:	14.0 kgCO₂/m²/annum
Improvement	35%

11.0 VENTILATION STRATEGY

The building shall benefit from a mechanical ventilation system with heat recovery which will provide tempered fresh air to each floor of the building. The air handling plant will be located on the roof with the intake and discharge positioned a minimum of 10m apart to ensure that no recirculation of vitiated air occurs. In addition G4 and F7 filters will be installed on both the intake and exhaust within the air handling unit.

The toilet extract plant will comprise of a central twin fan located at roof level, discharging a minimum of 10m away from any intake or opening.

There are no gas fired appliances in the building, therefore no flue terminals.

See a sketch of the proposed roof plant layout in Appendix B.

12.0 APPENDIX A – BRUKL OUTPUT

BER check

BRUKL Output Document

Compliance with England Building Regulations Part L 2013

HM Government

Project name

35 Greyfriars
As designed

Date: Wed Oct 07 19:48:26 2015

Administrative information

Building Details

Address: 35 - 43 Greyfriars Road, Reading, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.4

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.4

BRUKL compliance check version: v5.2.d.2

Owner Details

Name: Croudace Property Limited

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Desco

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	21.5
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	21.5
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	14
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 the building services should achieve reasonable overall standards of energy efficiency

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

Building fabric

Element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.24	0.26	RM000005:Surf[16]
Floor	0.25	0.21	0.22	RM000000:Surf[3]
Roof	0.25	0.15	0.15	RM000032:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.18	1.21	RM000005:Surf[6]
Personnel doors	2.2	2.2	2.2	RM000005:Surf[14]
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-Limit} = Limiting area-weighted average U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

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

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

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

13.0 APPENDIX B – VENTILATION PLANT

