



RIDGE

Passive Design Analysis Report
50 Fountain Street
Manchester
Ask Real Estate
16th August 2021

PASSIVE DESIGN ANALYSIS, 50 FOUNTAIN STREET



50 FOUNTAIN STREET MANCHESTER ASK REAL ESTATE

16th August 2021

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1. INTRODUCTION

Ask Real Estate have commissioned Ridge & Partners LLP to undertake a Passive Design analysis for the proposed redevelopment of the existing office block located at 50 Fountain Street in Manchester City Centre.

The brief is to target a BREEAM rating under the BREEAM New Construction 2018 Assessment Criteria.

With the focus placed on energy efficiency, the proposed design will incorporate passive design in addition to best practice measures therefore exceeding the current Building Regulations Part L Requirements.

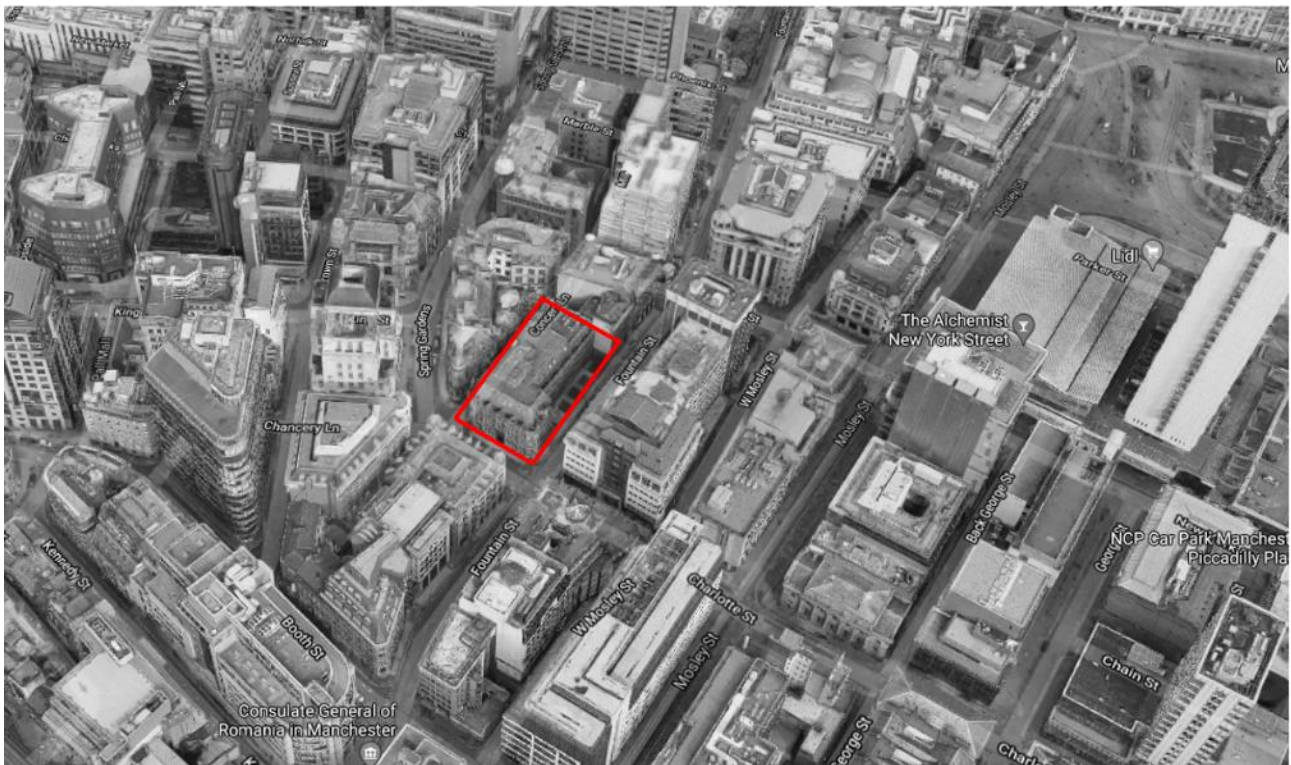
This report has been compiled in accordance with the requirements of BREEAM New Construction 2018 credit Ene 04 criteria 1-3 "Passive Design Analysis", to summarise how passive measures have been incorporated into the building's design.

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2. DEVELOPMENT PROPOSALS

2.1. Description of Development Site

The site is located in Manchester and is bounded by Fountain Street to the South East, Spring Gardens to the South West, Concert Lane to the North West and existing buildings off York Street to the North East.



3D View of the site and the surrounding area

The site has all major services (gas, water, telecoms and electricity) within the surrounding roads which do not present any risk in terms of requiring diverting or disconnections to develop the project.

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2.2. Development Proposals

The proposed development is for the redevelopment of 50 Fountain Street to provide office accommodation. The majority of the building will be demolished but the front façade will be retained.

Proposed Area Schedule

Floor	Gross Internal Area (GIA) (m ²)	Net Internal Area (NIA) (m ²)
Basement	826	
Ground	1045	418
Mezzanine	94	94
1st	1045	877
2nd	1045	877
3rd	927	760
4th	918	751
5th	875	708
6th	811	644
7th	234	
Total	7820	5129

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3. BREEAM

The Building Establishment's Environmental Assessment Method (BREEAM) is the world's leading and most widely used voluntary environmental assessment method for commercial buildings that aims to quantify and reduce the environmental impact of buildings in a robust and cost effective manner.

This is achieved by the use of the scheme by clients and their project team at key stages during the design and construction process.

The performance based assessment awards credits within the following categories:

- Energy
- Water
- Transport
- Materials
- Land use and ecology
- Pollution
- Health and wellbeing
- Management
- Waste

The assessment process provides in a report that covers the areas assessed, along with a formal certification on a scale of UNCLASSIFIED, PASS, GOOD, VERY GOOD, EXCELLENT and OUTSTANDING.

The diagram below shows how the BREEAM assessment scores and rates a building:

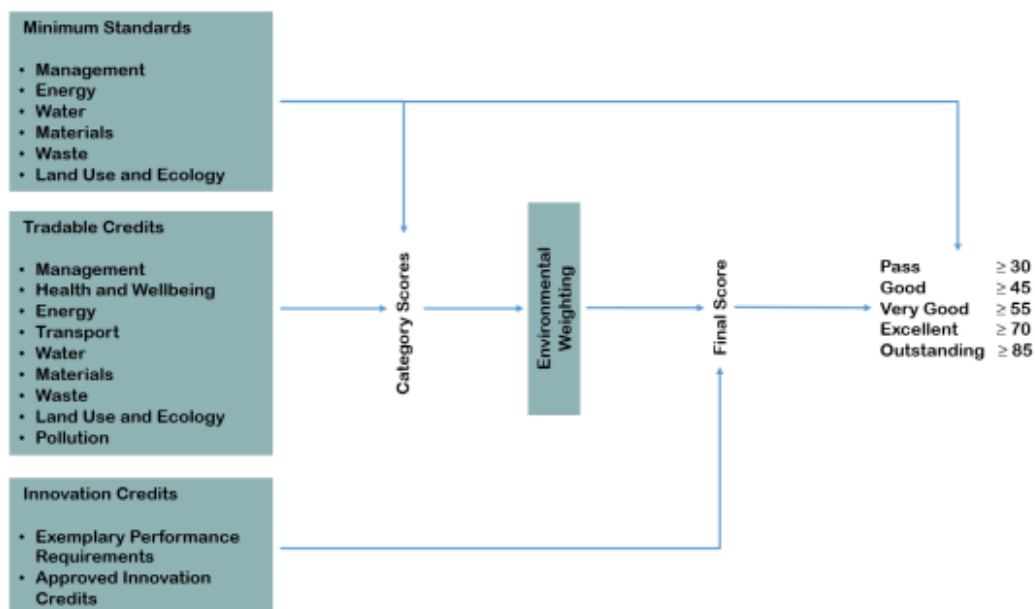


Figure 1 Process for Awarding BREEAM Ratings

The BREEAM categories include a number of environmental elements that reflect the different options available when designing, procuring and constructing a building. Each environmental element has credits available that are awarded when compliance has been demonstrated.

For the building to meet a specific BREEAM rating, there are a series of minimum standards that must be achieved for that rating to be awarded.

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In addition to the credits, there are also innovation credits available that provide additional recognition of sustainable performance that goes beyond what is currently recognised and rewarded by the standard BREEAM credits.

The innovation credits are awarded for either meeting the BREEAM exemplary level requirements or by an application to BRE to have a specific feature, system or process recognised as 'innovative'.

Each different BREEAM section has an environmental weighting applied to the scores which calculates the final BREEAM score. These factors have been derived from consensus based research with groups such as the government, suppliers and lobbyists.

The weightings are:

BREEAM SECTION	WEIGHTING (%)
Management	12.0
Health and Wellbeing	15.0
Energy	19.0
Transport	8.0
Water	6.0

BREEAM SECTION	WEIGHTING (%)
Materials	12.5
Waste	7.5
Land Use and Ecology	10.0
Pollution	10.0

Once the weightings have been applied, the score is then assigned a BREEAM rating as follows:

BREEAM RATING	SCORE (%)
UNCLASSIFIED	<30
PASS	≥30
GOOD	≥45
VERY GOOD	≥55
EXCELLENT	≥70
OUTSTANDING	≥85

At this stage it is difficult to predict the exact number of BREEAM credits achievable by each Low and Zero Carbon Technology. These technologies will have an influence over the following:

- Ene 01 – Reduction of CO₂ Emissions – Up to 15 (+5 innovation) credits are available
- Ene 04 – Low and Zero Carbon Technologies – Up to 3 (+1 innovation) credits are available
- Po12 – NO_x Emissions – Up to 3 credits are available.

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4. APPRAISAL OF SOLUTIONS

4.1. Reducing Demand

In order to deliver an environmentally responsible building, options have been reviewed for the use of passive technologies to reduce the carbon emissions from the building, including effective building form and orientation, good envelope design and the proficient use of services.

Reducing the initial demand is achieved by the adoption of passive measures which, if applied correctly, promote:

- Good natural daylight
- Avoid excessive heat losses,
- Avoid overheating,
- Good quality and controllable ventilation
- Acoustically sound environment

The aim of the passive design has been to reduce heating requirements, whilst ensuring that the building will be comfortable.

4.1.1. Building Location

The location of a building can have a significant effect on energy consumption. Buildings located at higher altitudes for example, will be subject to colder external temperatures. Typically, the temperature drops 0.65°C for every 100ft increase in altitude. Subsequently these buildings will have a greater heating demand than those closer to sea level.

Equally, the urban heat island effect means the ambient air temperature in built-up areas is greater than in more rural spaces. Buildings located in cities will have a lower heating demand in winter, but could require extra cooling in summer, as the effects of night purging are reduced.

4.1.2. Weather and Microclimate

The local weather and any microclimate will also influence energy usage. A development on the coast may have a maritime climate, experiencing milder winters and cooler summers than those further inland, particularly on the west coast where they are subject to the jet stream influence. Inland buildings will have a continental climate, suffering more extremes in temperature and therefore more likely to require heating and cooling.

A building in the south of the UK will also use more cooling than those further north, as the average temperatures in the south will be higher due to warm winds blowing from the tropics. The south coast of England is on average, 4°C warmer than the north of Scotland. Those in the north then, will have a greater heating demand as they are subject to cold arctic air blowing in. These northern areas may also have a greater lighting demand, experiencing roughly 750 fewer daylight hours per year than the south coast.

For the proposed redevelopment, the model used the closest TRY (Test Reference Year) weather data. This data is provided by CIBSE to IES for use in the Dynamic Simulation Model (DSM)

The TRY weather file consists of weather data from a historical sequence of twelve non-consecutive months selected from the last 30 years' weather data for the relevant location. The individual months are selected

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based on their correlation with the average weather conditions for that month over the 30 year selection period and combined to make a 12-month compilation of “typical” months.

4.1.3. Landscape

The site’s landscape also affects the energy demand of a building. Vegetation, land form and any existing buildings can all be used to provide shade. Shading to the south of the development will promote shade in the summer, thus reducing the cooling demand of the development.

50 Fountain Street is located on Fountain Street in Manchester City Centre and is bounded by Spring Gardens to the southwest, Concert Lane to the northwest and York Street to the northeast. There are existing buildings on all the surrounding roads which will provide some level of shading.

The site layouts below (Figures 5-7) show that due to the site location, the building will have relatively low heating demand in the winter but will require cooling in the summer due to the urban heat island effect.

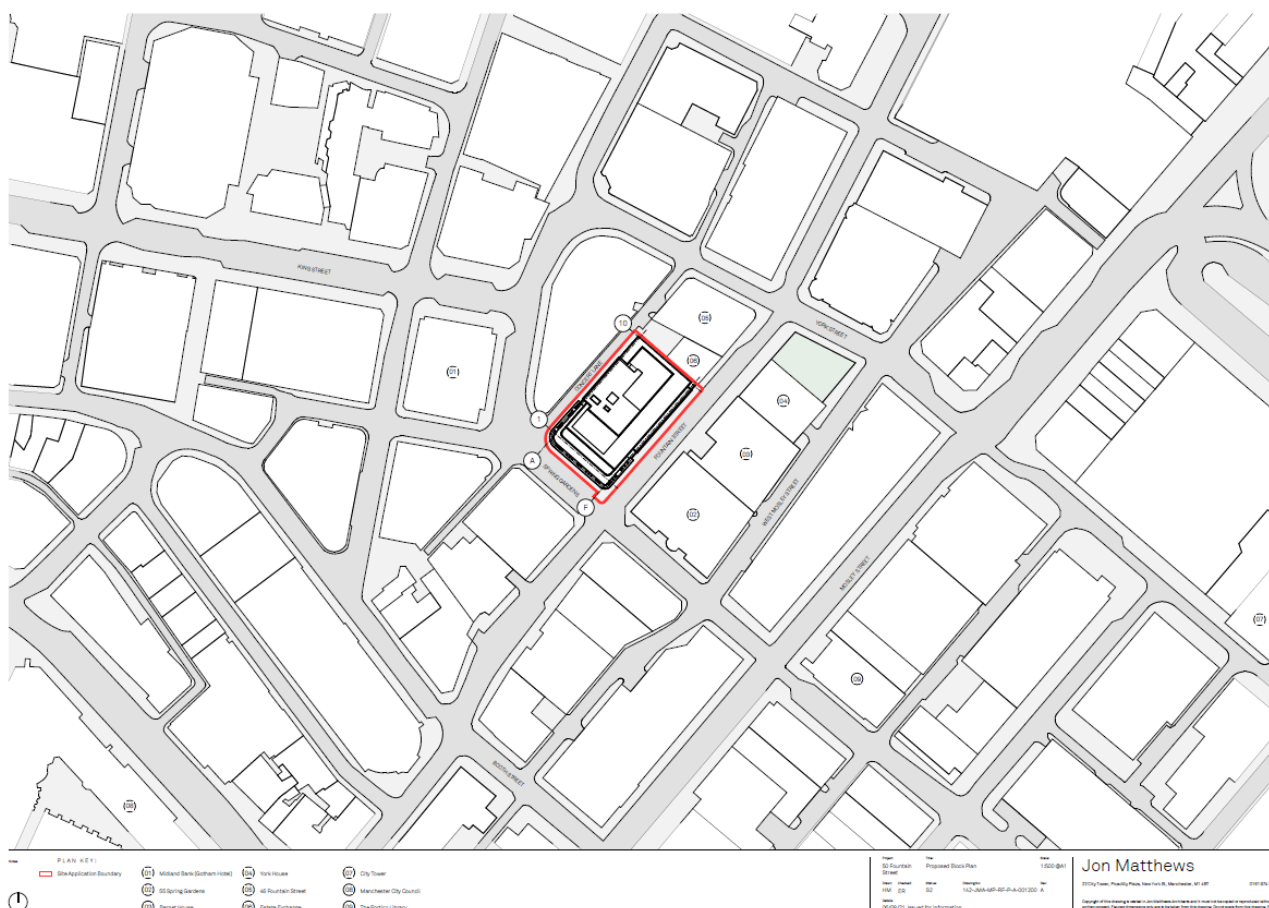


Figure 2 – Proposed site plan of 50 Fountain Street (architects layout)

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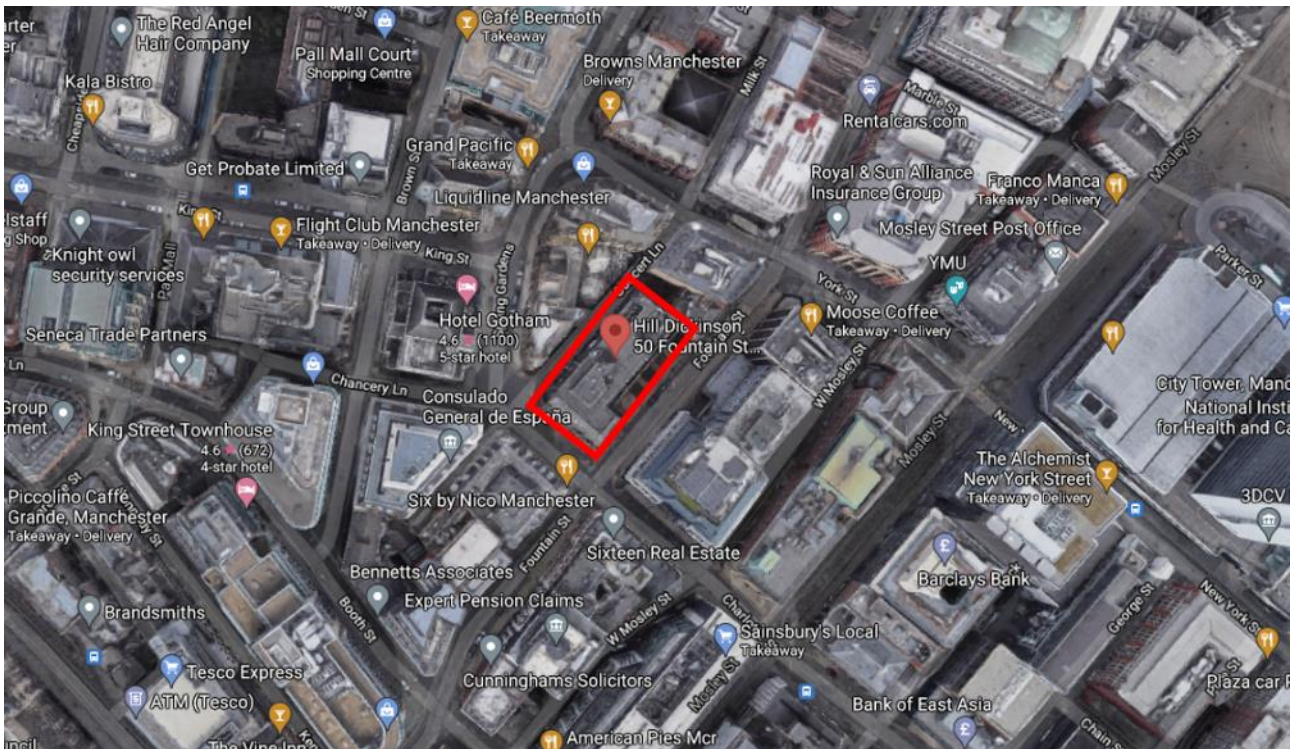


Figure 3 – Satellite view of 50 Fountain Street

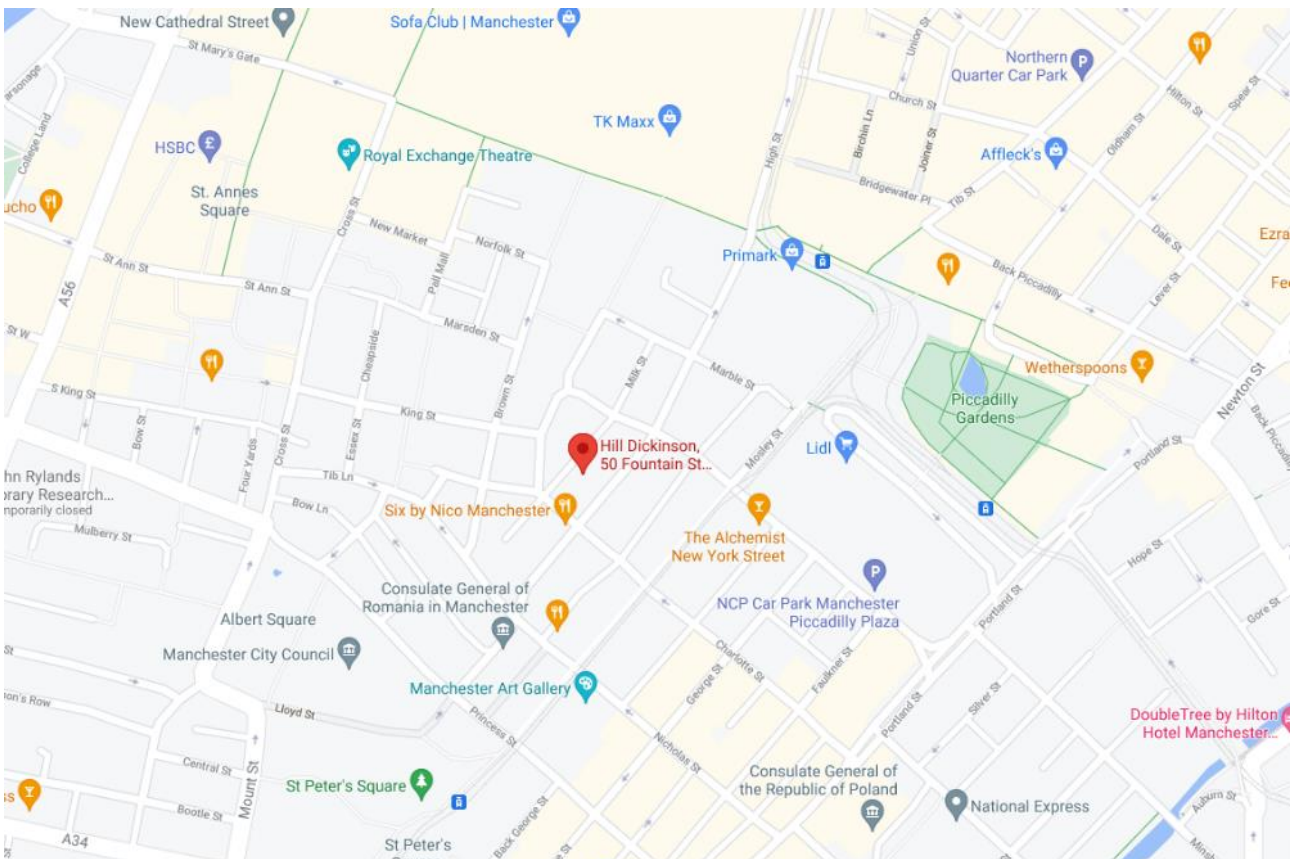


Figure 4 – Map view of 50 Fountain Street

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4.1.4. Building Layout, Orientation and Form

The building's layout, orientation and form can influence many of the key features of the development.

The design should provide an effective use of space with opportunity to benefit from natural daylight. Typically the percentage of glazing should represent approximately 40-60% of the façade area as this level reduces the excess solar gains in summer (thereby reducing heating consumption) in addition to reducing winter heat losses (thereby reducing heating consumption). Where access to daylight is limited, the proportion of glazing may be increased.

Solar gain is often welcome in the winter months, as this helps to heat up the building. However, careful consideration must be given to avoid summertime overheating, as an unshaded window in the UK can admit 3kWhr of energy per m² of glass on a clear day in summer.

Overheating is likely to occur to rooms with windows facing south, in addition to southeast and southwest elevations.

U-values surpassing the Minimum Building Regulations requirements will minimise the winter heat loss, while low g-value glazing will allow for optimal gain, without summertime overheating.

4.1.5. Building Fabric

The use of building materials with low U-values is vital in reducing the energy consumption and CO₂ emissions within any development.

The insulation of the building envelope will need to be better than that required under the 2013 Edition Part L Building Regulations. The limiting values, prescribed within the regulations, are the minimum acceptable levels of insulation for each element of the construction. Reducing the buildings thermal transmission by increasing the insulation will help to significantly reduce the heating demand and will result in lower heating energy consumption.

The benefit of any U-value reduction, in terms of energy/CO₂ saving, can quickly be ascertained using dynamic modelling software which can also help to determine the optimum selection of materials against cost.

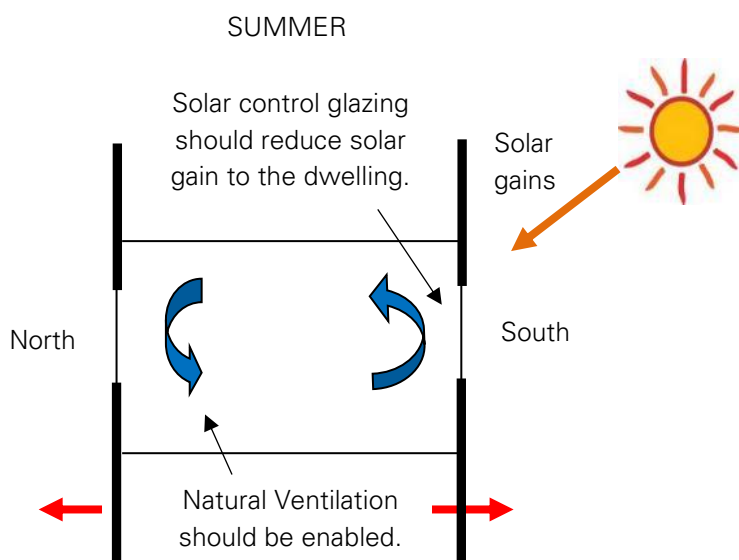
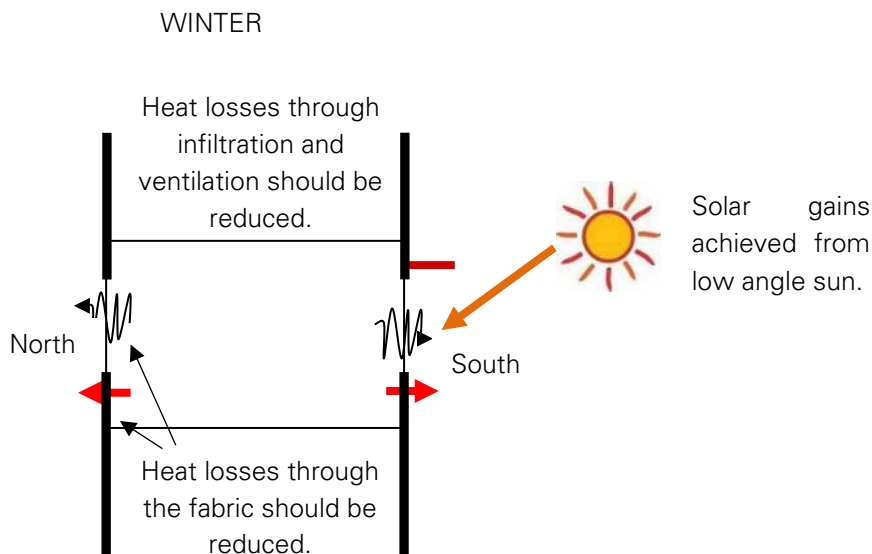
The building envelope should be designed to ensure that the fabric thermal transmittance values of the walls, floors and roof of the building are to a high standard, and the form of the internal spaces encompass the low energy sustainability principles, both of which are necessary to meet the target BREEAM rating.

The following table identifies the proposed 50 Fountain Street building envelope thermal performance criteria.

Element	Part L 2013 Building Regs	50 Fountain Street Value	Notes
Roof 'U' Value	0.25 W/m ² K	0.18W/m ² K	
External Wall 'U' Value	0.35 W/m ² K	0.23W/m ² K	
Ground Floor 'U' Value	0.25 W/m ² K	0.22W/m ² K	
External Glazing 'U' Value	2.2 W/m ² K	1.47W/m ² K	G-value = 0.26
Air-permeability	10m ³ /hour/m ² @ 50Pa	3m ³ /hour/m ² @ 50Pa	

Table 2: Summary of Building Envelope Thermal Performance Criteria

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4.1.6. Heavyweight Structure (Thermal Mass)

The incorporation of the existing façade will provide thermal mass which helps to regulate the internal temperatures and thus reduces the risk of overheating.

Exposed concrete has a high density and specific heat capacity and can absorb heat generated from occupants, equipment, artificial lighting and solar gain. At night, the exposed concrete can be cooled through the mixed mode ventilation system.

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Heavyweight buildings can maintain the room temperature 2°C - 4°C below external temperature whereas in comparison lightweight structures maintain room temperature 2°C - 4°C above the external temperature.

The existing façade will be retained which will contribute high thermal mass to the building.

To improve the thermal mass, the concrete slab and therefore the services will be exposed but this can cause issues with the acoustic performance as hard surfaces promote the reflection of noise though the building which reduces privacy. By adopting acoustic absorbent tiles suspended below part of the exposed ceiling can alleviate this issue.



Figure 5 – View of the existing façade which is to be retained.

For a BREEAM project, A-rated material as defined by The Green Guide must be sought but due to the energy needed to produce the cement for the concrete, concrete is not classified as an A-rated material.

An alternative that offers the benefits of the heavy weight construction but without the energy burden is Hempcrete, a bio-composite material comprising of processed woody core from plants and a lime-based binder which is usually applied on site using a shuttering system. Hemp, which is key to the product is grown and harvested in the UK.

The use of Hempcrete in the scheme should be discussed with the building insurers as the use of Hempcrete instead of traditional concrete may affect any insurance policy.

In addition to being an alternative, Hempcrete can also help to reverse the effects of greenhouse gases locking the CO₂ emissions within the wall construction whilst still delivering high levels of insulation and air tightness.

4.1.7. Building Use and Occupancy Type

Occupants, lighting, equipment and machinery within a building will emit both sensible and latent heat. This excess heat can lead to an increase in the temperature and humidity within the space and can have a notable effect on the heating and cooling demands within a building.

CIBSE Guide A provides typical values of internal heat gains for varying building types and activities.

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Table 6.2 Benchmark allowances for internal heat gains in typical buildings

Building type	Use	Floor area per person / m ²	Sensible heat gain / W·m ⁻²			Latent heat gain / W·m ⁻²	
			People	Lighting*	Equipment†	People	Other
Offices	General	12	6.7	8–12	15	5	—
		16	5	8–12	12	4	—
	City centre	6	13.5	8–12	25	10	—
		10	8	8–12	18	6	—
	Trading/dealing	5	16	12–15	40+	12	—
	Call centre floor	5	16	8–12	60	12	—
	Meeting/conference	3	27	10–20	5	20	—
Airports‡ and stations	IT rack rooms	0	0	8–12	200	0	—
	Airport concourse	0.83	75	12	5	4	—
	Check-in	0.83	75	12	5	50	—
	Gate lounge	0.83	75	15	5	50	—
	Customs/ immigration	0.83	75	12	5	50	—
	Circulation spaces	10	9	12	5	6	—
	Shopping malls	2–5	16–40	6	0	12–30	—
Retail	Retail stores	5	16	25	5	12	—
	Food court	3	27	10	†	20	§
	Supermarkets	5	16	12	†	12	§
	Department stores:						
	— jewellery	10	8	55	5	6	—
	— fashion	10	8	25	5	6	—
	— lighting	10	8	200	5	6	—
	— china/glass	10	8	32	5	6	—
	— perfumery	10	8	45	5	6	—
	— other	10	8	22	5	6	—
Education	Lecture theatres	1.2	67	12	2	50	—
	Teaching spaces	1.5	53	12	10	40	—
	Seminar rooms	3	27	12	5	20	—
Hospitals	Wards	14	57	9	3	4.3	—
	Treatment rooms	10	8	15	3	6	—
	Operating theatres	5	16	25	60	12	—
Leisure	Hotel reception	4	20	10–20	5	15	—
	Banquet/conference	1.2	67	10–20	3	50	—
	Restaurant/dining	3	27	10–20	5	20	—
	Bars/lounges	3	27	10–20	5	20	—

Figure 6 – CIBSE Guide A: Internal Heat Gains

Latent heat gain results in the instantaneous addition of moisture to the air, thus there is no cooling load factor associated with the heat gain. On the other hand, sensible heat is absorbed by the surrounding surfaces and is radiated more slowly into the building.

Internal heat gains vary depending on the room's use – an office would have different heat gains compared to a retail space, with differing occupancy and equipment gains. Equally, the lighting requirements will be different in each room with the heat gains dependent on the type of lamp, luminaire and the location of the fitting. As a result, the internal heat gains need to be considered as a whole.

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4.1.8. Air Permeability

The air tightness of a building impacts on its energy consumption and hence the CO₂ emissions.

The more air tight the building, the less energy is required to heat the building in winter. Part L2 of the Building Regulations states that air permeability must be less than 10m³/hr per m² @ 50Pa. It is usually necessary to make significant improvements on the statutory limit to achieve CO₂ emission compliance; new build development should target a value of 3-5m³/hr per m² @ 50Pa.

In accordance with the requirements of a low energy building, the target proposed for the redevelopment of 50 Fountain Street is 3.0m³/m²/hr @ 50Pa. This represents an improvement over the current Part L Building Regulations standard of 70%.

4.1.9. Low Energy Fit Out

A major contributing factor of the energy use of the building is what is deemed as 'unregulated loads' from electrical goods, such as:

- Fridges/Freezers
- Dishwashers
- Computers & Screens
- Printers
- Microwave cookers
- Photocopiers

All tenants will be encouraged to install the highest efficiency rated goods to promote energy efficiency.

4.1.10. Daylight

A typical working environment should be illuminated to a light level of 300 - 500 lux, and for approximately 70% of the working year, 10,000 lux is available externally from an overcast diffuse sky. Therefore, through effective window and façade design, light can be brought into a building, and artificial lighting within rooms can be dimmed or switched off, saving energy.



The amount of daylight within a room can be represented as a percentage of the available external daylight. BREEAM credit Hea 01 suggests that this factor should be a minimum of 2-3%, dependant on a room's function in order for the lights to be dimmed. However, to further reduce the energy consumption from the lights, other industry publications, such as CIBSE Lighting Guide 10, recommend daylight factors above 5%, meaning there is enough light in the room to allow the artificial lights to be switched off completely.

Increasing daylight factors is achieved through careful design and consideration of the window size and position. Too much or badly positioned glazing can also cause excessive glare and result in building users closing the blinds and turning on the artificial lights.

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Daylight factor and the uniformity ratio are important measures of daylight provision for 50 Fountain Street. High levels of natural daylight will be provided by the full height glazing in the new part of the development, and through the existing windows within the existing part of the development.

4.1.11. Glazing

The choice of glazing affects the amount of daylight, heat losses and, importantly for a naturally ventilated building, the solar heat gain through a window.

The optimum glazing area for saving energy is around 30% - 50% (varying with orientation and type of glazing), as overheating is a risk with areas greater than 50%.

A wide variety of solar control glazing is available to combat overheating, such as absorbing glass, reflective glass, and prismatic glass. There is also the option of a combination of solar photovoltaics (PV) and glass, where PV cells are laminated between two panes of specialised glazing. The resulting glass laminate serves the dual function of creating energy and shade at the same time.

Higher G-values are suited for the winter as the increased solar gain will help to heat the building but specifying higher G-value glass in summer can contribute to summertime overheating.

Good light transmittance is required all year round so as to minimise the use of artificial light. However, as the g-value decreases, so does the light transmittance. It is possible to achieve low g-values whilst maintaining high light transmittance, but cost has to be considered, leading to a balance between the two values.

The glazing specification should therefore ensure performance criteria for light transmission (Lt Value) of not less than 0.40 with a combined low solar transmission (G value not greater than 0.26) to protect against solar gain to mitigate effects of summertime overheating.

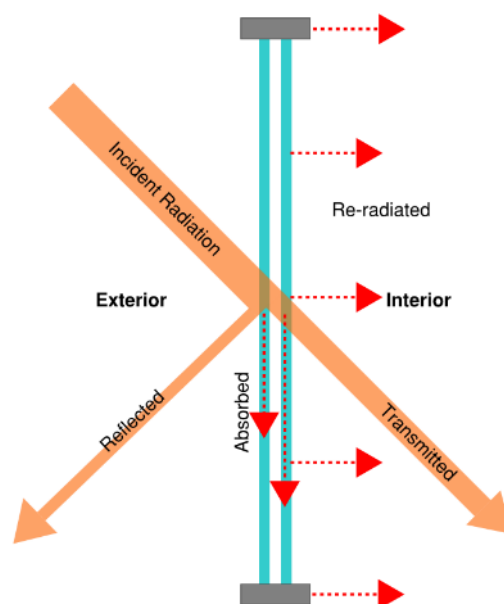
Encouraging the correct quality and quantity of daylight to penetrate the building is key to reducing the amount of light required from artificial sources and hence energy requirements. The table below gives target figures which have been calculated to allow the optimal daylight into redevelopment, without increasing the risk of summertime overheating.

Element	Part L 2013 Value	Targeted Value
External Glazing 'G' Value	0.4	0.26
External Glazing Lt Value	0.71	0.40

Table 3: Summary of Glazing Thermal Performance Criteria

4.1.12. Solar Shading

Solar shading can be a highly effective way of controlling overheating and help reduce glare by external, internal or mid-pane shading devices, or solar control glazing (low G-value). Only solar control glazing is proposed for the redevelopment of 50 Fountain Street.



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External shading is generally the most effective of these, as it intercepts the solar radiation before it enters the building so that very little solar gain is transmitted to the occupied rooms.

Horizontal shades are more effective on south facing facades that receive the most sunlight, but vertical shades are better for those that face east and west when the sun is low in the sky. North facing windows receive sunlight only in the early morning or evening in summer so shading is typically not required.

It should be noted that all shading devices will block some daylight and affect the occupants view out, so a compromise between the view and mitigating solar gain is required.

In some cases, it may be possible to use solar louvres as shading devices on the south façade; a technique whereby solar photovoltaic panels are incorporated into the brise soleil shading.

Due to the improved glazing performance (low G-value) and the shading promoted by the adjacent buildings, no solar shading is proposed to the redevelopment of 50 Fountain Street.



Figure 7 – An example of Solar Shading

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4.2. Meeting Demand Efficiently

4.2.1. Ventilation Strategy

The correct ventilation strategy is crucial to minimise the energy consumed by the building – mechanical ventilation is a significant contributor of the buildings electrical energy and therefore a strategy with natural ventilation is preferred.

However, mechanical ventilation will be needed to spaces that have high internal heat gains, in addition to reducing or negating external noise from traffic or other sources.

4.2.2. Natural Ventilation / Mixed Mode

The adoption of natural ventilation systems such as openable windows, atria and ventilation stacks reduce the dependency on mechanical system. It is important to note though that the performance of natural ventilation is dependent on nature.

Tall rooms and atria can take advantage of the 'stack effect' which is where warm air rises within the building and escapes via high level windows. Fresh, cooler air is drawn in at lower level windows or doors.

Double sided and shallow plan rooms can take advantage of cross ventilation from window to window, taking advantage of the forces of the wind. This is the most effective arrangement for providing ventilation (in winter) and cooling in summer.

Single sided room ventilation can also prove effective for rooms with a depth of circa 2.5 times the height of the room – giving a maximum depth of 7.5m for a 3.0m high space. This is particularly advantageous in areas which would be exposed to external noise levels (e.g. traffic noise), through the opening of windows.

However, natural ventilation alone is often not sufficient to meet the ventilation needs all the time and therefore mixed mode ventilation should be adopted, which combines elements of both natural and mechanical ventilation. Mixed mode has three modes of operations:

- Supplementary- when natural ventilation is no longer sufficient, mechanical ventilation via a low energy fan is applied to meet the ventilation need.
- Complementary – both natural and mechanical ventilation work together to meet the ventilation requirements.
- Alternate – both natural and mechanical ventilation systems are included separately within the system. The system used is dependant on both the ventilation requirement and the climate conditions.

4.2.3. Hybrid Heat Recovery Ventilation

Natural ventilation can be used to good effect in spring and summer, however in winter the use of natural ventilation in the form of openable windows can lead to an increase in heat loss and therefore higher heating demand. Using a mixed mode system, where mechanical ventilation is used in the winter, minimises heat losses to the environment and despite the additional electrical energy requirements, an overall reduction in CO2 emissions can be achieved.

A mechanical ventilation with heat recovery unit (MVHR) passes the warm exhaust air through a heat exchanger where some of the thermal energy is transferred to the colder incoming 'supply' air. This reduces the amount of heat needed to be added to the supply air, and can at times lead to no additional heat required, thus minimising the CO2 emissions.

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For the redevelopment of 50 Fountain Street, this hybrid heat recovery system has been proposed throughout to allow natural ventilation to be used wherever possible, thus reducing the energy demand but still providing a mechanical ventilation system for use in the winter.

4.2.4. High Efficiency Motors

Systems should be carefully designed to minimise pressure losses and therefore energy consumption. Fan and pump motor loads should always be minimised by good system design prior to motor selection with high-efficiency inverter controlled fan and pump motors selected to ensure accurate commissioning and reduced energy consumption at part load conditions.

This ensures that the plant output characteristics match the system pressure drops. Direct drives rather than belt drives should be used and the use of Variable Speed Drives should also always be considered for efficient system regulation and variable flow control.

Where fan systems are installed they shall be designed to limit the specific fan power at the design flow rate to the following minimum values:

System Type	SFP (W(litre/sec))
Central mechanical ventilation including heating, cooling and heat recovery	2.5
Central mechanical ventilation including heating and cooling	2.0
All other central systems	1.8
Local ventilation only units within local area such as window/wall/roof units, serving one room or area	0.5
Local ventilation only units remote from the area such as ceiling void or roof mounted units, serving one room or area including VAV units	1.2
Other local units, e.g. fan coil units (rating weighted average)	0.8

Table 4: Limiting Specific Fan Powers in New Buildings

4.2.5. Artificial Lighting

Electric artificial lighting is often the single largest end-use of energy within buildings and can account for over 40% of the total electricity costs. When artificial lighting is used, it not only consumes electrical energy but adds to the internal heat gains, which can lead to additional electrical energy required to cool certain spaces.

As a result of this, it is important that the lighting design philosophy provides the correct quantity of lighting with minimum energy usage and therefore lower internal heat gains.

A key approach is ensuring that the lighting systems used less, and when operational the lights emit as much artificial light as possible when used to minimise energy consumption. This can be achieved by using highly efficient dimmable luminaires.

This efficiency is expressed as the Light Output Ratio (LOR) which is the percentage of the light produced by the lamp which actually exits the luminaire as useful light. Dimmable luminaires which offer high LORs (>90%) should be considered, as these can reduce energy consumption even further. Choosing lamps that have high outputs compared to energy used is also important here.

Artificial lighting should be designed to an average initial efficacy of not less than 80 luminaire-lumens/circuit Watt as averaged over the whole area in the building but LED light sources can typically produce over 110lm/w.

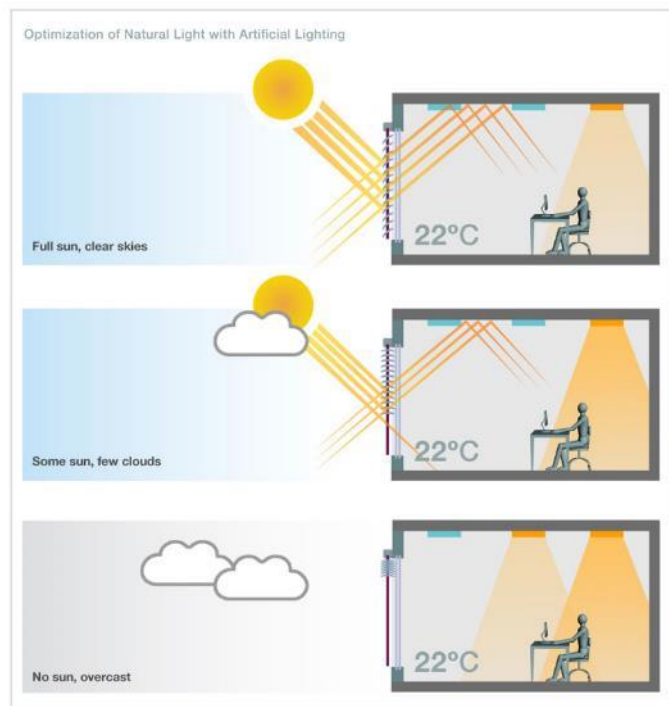
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Lighting controls should be adopted throughout the development, particularly daylight control sensors. This ensures that with the correct amount of daylight, the luminaires are used as infrequently as possible as they can be configured to dim to a specific level which in turn will save energy.

Occupancy or absence detection is an energy saving strategy that controls the lighting status depending on

whether a room has been vacant for a set period of time. The function of the room and occupancy profile should be carefully considered in terms of frequency of switching as some lamp types will fail early if switched too frequently (>8 switching's per day).

Artificial lighting strategies involve various mounting types such as recessed, pendant, wall etc. It is important that the lighting strategy provides the functional lighting quality and quantity to enable a user to perform the required task. At the same time, the illumination of other room surfaces is important to create an environment that is not depressive and one that stimulates the working environment.



Suspended pendant luminaires offer the advantage of providing additional light upwards onto the ceiling. They also lend themselves to exposed soffit ceilings due to the ability to conceal the wiring within the ceiling.

It is imperative that the lighting design philosophy for 50 Fountain Street provides the correct quality of lighting with minimum energy input and hence reduce internal heat gains. High light output luminaires combined with low energy lamps, will be used throughout the project. Lighting control systems will include daylight sensing and absence detection to ensure that the electrical energy and associated carbon emissions of the building lighting installation are kept to a minimum. Output performance or Light Output Ratios (LORs) will exceed 90%.

4.2.6. Building Management System (BMS)

A Building Management System (BMS) is a computer based centralised system that helps manage, control and monitor engineering services and equipment installed in a building. This equipment can include but is not limited to heating, ventilation, cooling, security, and lighting. BMS has evolved from being a simple supervisory controller, to a totally integrated computerised control and monitoring system and can include energy monitoring facilities that will allow the performance of the building, and its associated energy use, to be monitored accurately and consistently.

As well as being used to control services, the BMS has the potential to collate metering data and identify irregularities in energy consumption which can be used to provide meaningful input to energy management for energy/CO₂ savings.

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4.3. Adaptation to Climate Change

Average temperatures for central England have risen by approximately 1°C since the 1970s and this has resulted in higher temperatures, changing rain patterns, rising sea levels, in addition to unpredictable extreme weather events such as floods, droughts and freezing winters.

The UK Climate Change Risk Assessment Government Report (2012) outlined the risks faced by businesses, buildings and to health and wellbeing.

The risks noted within this report include the increased likelihood of increased external temperatures which could lead to staff illness and therefore lower productivity, damage to equipment due to the high internal building temperatures in addition to increased cooling demand.

Due the increase in the cooling demand, there would be increased pressure on energy infrastructure, which would become at risk of disruption resulting in less energy available on the grid.

The passive design features at 50 Fountain Street mean that the building is well adapted to these risks.

Firstly, the energy demand has been reduced and therefore the building will be less affected by the decreased availability of energy.

Secondly, the building will have a lower carbon footprint helping to stop the effects of climate change from increasing any further.

The expected increase in external temperatures could result in future overheating problems. Whilst the building cannot be relocated, by having low g-value glass, there is less solar heat gain entering the rooms.

The demand for cooling has also been reduced through the adoption of efficient building services and by exceeding the u-values stated in the Building Regulations.

This combination of passive design measures act to stabilise the temperatures within the building and enable it to adapt to the likely extremes of both high and low temperatures.

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4.4. Summary of Technologies & Measures Considered & Adopted

Key:

Y	–	Yes could be incorporated
P	–	Possible
N	–	Not appropriate

REDUCE DEMAND	SUITABLE FOR CONSIDERATION	COMMENTARY
Natural ventilation / Mixed mode	Y	The acoustic report supports the use of natural ventilation to reduce the amount of energy required to cool and ventilate the building. Mechanical ventilation (as part of a mixed mode system) will be included to ensure that the ventilation requirements are achieved.
Good natural daylight	Y	Essential to reduce the reliance on artificial lighting.
Thermal mass	Y	The existing elevation which contains high thermal mass is being retained and is being incorporated into the scheme. The new building elements will be a lightweight structure, but concrete roof
Air tightness	Y	Essential to minimise air leakage with the condition of the exposed site and reduce heat losses and exceed the minimum requirements of Part L 2013.
Solar shading/Low G Value Glass	Y	Specific solar shading not adopted but low 'G' value glass adopted to reduce unwanted solar gain on specific elevations
Thermal Insulation that Exceeds Minimum Standards	Y	Essential to minimise heat losses. Minimum standards Building Regulation U Values exceeded
Low 'G Value' glass specification	Y	Important to limit summertime overheating, the current G-value is 0.26.
ENERGY EFFICIENCY		
Ventilation Heat recovery	Y	Adopted on ventilation systems using a thermal wheel on AHU.
Low energy lighting	Y	Extensively adopted LED fittings throughout the scheme
Variable speed drives	Y	Variable speed drives can be adopted on all fan and pump motors where possible to reduce energy consumption (Central Plant)
Demand Operated Systems	Y	The use of passive infra-red (PIR) for lighting, heating, ventilation where feasible. Optimise mixed mode natural ventilation operation when internal temperature criteria satisfied.
Daylight Dimming	Y	Use of photocells to dim office lights when there is sufficient daylight from outside

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Peak load cooling/ Mixed mode	Y	Use of cooling only when mixed mode cannot satisfy internal summer temperature criteria.
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5. CONCLUSION

This report has set out the passive design elements incorporated within the redevelopment of 50 Fountain Street.

Our approach has followed the recognised strategy of fabric first followed by energy efficiency measures.

The use of the existing façade in conjunction with the exposed concrete slab allows the thermal mass of those elements to be used to retain the heat gained during the day and then released overnight, thus lowering the internal temperature.

The team have maximised passive measures to reduce the initial load of the building in terms of heating, cooling, and anticipated lighting loads with the following measures: -

- Appropriate glass to wall ratio
- U values that exceed minimum Building Regulation Standards as below:

Element	Target Values			G-Value
	Ua-Limit	Ua-Calc	Ui-calc	
Wall	0.35	0.23	0.3	
Floor	0.25	0.22	0.22	
Roof	0.25	0.18	0.18	
Windows, roof windows and rooflights	2.2	0.82	1.47	0.26
Personnel doors	2.2	0.26	0.26	

- Air leakage rates that exceed minimum Building Regulations as below:

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

- Improved glazing specification (G Value) that limits the amount of unwanted solar gain to avoid overheating.
- Exposed slabs for night-time cooling as shown in the image to the right.



5.1. Summary

In summary, the redevelopment's building emission rate is lower than the target emissions rate and passes criterion 1 as follows:

CO ₂ emission rate from the notional building, kgCO ₂ /m ² . annum	22.7
Target CO ₂ emission rate (TER), kgCO ₂ /m ² . annum	22.7
Building CO ₂ emission rate (BER), kgCO ₂ /m ² . annum	15
Are emission from the building less than or equal to the target?	BER=<TER

The proposed option provides a 33.92% improvement on Part L2A baseline calculation.

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If these passive design measures are not adopted, the redevelopment would only have a 27.97% improvement on Part L2A baseline calculation.

CO ₂ emission rate from the notional building, kgCO ₂ /m ² . annum	23.6
Target CO ₂ emission rate (TER), kgCO ₂ /m ² . annum	23.6
Building CO ₂ emission rate (BER), kgCO ₂ /m ² . annum	17.0
Are emission from the building less than or equal to the target?	BER=<TER

By adopting the passive design measures, there is a 5.59% improvement in the Buildings CO₂ emission rate (BER).



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