DECEMBER 2023

Sustainability, Energy and Overheating Statement

Ariel Hotel, Hayes, UB3 5AH

ICENI PROJECTS LIMITED ON BEHALF OF R ARIEL HEATHROW OPCO LIMITED

Iceni Projects Limited on behalf of

R Ariel Heathrow Opco Limited

December 2023

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1. EXECUTIVE SUMMARY

1.1 Iceni Projects Ltd has been commissioned by R Ariel Heathrow Opco Limited to produce a Sustainability, Energy & Overheating Statement to support the proposed redevelopment of the Ariel Hotel, Hayes, UB3 5AH.

1.2 This application proposes the redevelopment of the site to provide a two-storey upward extension to the existing hotel to deliver 113 new hotel rooms, in addition to the provision of a new 98-unit apart-hotel to the rear of the site, that would be operated in conjunction with the existing hotel.

1.3 Sustainability is a core consideration of the application, and has been incorporated from the project outset. Resource and water efficiency have been maximised, whilst the production of waste and pollution is to be minimised, thus ensuring the impact of the proposals on its immediate surroundings and the environment as a whole is minimised.

1.4 By designing to rigorous energy standards and employing electric-only systems within the proposed development, the application will respond directly to the Climate Emergency declared by the Council in January 2020. These measures combine to provide an approximate carbon dioxide emissions saving of 90% compared to the Part L:2021 baseline, aiming to comply the requirements of London Borough of Hillingdon and the Greater London Authority (GLA).

1.5 Through the use of electric-only systems for space heating and cooling and hot water, the scheme will be fossil fuel free, and compatible with the Government's intended trajectory to achieve net zero carbon emissions by 2050.

1.6 Consideration has been given to the London Borough of Hillingdon Local Plan Part 1 and 2 in the overall formulation of this strategy, aiming to minimise the environmental impact of the proposed development during construction and operation, and to ensure the development is constructed to rigorous sustainability standards.

1.7 The proposed strategy has been based around the objectives of the Local Plan Part 1 strategic objectives 8, 10, 11 and 13 and policy EM1, and Local Plan Part 2 policy DMEI 2. In summary, based on this strategy, the proposed development will;

- make efficient use of land, retaining and extending and existing building, and developing brownfield land;
- promote the use of sustainable modes of transport;

- minimise internal water consumption through the incorporation of water-efficient fittings and services;
- incorporate low-impact materials, according to the BRE Green Guide to Specification;
- minimise waste production during construction and maximise the proportion of waste to be diverted from landfill;
- incorporate measures to improve site biodiversity, including biodiverse planting;
- provide access to areas of green space in the form of a central podium landscaped courtyard;
- not increase the risk of surface water flooding onsite;
- ensure air, noise, land and water pollution are minimised as far as possible;
- minimise energy demand through the specification of low U-values, low air permeability and energy efficient systems and appliances; and
- utilise electric-only systems, such as air source heat pumps (ASHPs), to serve the space heating and cooling demands and water heating demands of both the proposed apart-hotel and the proposed extension to the existing Ariel Hotel.

1.8 By designing to rigorous energy standards, and omitting the use of fossil fuels for heating and cooling, the proposed development will achieve an approximate minimum 90% reduction in CO_2 emissions, following the Energy Hierarchy methodology. Figure 1.1 Carbon dioxide emissions after each stage of the Energy Hierarchy

Figure 1.1 Carbon dioxide emissions after each stage of the Energy Hierarchy

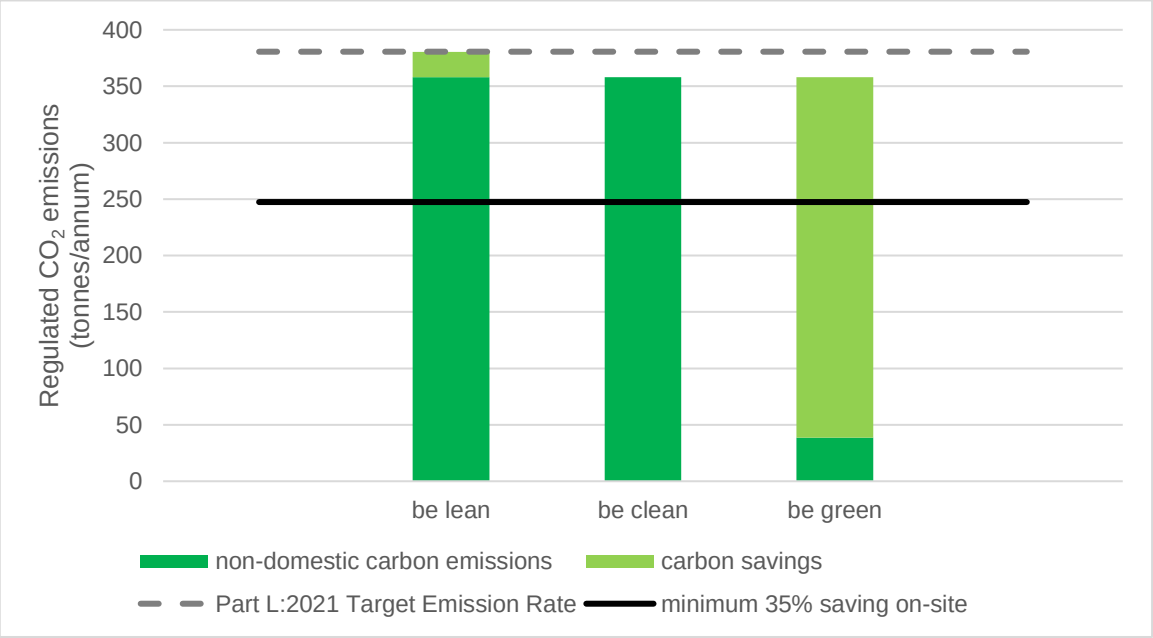


Table 1.1 Carbon dioxide emissions after each stage of the Energy Hierarchy

	Site-wide carbon dioxide emissions (Tonnes CO_2 per annum)
Baseline: Part L 2021 of the Building Regulations Compliant Development	380.6
After energy demand reduction	357.9
After renewable energy	38.7

Table 1.2 Regulated carbon dioxide savings from each stage of the Energy Hierarchy

	Regulated carbon dioxide savings	
	Tonnes CO_2 per annum	**%**
Savings from energy demand reduction	22.6	5.9%
Savings from renewable energy	319.3	83.6%
Cumulative on-site savings	341.9	89.8%

1.9 Overall, the proposals constitute sustainable development in accordance with national and local policy requirements and will provide a development that seeks to promote these principles in operation

2. INTRODUCTION

2.1 Iceni Projects Ltd was commissioned by R Ariel Heathrow Opco Limited to produce a Sustainability, Energy & Overheating Statement to support the application for the proposed redevelopment of the Ariel Hotel, Hayes, UB3 5AH.

Report Objective

2.2 This document details the sustainable design and construction measures adopted by the proposed redevelopment and gives an overview of the design proposals that will ensure the redevelopment operates in a sustainable manner over the lifespan of the scheme. The Sustainability & Energy Statement report headlines will provide a framework for the project team to operate consistently within sustainability guidelines set out by London Borough of Hillingdon.

2.3 The report is structured to meet these guidelines as follows:

- Section 3 discusses the planning context and policies which are relevant to sustainability;
- Section 4 discusses the development response to the policy drivers for sustainability;
- Section 5 sets out the development's energy strategy to minimise CO_2 emissions;
- Section 6 presents the results of the Sustainable Development Scorecard assessment; and
- Section 7 summarises the development's design response.

Site and Surroundings

2.4 The application site (Appendix A1) is located within the London Borough of Hillingdon, to the north of London Heathrow Airport. The site is bounded by Marlborough Crescent to the north, the Courtyard by Marriot hotel to the east, and High Street Harlington (A437) to the west. The southern boundary of the site is formed by Bath Road, with London Heathrow Airport located beyond.

2.5 The application site itself currently comprises the Ariel Hotel, with associated car parking and hard surfaces. The surrounding area is characterised by a mix of uses, with residential dwellings located to the north, additional hotel uses to the east and west, and London Heathrow Airport and associated buildings and car parking to the south.

The Proposed Development

2.6 The description of development is as follows:

"Reconfiguration, alteration and extension of existing hotel (providing additional hotel rooms), together with erection of a new apart-hotel building on car park land to the north."

2.7 The proposed extension to the existing Ariel Hotel comprises of the following number of hotel rooms on each floor.

Table 2.1 Hotel rooms within proposed refurbishment and extension of the Ariel Hotel

Hotel Room Size	Number
Ground Floor	12
Fourth Floor	51
Fifth Floor	50
Total	**113**

2.8 The proposed new-built apart-hotel will deliver the following mix of apart-hotel rooms:

Table 2.2 Apart-hotel mix

Apart-hotel Type	Number
1-bed	81
2-bed	17
Total	**98**

2.9 The images below show selected elevations and plans of the scheme, based on the information provided by Ackroyd Lowrie.

Figure 2.1 South elevation – Ariel Hotel

Figure 2.2 North elevation – Ariel Hotel

Figure 2.3 West elevation – Ariel Hotel

Figure 2.4 East elevation – Ariel Hotel

Figure 2.5 South elevation – Apart-hotel

Figure 2.6 North elevation – Apart-hotel

Figure 2.7 West (left) and east (right) elevations – Apart-hotel

Figure 2.8 Ground floor – Ariel Hotel

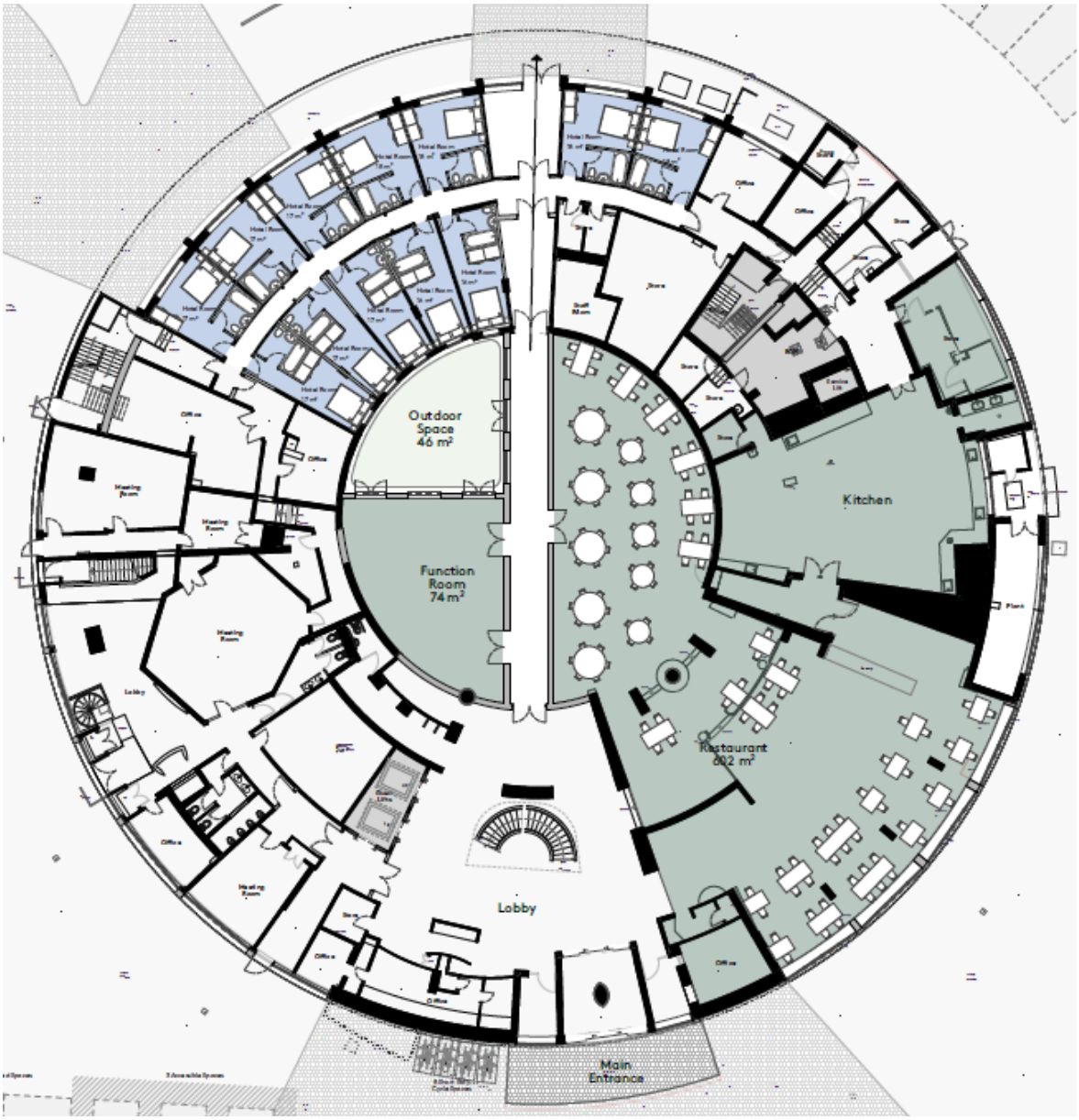


Figure 2.9 Fourth floor – Ariel Hotel

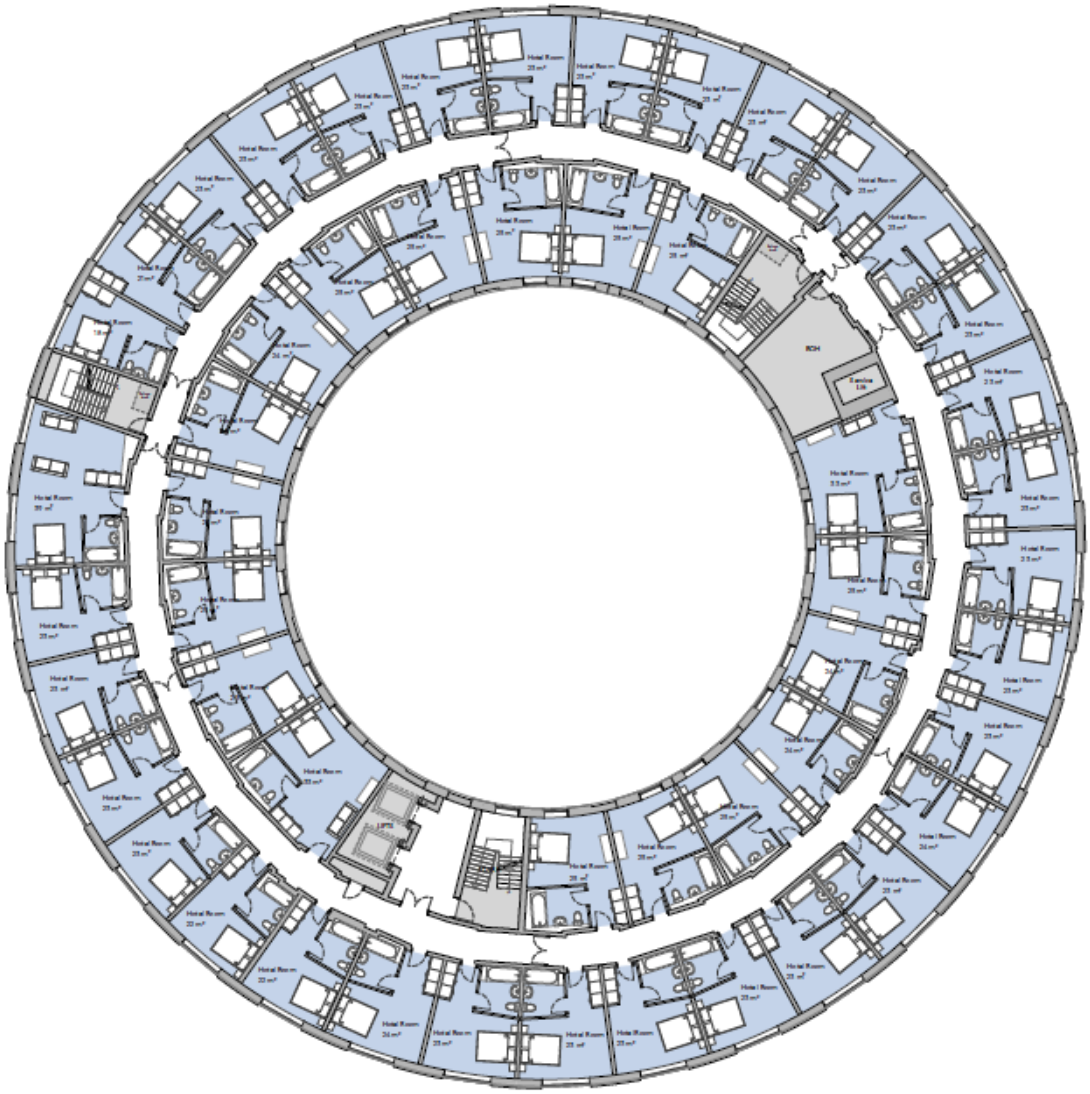


Figure 2.10 Fifth floor – Ariel Hotel

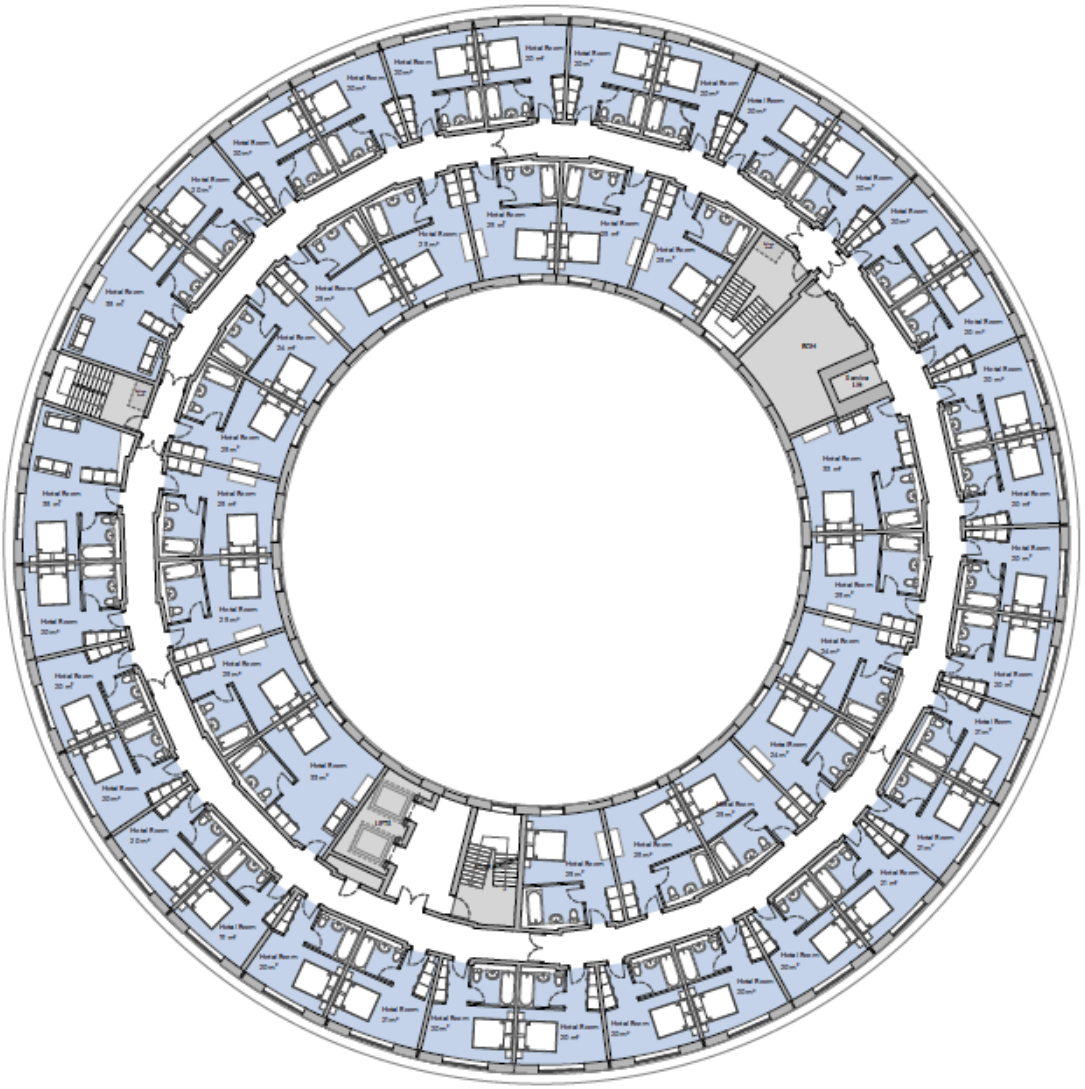


Figure 2.11 Ground floor – Apart-hotel

Figure 2.12 First and second floor – Apart-hotel

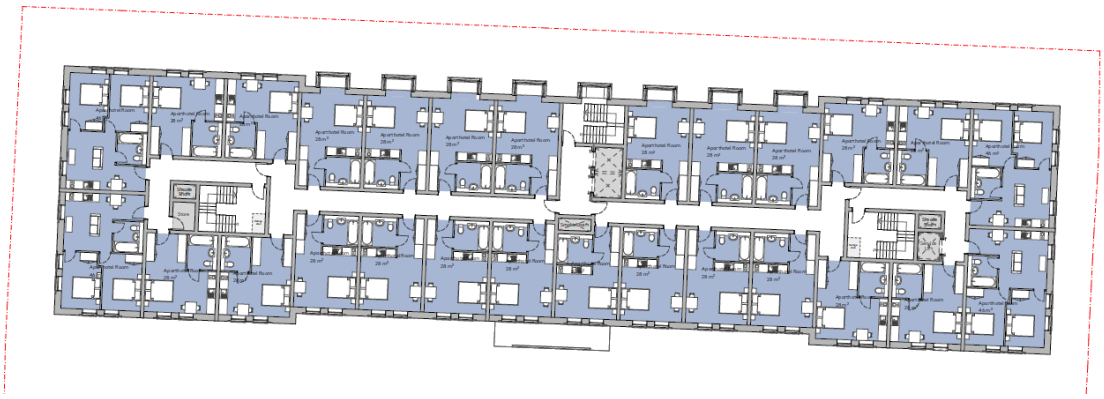
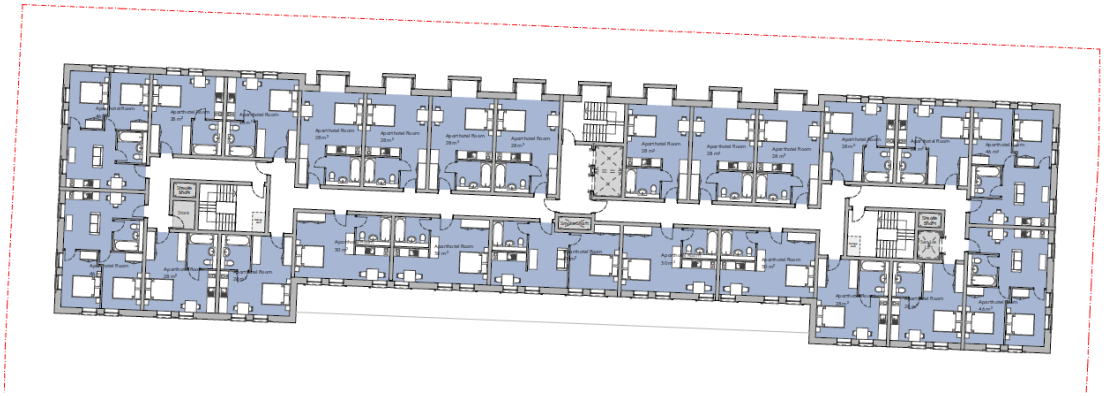


Figure 2.13 Third floor – Apart-hotel



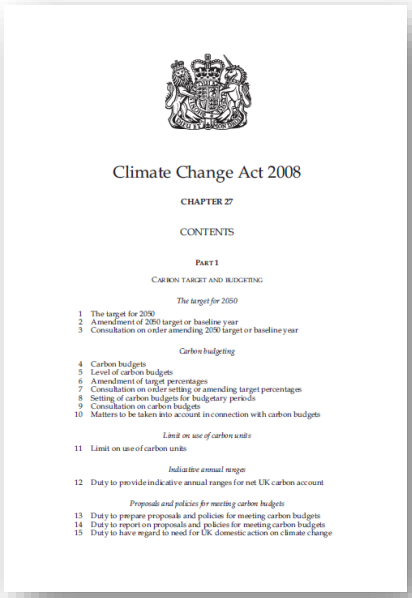
3. PLANNING AND REGULATORY CONTEXT

3.1 Built environment sustainability is incorporated within policy and regulation at a national and local level, as set out below.

National

Climate Change Act 2008

3.2 On 26th November 2008, the UK Government published the Climate Change Act 2008; the world's first long-term legally binding framework to mitigate against climate change. Within this framework, the Act sets legally binding targets to increase greenhouse gas emission reductions through action in the UK and abroad from the 60% target set out in the Energy White Paper, to 80% by 2050.


Climate Change Act 2008

CHAPTER 27

CONTENTS

PART 1

CARBON TARGET AND BUDGETING

The target for 2050

1 The target for 2050
2 Amendment of 2050 target or baseline year
3 Consultation on order amending 2050 target or baseline year

Carbon budgeting

4 Carbon budgets
5 Level of carbon budgets
6 Amendment of target percentages
7 Consultation on order setting or amending target percentages
8 Setting of carbon budgets for budgetary periods
9 Consultation on carbon budgets
10 Matters to be taken into account in connection with carbon budgets

Limit on use of carbon units

11 Limit on use of carbon units

Indicative annual ranges

12 Duty to provide indicative annual ranges for net UK carbon account

Proposals and policies for meeting carbon budgets

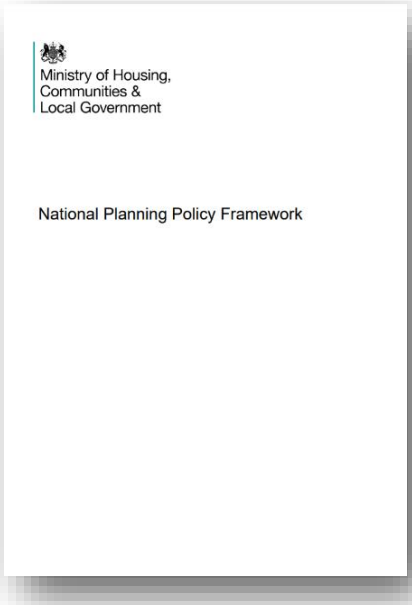
13 Duty to prepare proposals and policies for meeting carbon budgets
14 Duty to report on proposals and policies for meeting carbon budgets
15 Duty to have regard to need for UK domestic action on climate change

3.3 As required under Section 34 of the Climate Change Act, the Sixth Annual Carbon Budget was accepted by the Government in April 2021. This sets out a budget for UK emissions for the period 2033 – 2037.

3.4 Following a commitment in June 2019, the Climate Change Act has been amended to target net zero carbon emissions by 2050.

National Planning Policy Framework

3.5 The Ministry of Housing, Communities & Local Government determines national policies on different aspects of planning and the rules that govern the operation of the system. Accordingly, the National Planning Policy Framework (NPPF), which came into force in March 2012 and was updated in February 2019, aims to strengthen local decision making. Additional updates have since been made through the latter half of 2020 and in January and July 2021 to reflect changes related to use classes, permitted development rights, the calculation of housing need, and requirements to achieve beauty alongside sustainability. A further update was made in September 2023 with respect to onshore wind development.


Ministry of Housing, Communities & Local Government

National Planning Policy Framework

3.6 Paragraphs 10 and 11 of the NPPF confirm that at the heart of this document is a "*presumption in favour of sustainable development*", and that development proposals that accord with an up-to-date development plan should be approved without delay.

3.7 Paragraph 7 states that the purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs.

3.8 Achieving sustainable development means that the planning system has three overarching activities, which are interdependent and need to be pursued in mutually supportive ways, so that opportunities can be taken to secure net gains across each of the different objectives:

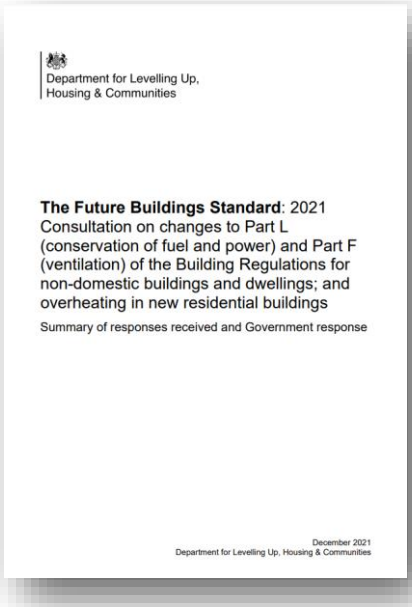
- **An Economic Role –** ensuring the provision of land and infrastructure needed to help build a *strong, responsive and competitive economy.*

- **A Social Role –** supplying the required amount of housing while at the same time ensuring and building *strong, vibrant and healthy communities.* Ensuring that the built environment is sited around accessible local services which help support a community's *health, social and cultural well-being.*

- **An Environmental Role –** ensuring development contributes to the protection and enhancement of the *natural, built and historic environment* through the improvement of biodiversity, minimising the use of natural resources and production of pollution / waste, and guaranteeing sufficient adaptation to climate change.

Future Buildings Standard

3.9 On 19th January 2021, the government announced the future introduction of the Future Buildings Standard. The Standard will deliver new non-domestic buildings that are zero-carbon ready from 2025 onward, which use low-carbon heat, and which have the best fabric standards possible. As the electricity grid continues to decarbonise, buildings built to the Standard will become net-zero carbon over time, with no need for further energy efficiency retrofit work as they will not rely on fossil fuels for heating and hot water.


Department for Levelling Up,
Housing & Communities

The Future Buildings Standard: 2021
Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for non-domestic buildings and dwellings; and overheating in new residential buildings

Summary of responses received and Government response

December 2021
Department for Levelling Up, Housing & Communities

3.10 This Standard is expected to build on the Prime Minister's Clean Growth Grand Challenge mission, which aims to at least halve the energy usage of new buildings by 2030. It

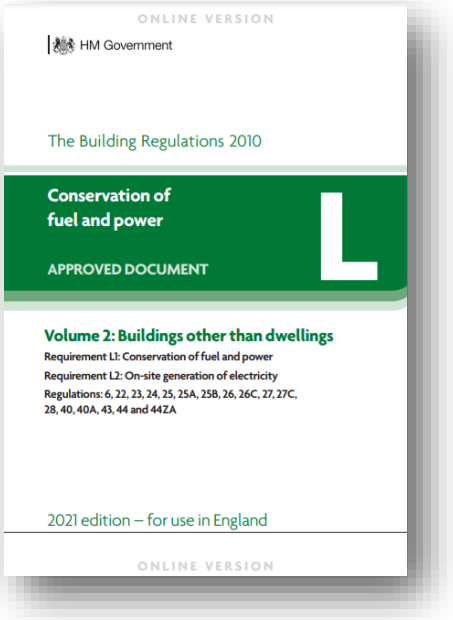
also looks to halve the costs of renovating new existing buildings to achieve a similar standard of energy efficiency as new buildings, whilst improving their quality and safety.

Part L:2021 of the Building Regulations

Part L of the Building Regulations relates to the conservation of fuel and power, and applies to both new and existing buildings. The current edition covers the energy efficiency requirements of the building regulations as set out in Part L of Schedule 1 to the Building Regulations. Technical guidance is contained in two Part L Approved Documents.

3.11 The documents of relevance to this scheme include:

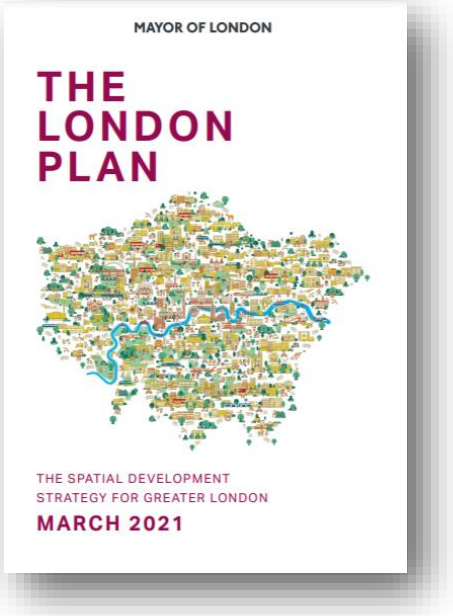
- **Approved Document L Volume 2: Buildings other than dwellings.** This provides the methodology for new build, non-domestic buildings to meet current energy efficiency standards, including backstop U-values, carbon dioxide emissions calculations and minimising the risk of overheating. Carbon dioxide emissions reductions are prescribed for 'regulated' emissions only, and relate to heating, hot water, lighting, auxiliary and cooling (where specified). Emissions from other equipment (computers, for example) are considered to be unregulated emissions, and are excluded from the analysis.



Regional

3.12 Within Greater London, key sustainable development principles for economic, environmental and social improvement are set out below:

The London Plan (March 2021)



3.13 The London Plan is the overall strategic plan for London and includes policies for sustainable development and energy within Chapter 9 (London's response to climate change). Key policies of relevance to this scheme are as follows:

- **Policy SI2 Minimising Greenhouse Gas Emissions.** This states that major development proposals should be net zero-carbon, by reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

    1. Be lean: use less energy
    2. Be clean: supply energy efficiently
    3. Be green: use renewable energy
    4. Be seen: monitor, verify and report on energy performance

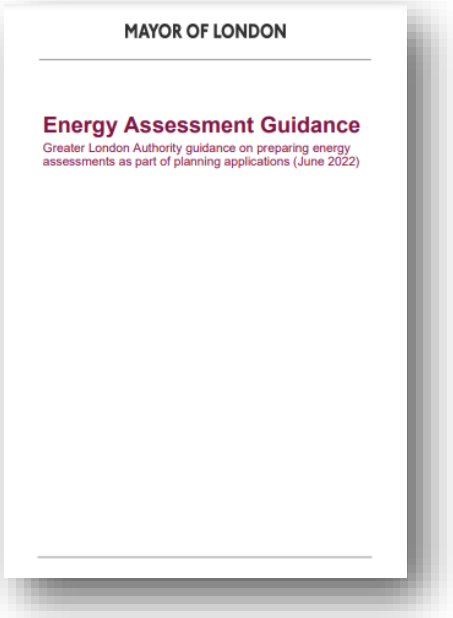
- **Policy SI3 Energy Infrastructure.** This policy recognises that combined heat and power installations can have negative effects on London's air quality and shifts the focus of decentralised energy networks to the use of waste or secondary heat sources, where available. The policy also recognises that, compared to increasingly decarbonised electricity generation, gas-fired heat will become comparatively more carbon intensive as the electricity grid is further decarbonised.

- **Policy SI4 Managing Heat Risk.** This policy states that development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

- **Policy SI5 Water Infrastructure.** This states that major development proposals should achieve at least the BREEAM excellent standard for the 'WAT 01' water category or equivalent (commercial development).

- **Policy SI7 Reducing Waste and Supporting the Circular Economy.** This states that resource conservation, waste reduction, increases in material re-use and recycling, and reductions in waste going for disposal will be achieved, in part, through designing developments with adequate, flexible and easily accessible storage space and collection systems.

Energy Planning – GLA guidance on preparing energy assessments (June 2022)



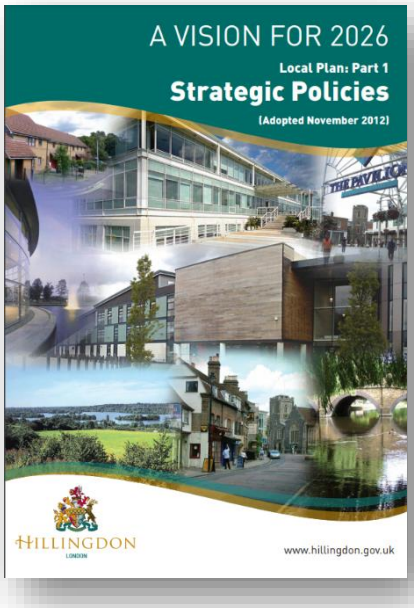
3.14 The guidance note provides further detail on addressing the London Plan's energy hierarchy through the provision of an energy assessment to accompany planning applications. The document sets out the expected carbon dioxide emissions targets for different building types.

3.15 The guidance outlines the requirement for all major application within London to achieve a minimum 35% carbon dioxide emissions savings over the Part L:2021 baseline through on-site means alone. The guidance also sets out the requirement to report the Energy Use Intensity (EUI) and the space heating demand of the development using the GLA's carbon emissions reporting spreadsheet.

Local

3.16 In determining the local context, the London Borough of Hillingdon Local Plan Part 1 Strategic Policies (November 2012) and the Local Plan Part 2: Development Management Policies (January 2020) set out policy relevant to sustainable development.

London Borough of Hillingdon Local Plan Part 1: Strategic Policies (November 2012)



3.17 The Local Plan: Part 1 sets out the planning vision and strategy for London Borough of Hillingdon. It identifies how the borough will guide future development in terms of the effective choice of housing, jobs and supporting infrastructure such as schools, health, leisure and community facilities, as well as ensuring places in the borough become vibrant, safe and welcoming. Policies and objectives of relevance to this project in the context of sustainability and energy are as follows:

- **Strategic Objective 8:** Protect and enhance biodiversity to support the necessary changes to adapt to climate change. Where possible, encourage the development of wildlife corridors.
- **Strategic Objective 10:** Improve and protect air and water quality, reduce adverse impacts from noise including the safeguarding of quiet areas and reduce the impacts of contaminated land.
- **Strategic Objective 11:** Address the impacts of climate change, and minimise emissions of carbon and local air quality pollutants from new development and transport.
- **Strategic Objective 13:** Support the objectives of sustainable waste management.
- **Policy EM1: Climate Change Adaption and Mitigation.** The Council will ensure that climate change mitigation is addressed at every stage of the development process by:
    - Prioritising higher density development in urban and town centres that are well served by sustainable forms of transport.
    - Promoting a modal shift away from private car use and requiring new development to include innovative initiatives to reduce car dependency.
    - Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.

- Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.

- Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.

- Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.

- Encouraging sustainable techniques to land remediation to reduce the need to transport waste to landfill. In particular developers should consider bioremediation as part of their proposals.

- Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydroelectricity and a greater use of waste as a resource.

- Promoting new development to contribute to the upgrading of existing housing stock where appropriate.

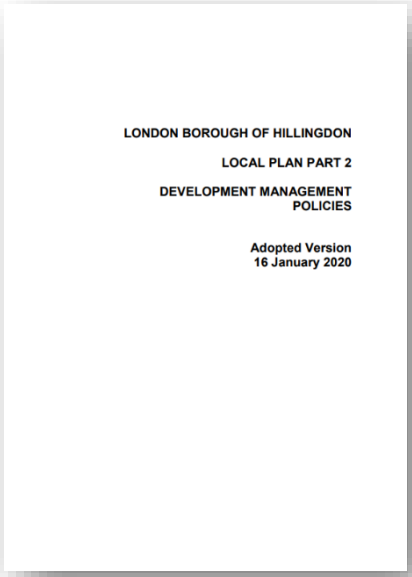
The Borough will ensure that climate change adaptation is addressed at every stage of the development process by:

- Locating and designing development to minimise the probability and impacts of flooding.

- Requiring major development proposals to consider the whole water cycle impact which includes flood risk management, foul and surface water drainage and water consumption.

- Giving preference to development of previously developed land to avoid the loss of further green areas.

London Borough of Hillingdon Local Plan Part 2: Development Management Policies (January 2020)



3.18 The purpose of the Local Plan Part 2: Development Management Policies is to provide policies that will form the basis of the decision making on individual planning applications. The document contains policies relating to new development and environmental protection and enhancement. Policies of relevance are as follows:

- **Policy DME 5: Hotels and Visitor Accommodation.** The Council will support a range of visitor accommodation, conference and related uses in accessible sustainable locations, as defined in the Site Allocations and Designations document, subject to:

    - A high standard of building and site design, including landscaping and placement of signage that makes a positive contribution to local amenity and the streetscape;

    - Provision of an accessible layout and rooms in accordance with Policy DME 6: Accessible Hotels and Visitor Accommodation; and

    - No adverse impact on nearby land uses or on the amenity of either adjoining occupants or proposed occupants by virtue of noise, lighting, emissions, privacy, overlooking, any other potential nuisance, parking or traffic congestion.

- **Policy DMEI 2: Reducing Carbon Emissions.**

A. All developments are required to make the fullest contribution to minimising carbon dioxide emissions in accordance with London Plan targets.

B. All major development proposals must be accompanied by an energy assessment showing how these reductions will be achieved.

C. Proposals that fail to take reasonable steps to achieve the required savings will be resisted. However, where it is clearly demonstrated that the targets for carbon emissions cannot be met onsite, the Council may approve the application and seek an off-site contribution to make up for the shortfall.

Other Considerations

Declaration of a Climate Emergency (January 2020)

3.19 On the 16th January 2020, the London Borough of Hillingdon Council declared a climate change emergency, agreeing to extend the Council's climate change targets beyond those set at the time to become carbon neutral across the Council's services by 2030, and to achieve 100% clean energy across the Council's services by 2030. The Council resolved that, to meet these targets practically and to be accountable to residents for them:

- Recognise that, initially, they will span the Council's direct services and, subject to future review by the Cabinet, may grow to encompass the Council's wider commercial supply chain;
- The Cabinet Member for Housing and the Environment, in consultation with the Leader of the Council assumes a new Executive responsibility within the Council's Constitution for climate change strategy;
- Responsibility for oversight and scrutiny of the Council's efforts in relation to climate change be given to the Corporate Services, Commerce and Communities Policy Overview Committee to review as they see fit and engage the community;
- The Chief Executive designate a lead officer to act corporately on climate change an in pursuit of the above targets;
- An annual action plan be submitted to Cabinet, aligned with the budget, to monitor achievement. Furthermore, a review of environmental performance reporting be undertaken to actively engage staff in ways to tackle climate change in their service areas and communicate progress more widely to residents.

4. SUSTAINABILITY STRATEGY

4.1 The Sustainability & Energy Statement for the proposed redevelopment is divided into two main parts.

4.2 The sustainability strategy for the proposed development has been assessed in line with the guidance set out within relevant policies of the London Borough of Hillingdon Local Plan Part 1: Strategic Policies and Part 2: Development Management Policies policy. This enables a holistic sustainability approach to be set out for the proposed redevelopment. The London Borough of Hillingdon Local Plan requires that all new development provides sustainable, high quality and inclusive design, and therefore represents best practice guidance to meet high standards of sustainable design and construction.

4.3 The carbon dioxide (CO_2) emissions reduction strategy for the proposed building to be delivered as part the development is based on the energy hierarchy to provide a rigorous methodology, which maximises cost-effective opportunities for emissions reduction, as detailed in Section 5.

Sustainable Design and Construction

4.4 In line with the guidance provided in the London Borough of Hillingdon Local Plan, the sustainability features of the proposed development are outlined below.

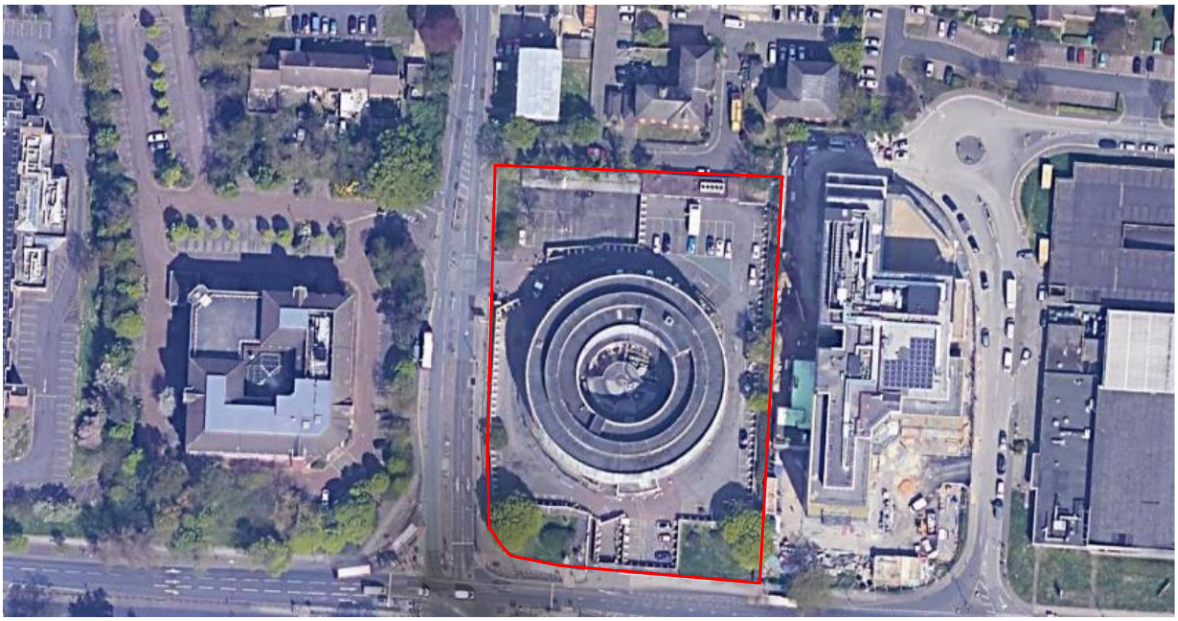
4.5 Issues related to energy conservation, renewables and reducing greenhouse gases follow in a dedicated section.

Land

4.6 As shown in Figure 4.1 below, the site is currently occupied by the Ariel Hotel and associated car parking. A car wash facility is also located at the northern boundary of the site.

Figure 4.1 View of the existing site

Approximate Site Boundary

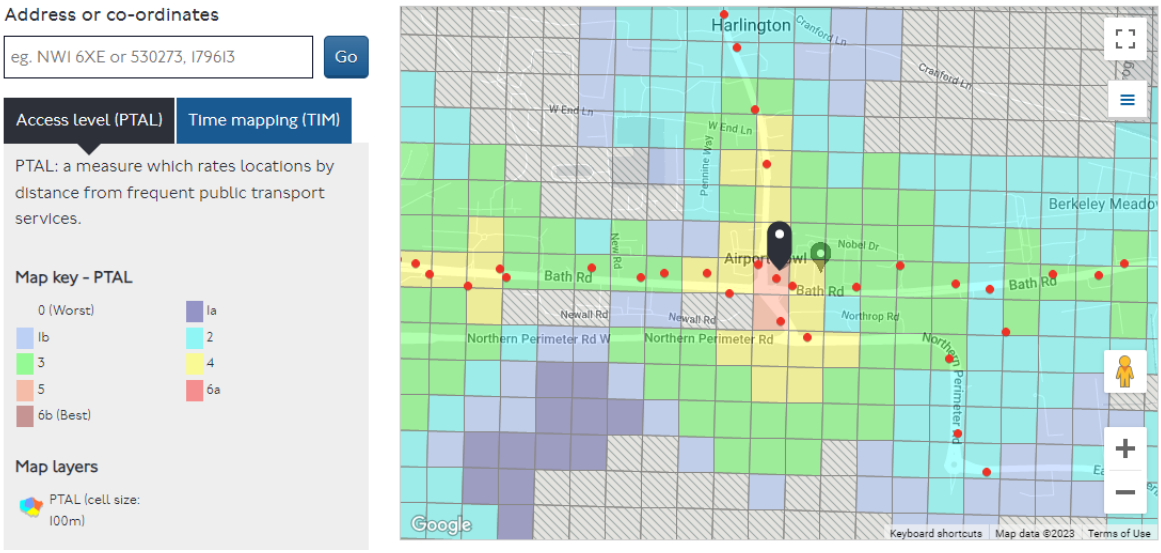


4.7 Based on this, the land has been previously developed. In this way, the proposed redevelopment and extension of the existing hotel within this location will provide additional hotel rooms, and the proposed new apart-hotel building will deliver new facilities, in a sustainable location within the London Borough of Hillingdon, in close proximity to London Heathrow Airport.

Location and Transport

4.8 According to the Transport Assessment, produced by Cole Easden, the site has public transport connections for the London Underground and London bus network, with the site scoring a PTAL rating of 6a. Hounslow West station is located approximately 3.6km to the southeast of the site, and provides access to London Underground services on the Piccadilly line. The site is also served by a number of bus stops, including one located on Bath Road (A1) at the southeastern corner of the site, and one on High Street Harlington (A437) to the west of the site. These bus stops are served by a large number of services including routes: 81 and 222 to Hounslow Bus Station; 90 to Northolt; 105 to Greenford Station; 111 to Kingston; 278 to Ruislip; H98 to Hayes End in a westerly direction and Hounslow West / Hounslow Bus Station in an easterly direction; N9 to Aldwych / Drury Lane; N140 and X140 to Harrow; and SL9 Superloop.

Figure 4.2 Extract from TFL PTAL map



4.9 Access to the site will be via the western boundary from Hight Street Harlington (A437), and via the southern boundary from Bath Road (A4), as per the existing case. The existing access at the southern boundary of the site will allow for movements into the site only, whilst the access on the western boundary will allow two-way movements. It is intended that a one-way system around the Ariel Hotel be implemented, with vehicles permitted to traverse around the site in a clockwise direction only. A total of 57 car parking spaces will be provided at the ground floor level, with 12 of these spaces to include for the installation of active electric vehicle (EV) charging facilities.

4.10 A total of 28 cycle parking spaces will be provided in the form of Sheffield Stands, as follows:

- 20 long stay cycle spaces for staff, to be provided in the north-east of the Ariel Hotel within a dedicated cycle store; and
- Eight short stay cycle spaces for guests, to be provided externally, in close proximity to the main entrance of the Ariel Hotel.

4.11 The proposed servicing and delivery strategy for the proposed development will replicate that for the existing case, with access to the site gained via High Street Harlington (A437) and Bath Road (A4), as detailed above. Through modelling undertaken as part of the preparation of the Transport Assessment, it has been demonstrated that the proposed development will result in a negligible impact on local public transport and pedestrian infrastructure, though it is expected that the greatest impact will be on local bus services. The proposed development is therefore not anticipated to result in severe impacts from a transport perspective, particularly as it is anticipated that the majority of staff members and future guests will preferentially use sustainable modes of transport.

4.12 A Travel Plan has also been prepared by Cole Easden. This document has been developed as a long-term strategy with the aim of promoting sustainable modes of transport to reduce reliance on

single occupancy private car travel for future staff members and guests of the proposed development. It is proposed that a number of measures and initiatives be implemented in order to work towards the objectives and targets of the Travel Plan. These include: the appointment of a Travel Plan Coordinator (TPC) for the site, who will be responsible for overseeing the implementation of the Travel Plan; provision of Sustainable Travel Information Packs, containing details of sustainable ways to travel such as cycle and walking maps within the local area; the provision of secure cycle parking; and the requirement for future guests to book car parking spaces when making room reservations, due to the reduced number of car parking spaces to be made available.

Water Efficiency

4.13 The city often consumes more water than is available during dry weather. As the population of London continues to grow, this situation will be further exacerbated, with greater pressure on the supply of potable water. Hotels in particular often use considerable amounts of water for washing and laundry.

4.14 In order to actively mitigate against this, it is intended that water efficient fittings and appliances shall be installed to reduce the water consumption rate over the baseline building water consumption. Subject to confirmation, it is expected that this will include the incorporation of low consumption fittings, such as flow restrictors on showers, low flow taps and dual flush, low volume toilets. Measures to deliver further reductions in water consumption will be explored during the detailed design stages.

4.15 The potential for rainwater harvesting or grey water recycling on-site will also be explored during the further detailed design stages. In particular, the viability of harvesting rainwater for landscaping irrigation purposes will be explored, to further reduce the consumption of potable water.

Materials and Waste

4.16 Materials should be responsibly sourced by the main contractor, and be specified to have a low embodied impact. Materials with a low embodied impact, as defined within the BRE Green Guide to Specification, should be selected for use in the building design and construction.

4.17 The selection of materials is determined by a variety of factors, such as the architectural context, design rationale, embodied carbon and maintenance requirements. For the proposed development, consideration will be given to the lifecycle environmental performance with materials selected in consideration of the BRE’s Green Guide to Specification, aiming for A or B rated materials wherever possible.

4.18 The use of locally sourced materials will be prioritised wherever possible to reduce the impacts associated with the transportation of materials. Using materials produced in the local area will also aid in developing the identity of the development, by ensuring it is in line with the local character and

context. For the proposed development, there will be a focus on sustainable design, with materials selected that are in keeping with the local vernacular and landscape character, aiming for locally sourced materials where possible.

4.19 During detailed design of the building fabric, consideration will be given to minimising the environmental impact of materials, by selecting non-toxic and robust materials to ensure longevity and a minimal impact on the health of occupants.

4.20 Timber will be selected and purchased in consideration of sustainability certification. It is intended that all structural timber elements along with any timber used for temporary uses, such as scaffolding, will be sustainably sourced, e.g. from FSC and/or PEFC sources.

4.21 Consideration has been given to the reduction and recycling of waste during both the construction and operation phases. During the construction phase, the principal contractor will be required to implement a Site Waste Management Plan (SWMP), which will detail who will be responsible for resource management, which types of waste will be generated, how the waste will be managed (e.g. reduced, reused or recycled), which contractors will be used, and how the quantity of waste generated by the project will be measured. Should any demolition be required on the site, demolition contractors will incorporate best practice measures to maximise the recovery of materials from the demolition site for reuse or recycling, in line with the guidance set out by the Institute of Civil Engineers' (ICE) "Demolition Protocol".

4.22 To encourage the responsible management of operational waste, a bulk waste container will be provided at the eastern boundary of the site. This container will be privately managed and serviced on-site, and the facilities will be considerate of Building Regulations and Council requirements.

4.23 A Circular Economy Statement and Whole Life Carbon Assessment have also been prepared by Iceni Projects to support this application. These documents provide further details of the measures incorporated to minimise resource consumption and reduce the generation of waste across the lifetime of the proposed development.

Tackling Increased Temperature and Drought

4.24 In order to protect the development against overheating in the future, a number of key design features have been proposed to ensure the proposals are resilient to increased temperatures, which may be experienced as a result of climate change and the urban heat island effect. A summary of the measures included to reduce overheating risk is provided below.

4.25 The design of the dwellings has been developed in line with the GLA's recommended 'Cooling Hierarchy' approach, detailed in London Plan policy SI4. This applies a similar principle to the

thorough decision-making process of the Energy Hierarchy, with the aim of reducing CO_2 emissions from cooling and minimising the risk of overheating where no cooling is present:

Minimisation of internal heat generation through energy efficient design

- Heat gain from lighting is kept to a minimum as a result of an energy-efficient lighting design solution.

- The availability of natural light is maximised by optimising the light transmittance of the glass elements of the façade.

- The proposed apart-hotel will employ a communal air source heat pump (ASHP) system for heating and hot water. This is a low temperature distribution system, leading to lower internal heat gains from distribution pipework.

Reduction of the amount of heat entering the building in the summer

- The building's facades will have a limited amount of glazing to mitigate direct solar heat gain while optimising daylight penetration, and windows will be recessed to further mitigate direct solar heat gain.

Management of the heat within the building through exposed thermal mass and high ceilings

- Due to the dense nature of the proposed development, there is little external exposed thermal mass within the building structures, minimising thermal transmission.

Passive ventilation

- Due to the location of the proposed development within close proximity to London Heathrow Airport and road traffic noise sources, windows will not be openable. This will limit the opportunity to facilitate passive and crossflow ventilation.

4.26 **Mechanical and active cooling**

- It is expected that the existing hotel is served by an air condition (AC) system that will be extended to serve the proposed additional hotel rooms. Due to the limited opportunity to provide openable windows for the proposed apart-hotel, it is expected that the air source heat pumps (ASHPs) employed to deliver space and water heating will be reversible, to therefore also provide space cooling where required.

4.27 An overheating assessment for the proposed development has been carried out using dynamic thermal modelling. This assessment has employed the guidance set out in CIBSE TM52 to model overheating in non-residential properties, including urban heat island effects. The overheating assessment made use of the Design Summer Year weather data for London Heathrow, representing a peri-urban location to predict overheating risk for three different scenarios:

- DSY1. 1989: a moderately warm summer (current design summer year).

- DSY2. 1976: a year with a prolonged period of sustained warmth.
- DSY3. 2003: a year with a very intense single warm spell.

4.28 The risk of overheating has been assessed using the guidance contained in CIBSE TM52, which details the limits of thermal comfort.

4.29 Full details of the overheating assessment are provided in Appendix A2, and a summary of results is given below.

4.30 The proposed development has been designed to minimise the risk of overheating, in accordance with the London Plan Policy SI4 'cooling hierarchy'. Passive cooling design measures have, however, been constrained by the location of the proposed development within proximity to elevated levels of road and air traffic. To ensure the comfort and wellbeing of future occupants and guests is safeguarded, the application has not implemented openable windows. Nevertheless, the building fabric and building services designs have maximised all available measure to minimise heat generation within the tested spaces, to reduce the amount of heat entering the building, and to mechanically ventilate these spaces in line with the cooling hierarchy in Policy SI4 of the London Plan.

4.31 The results were then compared to the CIBSE TM52 overheating criteria for the three weather files specified in CIBSE TM49, as required by the GLA.

4.32 When discounting the proposed cooling systems, the tested spaces are demonstrated to fail the TM52 overheating criteria for all three tested weather files.

4.33 However, when including for the proposed cooling system, the tested spaces are shown to pass the TM52 criteria for the DSY1 and DSY3 weather files, therefore meeting the requirements of the GLA. It is noted that one tested space is projected to fail the TM52 criteria for the DSY2 weather file, however the GLA guidance acknowledges that this can be expected given the more extreme temperatures required to be assessed in the DSY2 weather file.

4.34 In this way, despite the adoption of an approach employing the cooling hierarchy, overheating of the buildings is a realistic prospect when not including for active cooling, and there is therefore a clear need for air conditioning in this instance.

Nature Conservation and Ecology

4.35 The Preliminary Ecological Appraisal (PEA), prepared by Arbtech, confirms that there are no statutory or non-statutory nature conservation designations present within the site. The site does not fall within or adjacent to any statutory designated areas. One statutory designated site, the Cranebank Hatton Local Nature Reserve (LNR), is located within a 2km radius of the proposed

development site, and is situated approximately 1.4km to the south east. It is concluded that, due to the small scale of the proposed works, the distance of the proposals from any designated sites and the physical barriers present due to the urban location, there is unlikely to be a direct or indirect impact on statutory designated sites as a result of the proposed development.

4.36 As part of the survey of the site, the following habitat types were observed: commercial buildings, areas of grassland with scattered trees and introduced shrubs, and built linear features. Whilst none of these habitats identified on site are categorised as Habitats of Principal Importance, it is noted that there are areas of good quality semi-improved grassland, deciduous woodland and lowland meadow habitats present within a 2km radius of the site. Due to the small scale of the proposals, the distance present between the site and identified habitats, and the urban nature of the site location, it is not anticipated that the proposed development will result in adverse impacts on notable habitats. It is noted, however, that to ensure any trees that are to be retained as part of the proposed development are suitably protected, the measures outlined within BS 5837 should be implemented during the construction phase. It is also recommended that best practice measures to minimise the possibility of pollution be implemented during the construction of the proposed development.

4.37 With respect to protected species, the habitats present on the site are not considered suitable to support populations of reptiles, dormice, badgers, Great Crested Newt, hedgehogs, water vole, or otters. The existing building on-site is considered to be of negligible suitability for roosting bats, as is also the case for the existing trees present. The site is also considered to offer low potential to support foraging and commuting bats, however the trees and shrubs on the site may provide opportunities to nesting, foraging and commuting birds. It is not anticipated that the proposed development will result in adverse impacts on birds utilising the site, however, as it is intended that all trees and shrubs present on the site be retained as part of the proposed development.

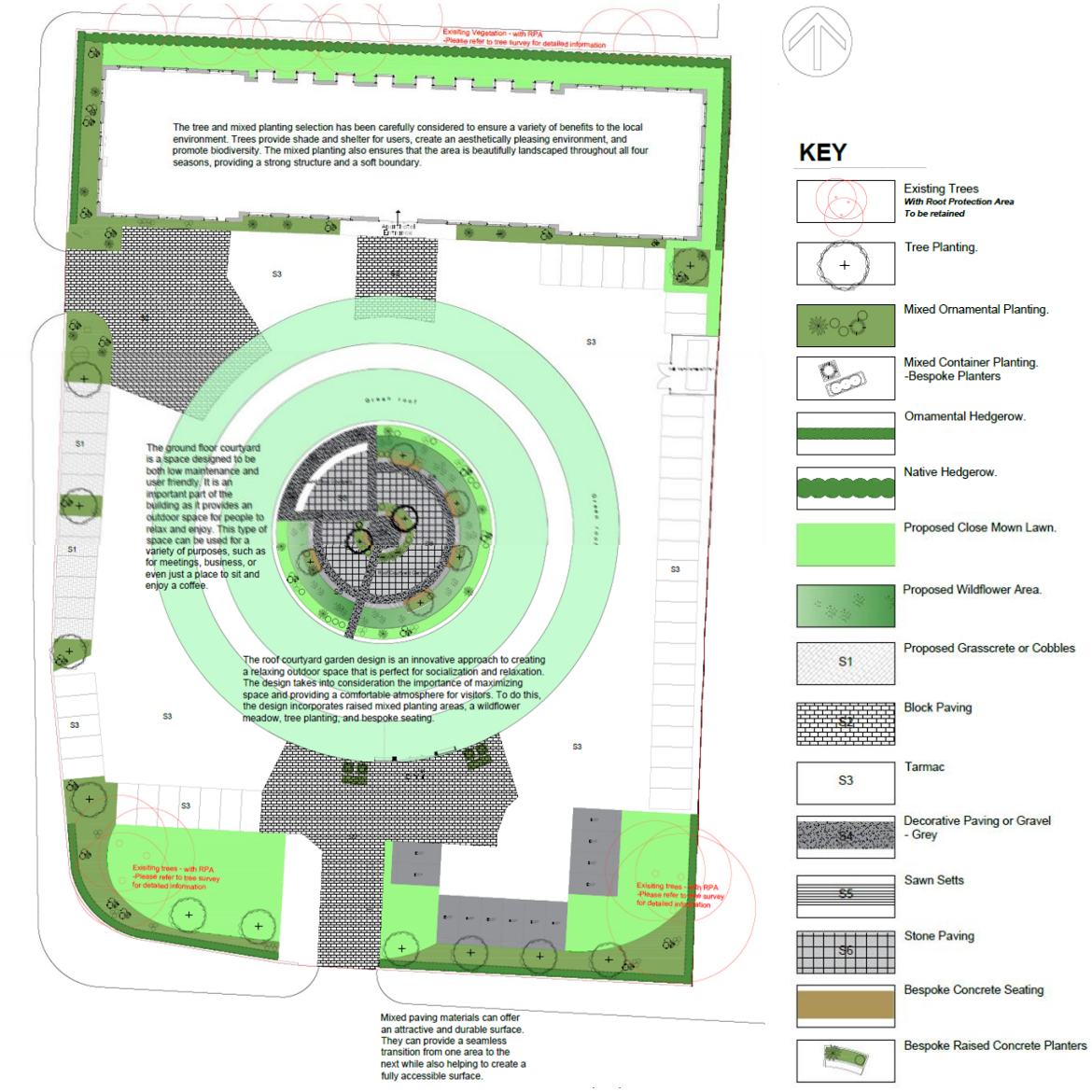
4.38 Whilst the existing habitats on the site are considered to be low ecological value, it is recommended that a number of ecological enhancements are delivered as part of the proposed development, as follows:

- Planning of native trees, hedgerow and shrubs. This will increase foraging opportunities for wildlife, including bats and birds;
- Installation of two bat boxes to provide additional bat roosting opportunities. The bat boxes should be positioned 3 – 5m above the ground level, facing in a south or south-westerly direction, and with a clear flight path to and from the entrance, away from artificial light;
- Installation of bird boxes to provide additional nesting opportunities. General purpose bird boxes may be incorporated, and should be positioned 3m above the ground level, and should be sheltered from prevailing wind, rain and strong sunlight; and

- The inclusion of pollinator-friendly species within the proposed Landscaping Strategy to provide opportunities for invertebrates on-site.

4.39 The proposed Landscape & Planting Concept Plan, prepared by Anna French Associates Ltd, is shown in Figure 4.3 below.

Figure 4.3 Proposed Landscape & Planting Concept Plan

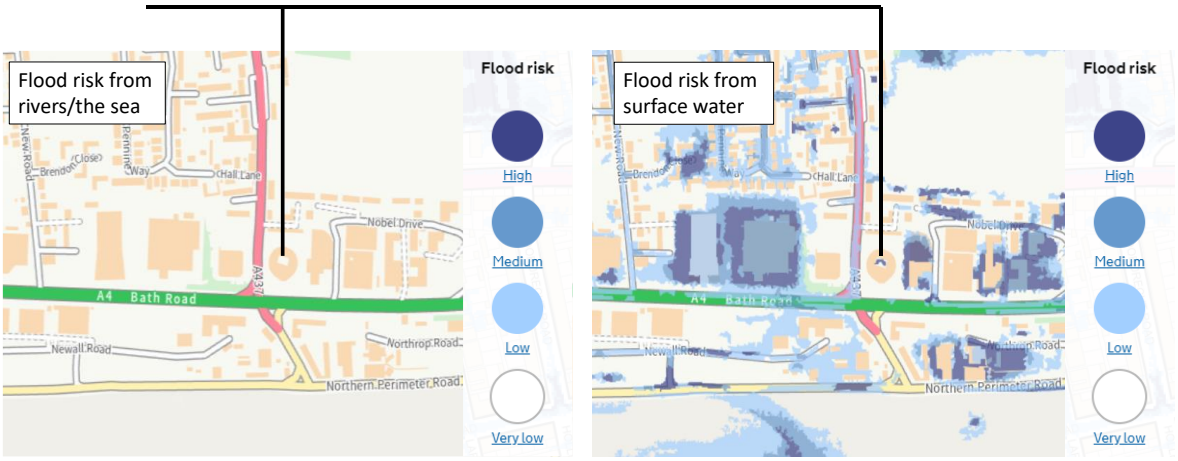


4.40 The incorporation of the proposed Landscape & Planting Concept Plan, shown above, will deliver a wider range of new planting, including trees, ornamental species, ornamental and native hedgerow, grass and wildflower species. It has been calculated that, through the delivery of the Landscape Strategy proposed, an Urban Greening Factor (UGF) of 0.30 will be achieved, which is in compliance with the requirements of the London Plan.

Reducing Flood Risk and Surface Water Runoff

4.41 As detailed within the Flood Risk Assessment & Drainage Strategy, prepared by Cole Easden, and confirmed in Figure 4.4 below, the site is located wholly within Flood Zone 1, indicating a very low risk from tidal and fluvial sources. Furthermore, as shown below, the majority of the site is at very low risk of flooding from surface water sources, with the exception of a very small portion of the existing central courtyard of the hotel, which is shown to be at high risk of surface water flooding. In addition, there are areas shown to be at low to high risk of surface water flooding on the site adjacent to the east, and a low risk of flooding within the carriageway of High Street Harlington (A437) to the west. It is noted, however, that the risk of surface water flooding on-site will be managed through the incorporation of a sustainable drainage system, and that the risk of flooding identified off-site is anticipated to be contained within the respective adjacent site and road carriageway, and is therefore not anticipated to encroach within the proposed site boundaries. In addition to this, it is stated that there is a medium to high risk of groundwater flooding at the site, with a more than 75% chance of flooding from this source occurring across the majority of the site each year. However, the hotel building will be located within an area that is demonstrated to have a 25% chance of flooding from this source annually. In the event that groundwater emergence does occur, the topography of the site would mean that floodwater would flow in a southerly direction away from the building. In addition, the proposed sustainable drainage strategy will incorporate features that are wrapped, in order to prevent groundwater ingress, and anchored, to prevent uplift. The Flood Risk Assessment & Drainage Strategy concludes that the site is therefore at low residual risk of groundwater flooding, and is not at risk from sewer or reservoir flooding.

Figure 4.4 Extract from the Environment Agency's online flood map



4.42 As detailed within the Flood Risk Assessment & Drainage Strategy, prepared by Cole Easden, the proposed surface water drainage strategy has been designed to attenuate and restrict runoff to a rate of 3.5 l/s. Below-ground attenuation crates are to be incorporated within the existing car parking area to manage surface water run-off at source as part of the proposed sustainable drainage system (SuDS). The below-ground storage void system will connect to an existing Thames Water surface water sewer which runs along High Street Harlington (A437) to the west of the proposed site.

4.43 The proposed surface water drainage strategy provides a significant improvement to the existing situation, firstly by reducing the runoff rate to 3.5 l/s, but also reducing the volume of water entering the adopted sewer network.

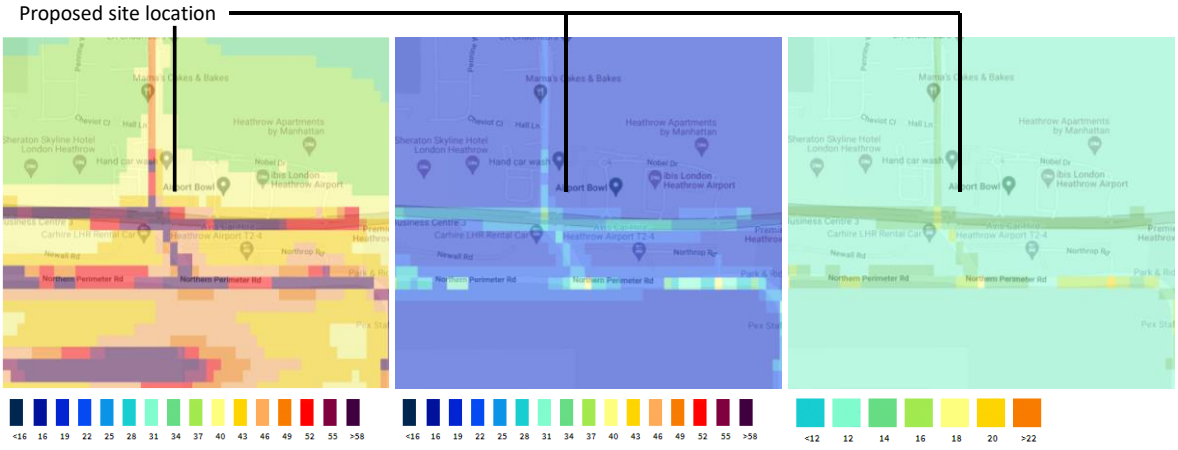
Air Pollution

4.44 The Environment Act 1995 requires all Local Authorities to review air quality within the districts. If it appears that any air quality 'Objective' prescribed in the regulations, and in the National Air Quality Strategy, is not likely to be achieved, then the local authority must designate the affected area as an Air Quality Management Area (AQMA).

4.45 The site location, and the area from the southern boundary of the London Borough of Hillingdon to the border defined by the A40 corridor, is specified as an AQMA due to excessive levels of nitrogen dioxide (NO_2) resulting from road transport.

4.46 Figure 4.5 below, taken from the London Air Annual Pollution Maps, shows the levels of NO_2, PM_{10} and $PM_{2.5}$ measured at the site in 2016. The images below indicate that the levels of PM_{10} and $PM_{2.5}$ present at the site in 2016 would have been below both the National Air Quality Objective (NAQO) and World Health Organisation (WHO) guidelines, however the level of NO_2 would likely have been above the levels recommended within both guidelines.

Figure 4.5 Maps indicating annual levels of NO_2 (left), PM_{10} (middle) and $PM_{2.5}$ (right) exposure



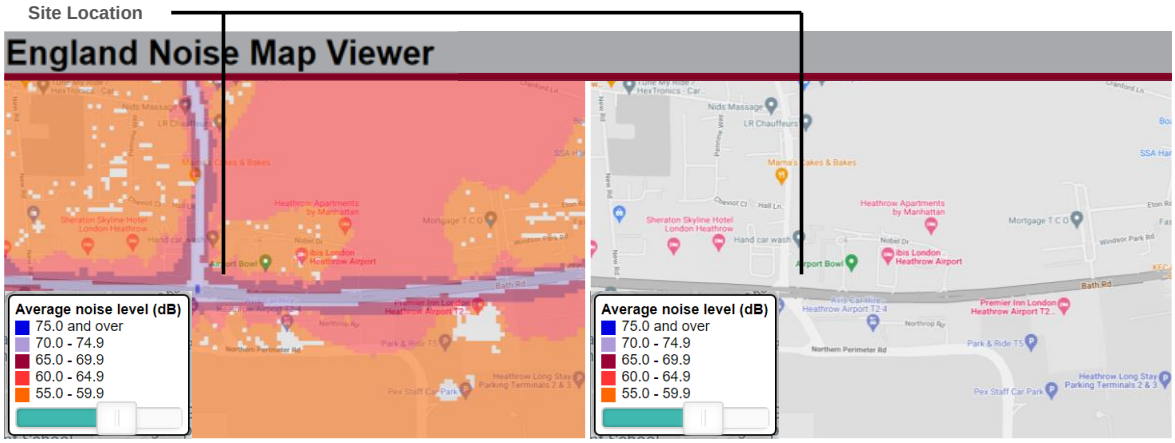
4.47 An Air Quality Assessment of the proposed development has been undertaken and further details can be found within the report submitted in support of this application.

Noise

4.48 As shown in the maps below, the development located within close proximity to transport noise sources. The closest road noise sources are Bath Road (A4), which forms the southern boundary of the site, and High Street Harlington (A437), which forms the western boundary. However, the site is

not located within close enough proximity to any rail lines for noise from this source to impact on the occupants in the future, as demonstrated on the map below (right). It is noted that the proximity of the site to London Heathrow Airport will also results in increased exposure to airport and aeroplane noise sources.

Table 4.1 Figure 4.6 Noise map showing road noise (left) and rail noise (right)



4.49 An Environmental Noise Impact Assessment has been undertaken by ES Acoustics. The results of the sound survey undertaken at the site indicates that the main Ariel Hotel building falls within the '3-High' Noise Risk Category, whilst the proposed Apart-hotel building to the rear of the site falls within the '2-Medium' Noise Risk Category. It is considered that this is commensurate to the expectations for the proposed development site, considering its close proximity to London Heathrow Airport to the south. In order to sufficiently mitigate the high levels of noise at the site, such that there is 'no adverse effect on health and quality of life' it is recommended that high acoustic-performance glazing be employed, with a number of attenuation figures set out within the Environmental Noise Impact Assessment that it is noted glazing suppliers should verify compliance with. Further to this, it is recommended that mechanical ventilation be employed to provide background ventilation, with windows required to be opened only for occasional 'purge' ventilation. Based on this, the use of double-glazed windows has been included for within the Energy Strategy detailed below, and it is recommended that windows provided for the proposed hotel rooms and apart-hotel units be closed but not sealed, and mechanical ventilation with heat recovery (MVHR) has been included for within the Energy Strategy. It is considered that the design specifications proposed within the Environmental Noise Impact Assessment would ensure that the internal noise level targets outlined in BS 8233:2014 are achieved and a good internal noise climate is provided for future occupants.

4.50 As part of the Environmental Noise Impact Assessment, plant noise emission limits have been set out to ensure the impacts of noise generated by the plant serving the proposed development are mitigated as far as possible. It is noted that, due to the variations in the background noise levels at the site, the noise limit emissions for new plant will depend on the location within which it is to be installed. It is typically recommended that the noise emissions from new plant be no greater than 10

decibels (dB) less than the representative background noise level to ensure a low likelihood of adverse impacts arising. As detailed above, the levels of noise experienced within the southern portion of the site are higher than those within the northern portion, therefore the maximum noise limits for new plant installations set out within the Environmental Noise Impact Assessment reflect this.

4.51 It is noted that, at this stage, the exact details of the proposed units and locations within which plant will be installed are not known. It is therefore recommended that a more detailed noise assessment be undertaken when more detailed information is available, with advice to be based on the specific plant to be employed, the location of its installation and to include for acoustic feature corrections. It is also noted that suitable attenuation measures, such as acoustic screens, should be specified where required to comply with the noise limits set out within the Assessment.

4.52 The Environmental Noise Impact Assessment concludes that adverse effects are unlikely to occur at the proposed development should appropriate mitigation measures be implemented, in line with the specified external building fabric performance recommended.

Land Contamination

4.53 As detailed within the Phase 1 Site Investigation & Preliminary Risk Assessment, prepared by Remada Ltd, the ground conditions at the site comprise superficial deposits of Langley Silt Member, overlying the London Clay Formation. It is noted that both the Langley Silt Member and London Clay Formation are classified as Unproductive Strata. The site is not located within a Source Protection Zone (SPZ), however the nearest groundwater abstraction point is located 156m to the south-east of the site, and the nearest surface water feature in an inland river located 335m to the east.

4.54 Based on the historical and current land use at the site, the Phase 1 Site Investigation & Preliminary Risk Assessment identifies a number of potential sources of contamination on-site, including: the historic ‘Coach & Horses’ public house and associated outbuildings; Made Ground associated with historic development; a historic access road bisecting the site; and the existing and operational Ariel Hotel and associated car parking. Within the area surrounding the site, potential off-site sources of contamination have also been identified, including: historic large-scale site clearance and development; a historic sports ground and greyhound racing stadium; a historic nursery, including greenhouses; a historic hostel with associated unspecified tanks; a historic sewage pumping station; existing electricity sub-stations; the London Heathrow Airport; existing tanks of unspecified contents; a contractors yard, a telephone exchange; and an existing depot. The Assessment has identified a number of potential contaminants of concern (PCOCs), that may impact on human health and controlled waters, including: metals; asbestos associated with the demolition and redevelopment of existing buildings on the site; total petroleum hydrocarbons (TPH); polycyclic aromatic hydrocarbons (PAH); ground gases, including carbon dioxide and methane; and polychlorinated Biphenyls (PCBs). The Preliminary Conceptual Site Model prepared as part of the Assessment notes that all identified

potential contaminants may result in a risk to human health and controlled waters, however it is noted that the residual risks associated with these contaminants is yet to be determined, following the specification of proposed remediation and mitigation measures.

4.55 It is therefore recommended that the following be undertaken:

- Investigation of the lateral and vertical extent of Made Ground and/or fill beneath the extent of the proposed hotel extension footprint;
- Collection of soil and groundwater samples from the areas identified above to determine the presence of contaminants of concern;
- Ground gas monitoring; and
- A ground investigation to inform the preliminary design of the foundations.

Water Pollution

4.56 The implementation of the proposed surface water management strategy, prepared by Cole Easden, will include appropriate pollution control measures to minimise the risk of pollution entering the ground from surface water runoff from the development. An appropriate SuDS treatment train, consisting of below-ground attenuation tanks, has been incorporated within the design to treat surface water before it is discharged to the public sewer network.

4.57 Additional measures will also be adopted during construction to minimise the risk of ground and surface water pollution, including::

- Oil separators;
- Clear marking and signage of drainage stems;
- Full bunding of on-site fuel or oil delivery areas;
- Bunding of areas to be used for cleaning activities; and
- Best practice measures, implemented as part of a Construction Environmental Management Plan (CEMP), to mitigate the impacts of construction-related dust and emissions.

5. ENERGY STRATEGY

5.1 With reference to the policy requirements, guidance and industry best practice detailed in Section 3, an energy and carbon dioxide (CO_2) emissions strategy has been defined for the proposed development. The proposed energy performance of the scheme has been analysed and evaluated to target a high level of CO_2 emissions performance when assessed against Part L:2021 of the Building Regulations and associated policies, accounting for economic, technical and functional feasibility.

5.2 The following section includes a breakdown of potential measures proposed at each level of the Energy Hierarchy (below), including a renewable energy generation options study. The specifications for the retained building elements are also detailed, in addition to the proposed fixed building services.

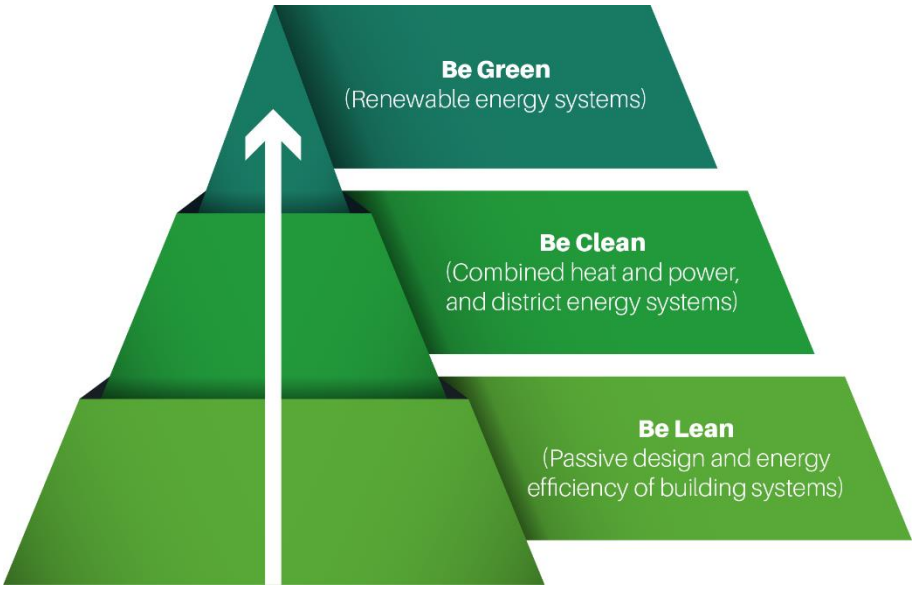
The Energy Hierarchy

5.3 The proposed energy strategy is based upon the principles of the Energy Hierarchy on the basis that it is preferable to reduce carbon dioxide emissions through reduced energy consumption above decarbonisation through alternative energy sources.

5.4 The tiers of the Energy Hierarchy are:

- Be Lean Use less energy
- Be Clean Supply energy efficiently
- Be Green Use renewable energy

Figure 5.1 The Energy Hierarchy



'Be Lean' (Use Less Energy)

5.5 Within the first stage of the energy hierarchy, it is proposed to incorporate high levels of passive and energy efficient design measures in order to reduce the development's energy consumption and associated CO_2 emissions, utilising a 'fabric first' approach to reduce energy demand.

5.6 Details of the passive design and energy efficiency measures proposed have been detailed below.

5.7 Passive design utilises daylight, solar energy, shading and stack or wind driven ventilation to illuminate, heat, shade where necessary and ventilate/cool the building, thus requiring less (mechanical) energy to achieve the performance standards for health and wellbeing of the residents.

5.8 Site characteristics relating to local climate, surroundings, scale and size of the development therefore passively influence the potential energy requirement and savings that can be achieved through the consideration of these aspects. The parameters that most influence the potential to utilise sunlight and solar gains are the orientation and layout of buildings, however these are typically driven by various factors other than energy efficiency or bioclimatic design considerations (e.g. aesthetics, function, etc.).

5.9 As shown in Figures 2.8 to 2.13 above, the massing and orientation of the proposed hotel rooms and apart-hotel units are constrained by the overall masterplan in terms of retaining the existing hotel building and making efficient use of the land within the northern portion of the site. The distance between the proposed buildings and the existing surrounding properties has been carefully considered, to ensure sufficient access to natural daylight and passive solar gains to the proposed

hotel rooms and apart-hotel units. Light and solar gain will also be influenced by the fenestration and the selection of glazing with a high degree of light transmittance.

5.10 U-values are a measure of the rate of heat transfer through a building element over a given area, under standardised conditions. They measure the rate at which heat is lost or gained through a fabric.

5.11 The following U-values are proposed as a means of limiting heat loss through the dwelling building fabric.

Table 5.1 Proposed building fabric U-values

Building Fabric Element	Part L:2021 backstop U-values (W/m^2K)	Proposed U-values (W/m^2K)
Exposed wall	0.26	0.10
Ground / exposed floor	0.18	0.10
Roof	0.18	0.10
Windows	1.60 (including frame)	1.20 (including frame)

5.12 The glazing will be double glazed, argon filled with a low emissivity coating. Although this has yet to be formally specified, it is expected that window U-values will be 1.20 W/m^2K or better (including frame), with a g-value of 0.63 and light transmission of ~70% to improve natural daylight penetration.

5.13 A high level of air tightness is proposed, where a level equal to or below 1 $m^3/h/m^2$ shall be targeted, meaning that air infiltration between the internal and the external environment will be largely controlled, and space heating/cooling demand further reduced.

5.14 High efficiency plant, equipment and controls are proposed to limit the energy consumed in order to provide the required level of indoor environmental performance and control. Performance efficiency values were tested and improved in energy models to benchmark the resulting predicted CO_2 reduction.

- Low energy LED lighting will be installed throughout the hotel rooms and apart-hotel units. Lighting with an efficacy of 115 lumens/W has been specified, with presence detection controls applied to reduce operational lighting energy consumption. It should be noted that this is subject to confirmation following further detailed design.

- In order to meet the requirements of the GLA's Energy Planning Guidance document under the 'Be Lean' scenario, space and water heating has been specified as gas-fired boilers with an efficiency of 93% for the proposed development.

- All proposed hotel rooms and apart-hotel units will be provided within mechanical ventilation with heat recovery (MVHR), with a specific fan power (SFP) of 0.7 W/l/s. This efficiency is improved over those specified in Part L of the Building Regulations.

- Cooling will be provided to the hotel rooms provided at the ground floor level of and within the proposed extension to the existing Ariel Hotel using the existing systems, and to the apart-hotel units via a variable refrigerant flow (VRF) system, with a cooling seasonal energy efficiency ratio of at least 6.0.

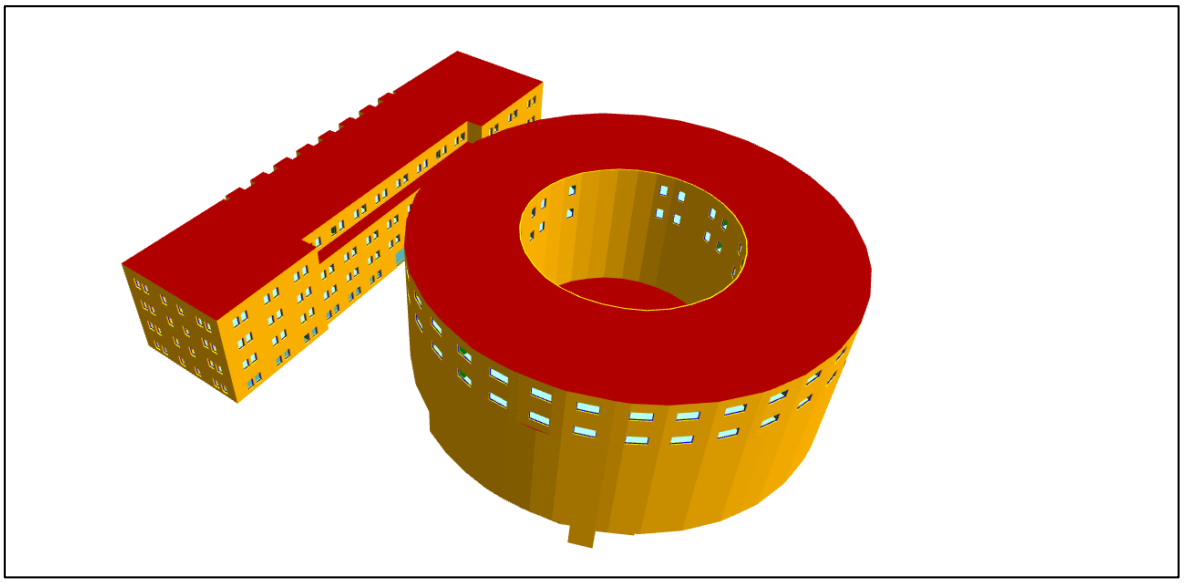
- Energy usage will be metered to ensure that charging for energy is linked to usage.

- The electricity power factor will be greater than 0.95 and light metering with warnings about out of range values will be utilised as part of the building management system

5.15 Energy modelling of the proposed scheme has been undertaken using EDSL Tas accredited software. The spaces assessed are highlighted in Figures 2.9 to 2.13 above.

5.16 Figure 5.2 below shows the proposed building geometry, as modelled within EDSL Tas.

Figure 5.2 3D model of building geometry



5.17 Based on the energy analysis of the proposed spaces, the total energy demand for the development is shown below.

Table 5.2 Annual energy demand

Energy Demand (kWh/year)					
Space heating	Hot Water	Lighting	Auxiliary	Cooling	Unregulated loads
33,180	1,669,997	17,572	54,202	10,357	722,699

5.18 The carbon dioxide emissions for the proposed development, under the 'Be Lean' tier of the Energy Hierarchy, are shown in Figure 5.3 below. BRUKL worksheets showing the 'Be Lean' performance of the proposed development are provided in Appendix A3.

Figure 5.3 Non-domestic carbon dioxide emissions (Be Lean)

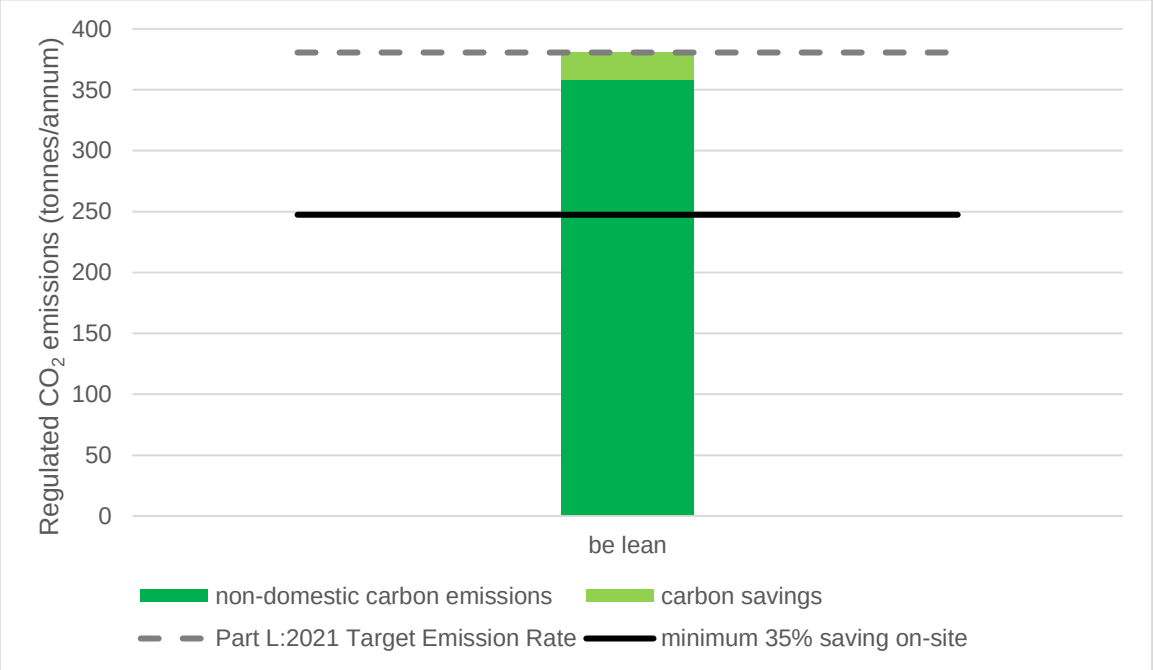


Table 5.3 Non-domestic carbon dioxide emissions (Be Lean)

TER: Baseline: Part L:2021 Emissions (tonnes CO_2 per annum)	BER: Proposed 'Be Lean' Emissions (tonnes CO_2 per annum)	Emissions Savings (tonnes CO_2 per annum)	Emissions Savings (%)
380.6	357.9	22.6	5.9%

5.19 The above analysis shows that the proposed development will achieve an approximate 6% saving through energy efficiency measures alone.

‘Be Clean’ (Supply Energy Efficiently)

5.20 The potential for the proposed development to incorporate a low carbon heating/cooling system has been reviewed for the scheme, in line with the hierarchy presented in the London Plan policy SI2, copied below:

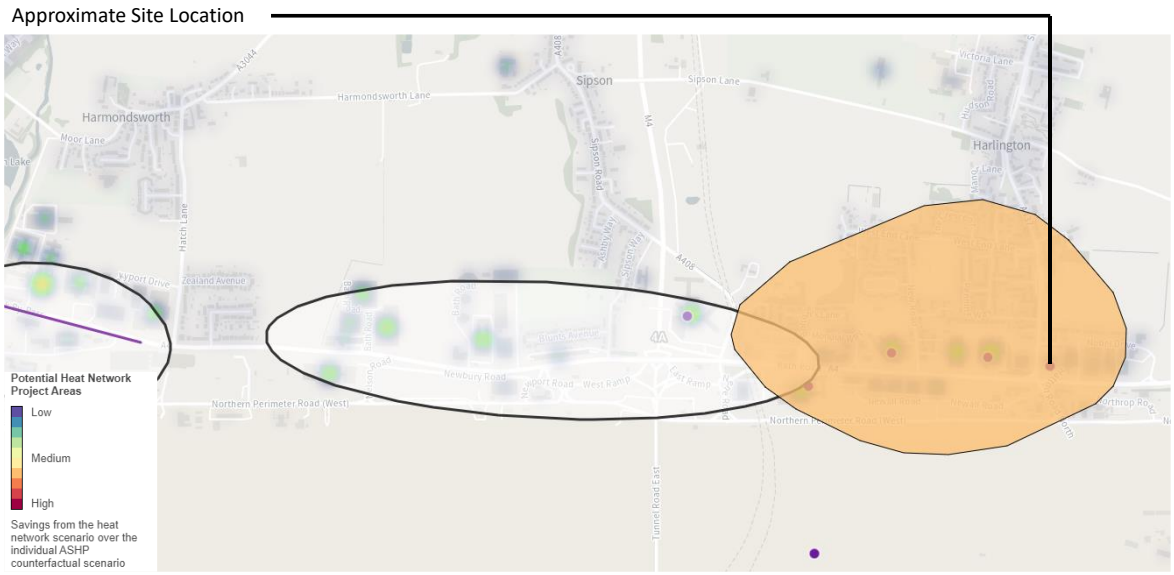
1. Connection to existing heating or cooling networks;
2. Site wide CHP network; and
3. Communal heating and cooling.

5.21 The London Heat Map is a tool provided by the Mayor of London to identify opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study.

5.22 The image below is an extract from the London Heat Map, showing the area in the vicinity of the site. It illustrates;

- Heat demand (areas of heat demand are shown in red, with areas with a high density of heat demand appearing more opaque, and areas of zero heat demand appearing transparent);
- Existing heat networks (shown as red lines);
- Proposed heat networks (shown as purple lines);
- Heatmap study areas (shown as transparent white circles);
- Potential Heat Network Project Areas (shown as semi-transparent orange areas); and
- Potential heat supply sites (shown as purple dots).

Figure 5.4 Extract from the London Heat Map



5.23 The extract above indicates that the proposed development site is located within an area of low heat density. There are no existing district heat networks located within the surrounding area, however there is proposed district heat network to the west of the site at Hillingdon Bath Road. It is also indicated that the proposed development site is located opposite a potential heat supply at the Excelsior Hotel site. Heat will be supplied to this site via a Combined Heat and Powe (CHP) system, likely including gas-fired boilers. It is unlikely to be suitable for a connection to the proposed development site due to the infrastructure costs associated with establishing a connection and the separation of the two sites by the M4 spur – Tunnel Road West. in addition, the proposed development site is shown to fall within a Heatmap Study Area, for which a study was undertaken by the London Borough of Hillingdon in January 2011. This study concluded that the properties located along Bath Road were a low priority with respect to the provision of district heating, in particular due to the fact that all the identified properties are within the private sectors, the difficulty of crossing the M25 and Bath Road, and the high capital costs associated with delivering a district heat network in this location.

5.24 Whilst the connection of the proposed development to a district heat or energy network is not considered feasible at this time, it is noted that, where viable and appropriate, the proposals will be future-proofed to enable a connection to a district heat or energy network, should one come forward. This will be explored further during the detailed design stage.

5.25 The use of CHP is considered to be unviable for the proposed development site. CHP technology is appropriate for building uses with large hot water demands due to the requirements for CHP to be kept running to meet a base load. As heating is not required during summer months, base loads are driven by hot water demand. Due to the planned use of the proposed development for flexible

industrial and office uses, hot water demand for the development is low and as such CHP does not represent a feasible technology for the proposed development.

5.26 It is instead proposed that the existing space heating and cooling systems, and the existing hot water system within the Ariel Hotel building be employed to serve the proposed new spaces at the lower-ground and ground floor levels, in addition to the new hotel rooms to be delivered within the fourth and fifth-floor level extension. For the proposed apart-hotel building, it is proposed that space heating and cooling demand, as well as hot water demand, be served by an air source heat pump (ASHP) system. It is noted that, through the use of all-electric systems, the carbon emissions associated with this portion of the development will decrease in line with the decarbonisation of the electricity grid. The use of the proposed all-electric systems for the apart-hotel building has been included for within the "Be Green" modelling of the proposed development, the results for which are presented in the next section.

'Be Green' (Utilise Renewable Technologies)

5.27 The proposed development has given consideration to renewable energy technologies that may be applicable to deliver the required level of carbon dioxide savings over the Part L:2021 baseline, and the likely local effects on the environment.

5.28 A full review of potentially applicable renewable technologies has been carried out, considering both the effectiveness and viability of the different technologies. Full details of the assessment and outcomes are provided in Appendix A4.

5.29 Given the site location, lack of local existing or proposed heat networks, it is proposed that air source heat pump (ASHP) technology is employed to serve the heating and cooling demands of both the apart-hotel building and the proposed extension to the existing hotel.

5.30 It is intended that a highly efficient ASHP system be employed to serve the space heating and cooling, and the hot water demand, of the proposed development. At this stage, it is expected that a system with a heating coefficient of performance of at least 4.00, and a seasonal coefficient of performance of at least 6.0 will be specified. Whilst the specified systems operate quietly, as the design progresses, acoustic measures to further limit the noise generated by the outside unit of the systems during operation will be considered.

5.31 Rooftop photovoltaic (PV) technology is also proposed to generate renewable electricity onsite. The location of the proposed arrays is highlighted on the roof plans displayed below, based on the drawings produced by Ackroyd Lowrie. It should be noted that these plans are indicative at this stage, and demonstrate the proposed location of the PV arrays. These areas have been selected to be free from overshading from neighbouring buildings, and rooftop lift overruns.

Figure 5.5 Proposed PV panel locations – Ariel Hotel

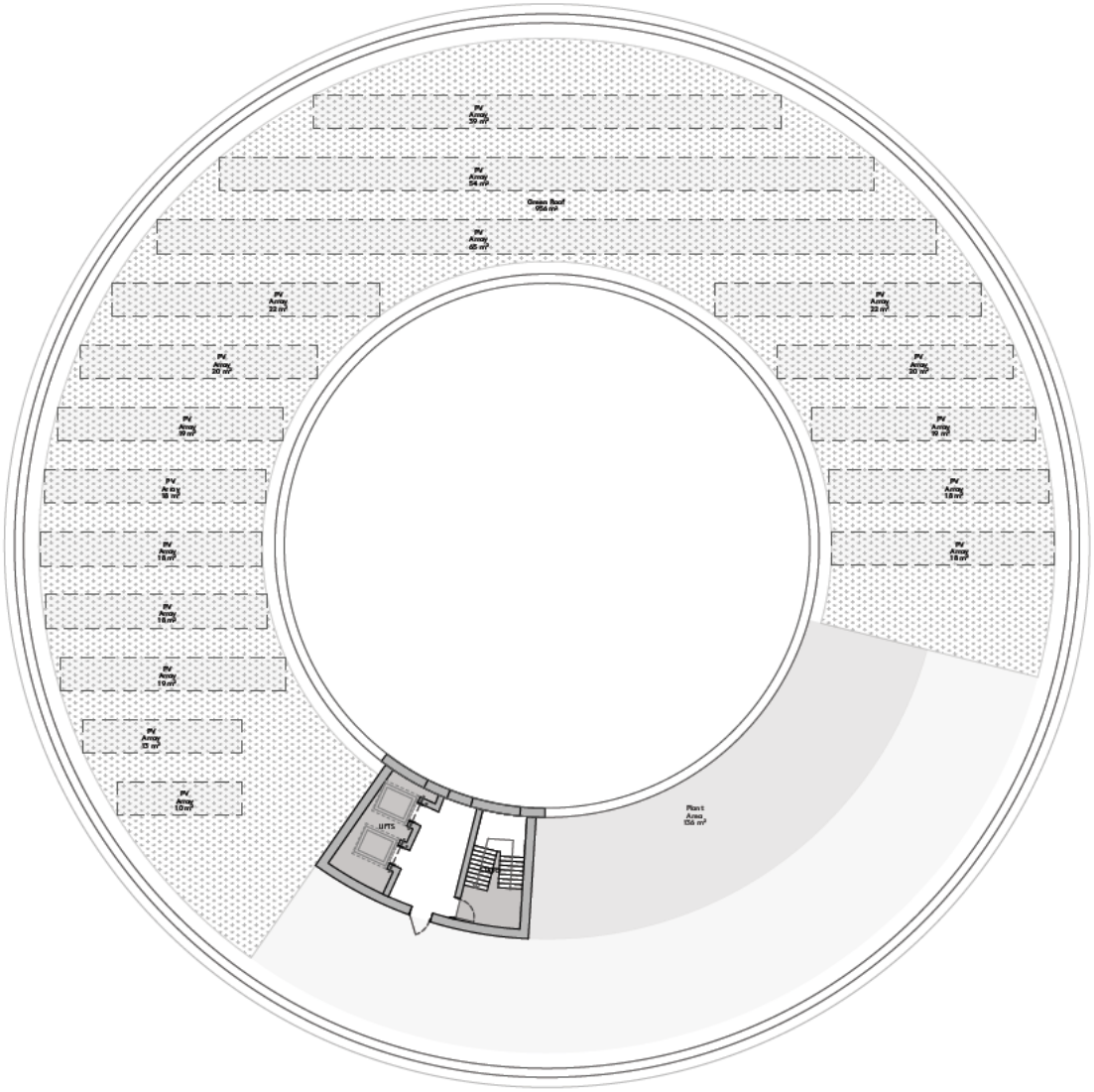
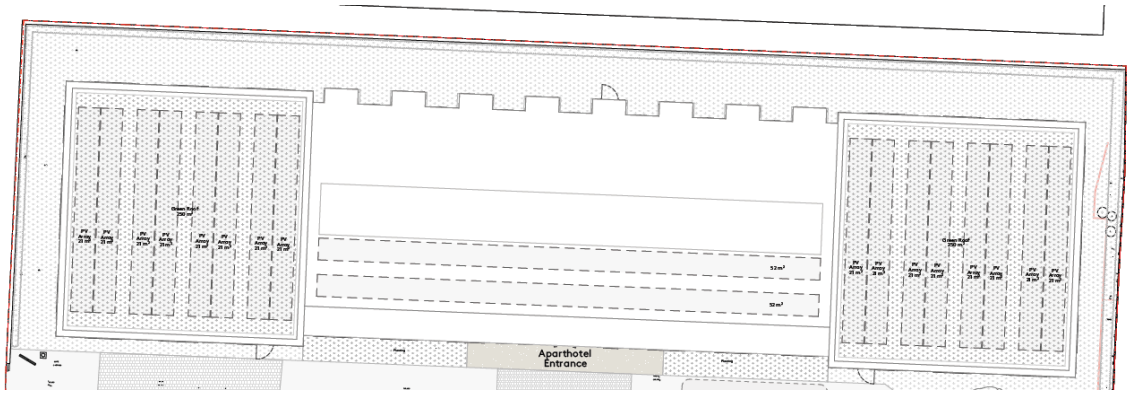


Figure 5.6 Proposed PV panel locations – Apart-hotel



5.32 The roof area selected, which has been maximised based on the available roof space when taking the requirements for plant space into account, is proposed to house 394 sqm of PV panels on the

roof of the Ariel Hotel, and 440sqm of PV panels on the apart-hotel roof. The PV coverage extends to all reasonably available roof space that is unshaded and not used by building plant. Standard PV panels have been assumed, with an output of 250W per sqm of panel, and an efficiency of ~20%. Panels will be oriented between 15° and 30° to the horizontal and will face due south to maximise output per panel.

5.33 It is estimated that the 834sqm of PV panels will produce approximately 185,890 kWh of renewable electricity per year, equating to a carbon dioxide saving of 25.3 tones of CO_2 per year using the SAP 10 electricity emissions factor of 0.136 kgCO_2/kWh.

5.34 The carbon dioxide emissions for the proposed development, under the 'Be Green' tier of the Energy Hierarchy, are shown below. BRUKL worksheets showing the 'Be Green' performance of the proposed development are provided in Appendix A3.

Figure 5.7 Non-domestic carbon dioxide emissions (Be Green)

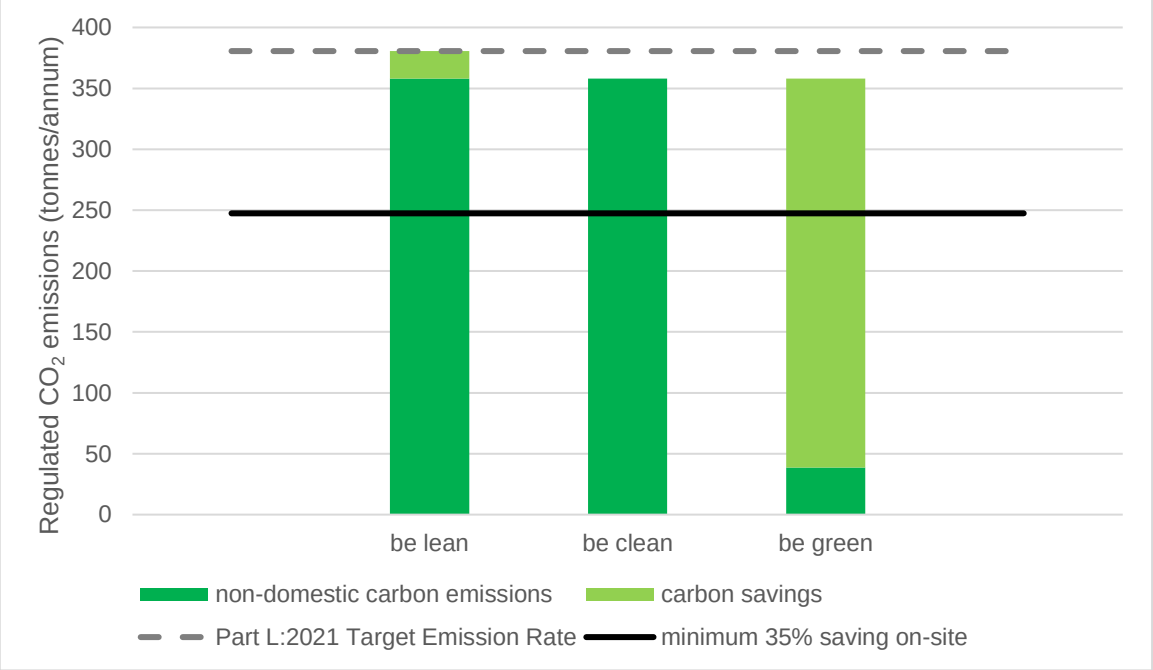


Table 5.4 Non-domestic carbon dioxide emissions (Be Green)

TER: Baseline: Part L:2021 Emissions (tonnes CO_2 per annum)	BER: Proposed 'Be Green' Emissions (tonnes CO_2 per annum)	Emissions Savings (tonnes CO_2 per annum)	Emissions Savings (%)
380.6	38.7	341.9	89.8%

5.35 The above analysis shows that the proposed development achieves a carbon dioxide emissions saving of approximately 90% through energy efficiency measures and renewable technologies, under the 'Be Green' scenario.

5.36 The site-wide carbon dioxide emissions and savings are provided in the tables below.

Table 5.5 Site-wide carbon dioxide emissions after each stage of the Energy Hierarchy

	Site-wide carbon dioxide emissions (Tonnes CO_2 per annum)
Baseline: Part L 2021 of the Building Regulations Compliant Development	380.6
After energy demand reduction	357.9
After renewable energy	38.7

Table 5.6 Site-wide carbon dioxide savings from each stage of the Energy Hierarchy

	Regulated carbon dioxide savings	
	Tonnes CO_2 per annum	**%**
Savings from energy demand reduction	22.6	5.9%
Savings from renewable energy	319.3	83.6%
Cumulative on-site savings	341.9	89.8%

'Be Seen' (Monitor and Record Energy Usage)

5.37 Under the 'Be Seen' tier of the Energy Hierarchy, it is required that energy usage within the proposed development be monitored and reported in operation.

5.38 Effective energy metering will be employed, in line with the 'Be Seen' requirements, and this will be enabled by the provision of suitable infrastructure within the buildings' services systems.

5.39 Where required, electrical meters will be provided on the proposed air source heat pump (ASHP) systems serving the apart-hotel and Ariel Hotel buildings, to provide data on plant energy consumption throughout the year. Where necessary, areas of high energy load will be sub-metered to monitor energy consumption in greater granularity and to facilitate reporting. It is intended that the

main sub-systems, such as lighting and small power, will be monitored separately and their usage accounted for separately. This will enable energy intensity and carbon emissions to be monitored and annually reported. Where required, the applicant will complete the GLA's suggested 'Be Seen' energy reporting protocols via the appropriate web portals.

6. SUMMARY

6.1 This Sustainability, Energy & Overheating Statement provides an overview as to how the proposed redevelopment at Ariel Hotel, Hayes, UB3 5AH contributes to sustainable development in the context of the strategic, design and construction considerations.

6.2 Consideration has been given to the London Borough of Hillingdon Local Plan Part 1: Strategic Policies and Part 2: Development Plan Policies in the formulation of this strategy. The overall development has been assessed using the guidance outlined in strategic objectives 8, 10, 11 and 13, and policies EM1 (Climate Change Adaptation and Mitigation) and DMEI2 (Reducing Carbon Emissions) of the Local Plan, providing a holistic sustainability approach for the proposals.

6.3 By designing to rigorous energy standards and employing electric-only systems within the proposed scheme, the application will respond directly to the Climate Emergency declared by the Council in January 2020. These measures combine to provide an approximate carbon dioxide emissions saving of 90% compared to the Part L:2021 baseline, aiming to comply the requirements of London Borough of Hillingdon and the Greater London Authority (GLA).

6.4 Sections 4 and 5 of this report demonstrate that the siting and design of the proposals support relevant policy relating to sustainable development. This shows that the proposed development will:

- make efficient use of land, retaining and extending and existing building, and developing brownfield land;
- promote the use of sustainable modes of transport;
- minimise internal water consumption through the incorporation of water-efficient fittings and services;
- incorporate low-impact materials, according to the BRE Green Guide to Specification;
- minimise waste production during construction and maximise the proportion of waste to be diverted from landfill;
- incorporate measures to improve site biodiversity, including biodiverse planting;
- provide access to areas of green space in the form of a central podium landscaped courtyard;
- not increase the risk of surface water flooding onsite;
- ensure air, noise, land and water pollution are minimised as far as possible;

- minimise energy demand through the specification of low U-values, low air permeability and energy efficient systems and appliances; and

- utilise electric-only systems, such as air source heat pumps (ASHPs), to serve the space heating and cooling demands and water heating demands of both the proposed apart-hotel and the proposed extension to the existing Ariel Hotel.

6.5 By designing to rigorous energy standards, and omitting the use of fossil fuels for heating and cooling within the scheme, the proposed development will achieve an approximate minimum 90% reduction in CO_2 emissions, following the Energy Hierarchy methodology.

Figure 6.1 Carbon dioxide emissions after each stage of the Energy Hierarchy

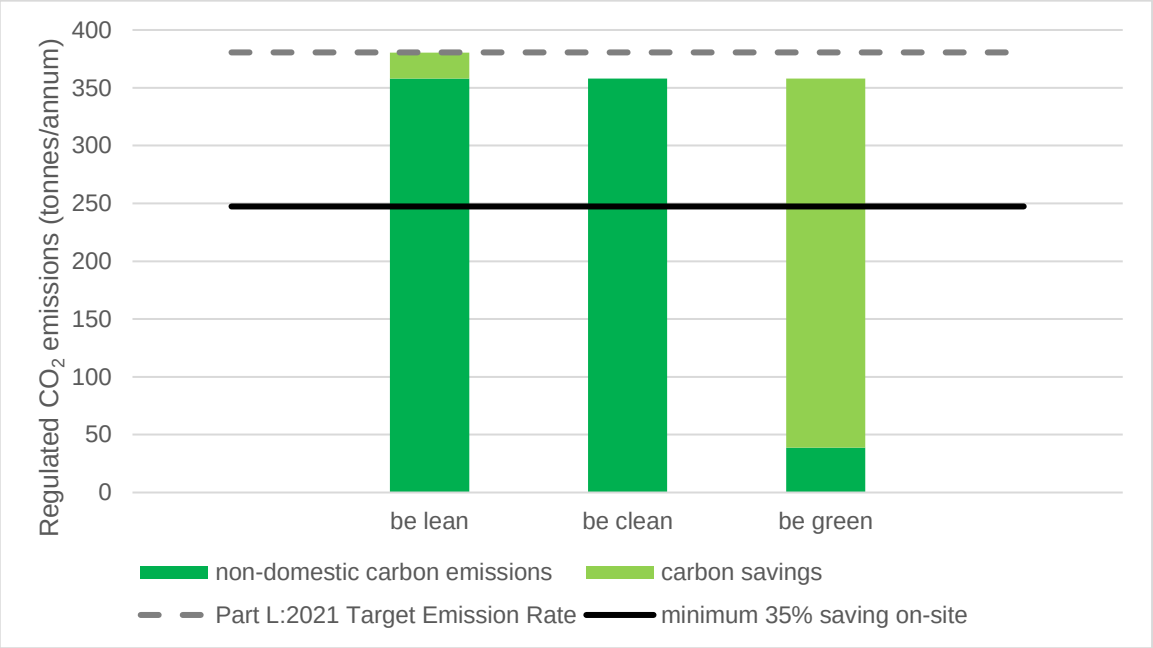


Table 6.1 Carbon dioxide emissions after each stage of the Energy Hierarchy

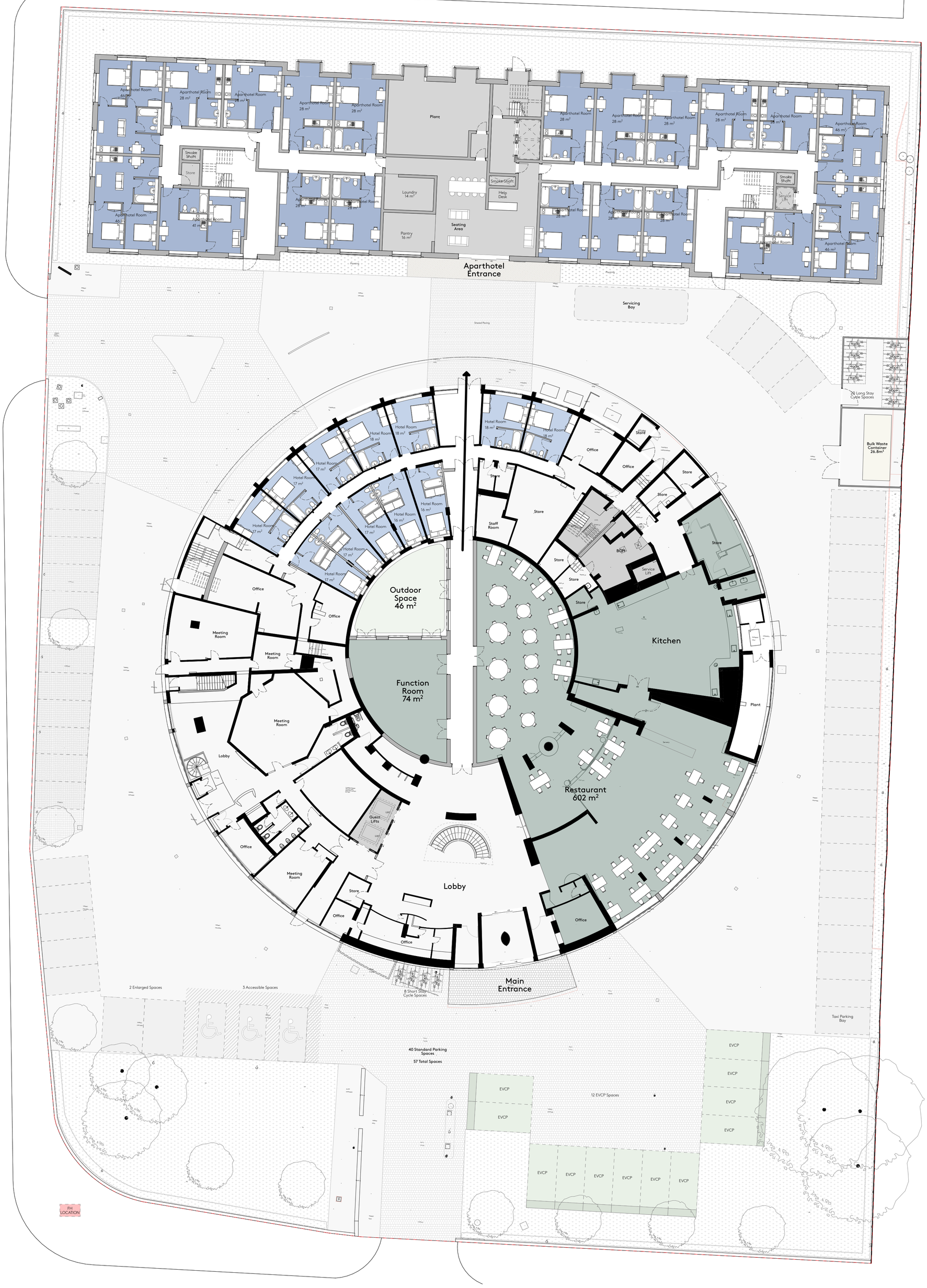
	Site-wide carbon dioxide emissions (Tonnes CO_2 per annum)
Baseline: Part L 2021 of the Building Regulations Compliant Development	380.6
After energy demand reduction	357.9
After renewable energy	38.7

Table 6.2 Regulated carbon dioxide savings from each stage of the Energy Hierarchy

	Regulated carbon dioxide savings	
	Tonnes CO_2 per annum	**%**
Savings from energy demand reduction	22.6	5.9%
Savings from renewable energy	319.3	83.6%
Cumulative on-site savings	341.9	89.8%

6.6 Overall, the proposals for the scheme are in line with the principles of sustainable development as well as the policy requirements of the NPPF, the London Plan and the London Borough of Hillingdon, and will provide a development that promotes these principles in operation.

A1. SITE PLAN



Proposed Site Plan 1:200

Ackroyd Lowrie

23 Vyner Street, London E2 9DG
Ph: 0203 770 9780
www.ackroydlowrie.com

NOTE

DO NOT SCALE FROM THIS DRAWING.

DO NOT USE ANY AREAS INDICATED FOR EITHER VALUATION, PURCHASE SALE OR ANY OTHER FORM OF LEGALLY BINDING CONTRACT.

KEY

Site boundary

0 5 10m
1:200

N

LOCATION

ISSUE

Rev.	Date	Change No.	Change Name
P1	31/08/2023		

PROJECT

NAME
1041 - Ariel Hotel

CLIENT
R Heathrow Ariel Opco Limited

DRAWING NO.
1041-099

DRAWING
Proposed Site Plan

REVISION
P1

Drawn	Checked	Scale	Current Stage	Date
JM	AB	1:200@A1	Planning	31/08/2023

A2. NON-DOMESTIC OVERHEATING ASSESSMENT

A2.1 Policy SI4 of the London Plan 'Overheating and Cooling' seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

A2.2 In order to reduce overheating and reliance on air conditioning, the design of the proposed scheme at Ariel Hotel has followed the Cooling Hierarchy detailed in Policy SI4:

1. Minimise internal heat generation through energy efficient design;
2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and walls;
3. Manage the heat within the building through exposed internal thermal mass and high ceilings;
4. Passive ventilation;
5. Mechanical ventilation;
6. Active cooling systems.

Cooling Hierarchy

A2.3 The methods used to minimise overheating and excessive heat generation in line with the cooling hierarchy are outlined below.

Minimisation of internal heat generation through energy efficient design

- Heat gain from lighting is kept to a minimum as a result of an energy-efficient lighting design solution.
- The availability of natural light is maximised by optimising the light transmittance of the glass elements of the façade.
- The proposed apart-hotel will employ a communal air source heat pump (ASHP) system for heating and hot water. This is a low temperature distribution system, leading to lower internal heat gains from distribution pipework.

Reduction of the amount of heat entering the building in the summer

- The building's facades will have a limited amount of glazing to mitigate direct solar heat gain while optimising daylight penetration, and windows will be recessed to further mitigate direct solar heat gain.

Management of the heat within the building through exposed thermal mass and high ceilings

- Due to the dense nature of the proposed development, there is little external exposed thermal mass within the building structures, minimising thermal transmission.

Passive ventilation

- Due to the location of the proposed development within close proximity to London Heathrow Airport and road traffic noise sources, windows will not be openable. This will limit the opportunity to facilitate passive and crossflow ventilation.

Mechanical and active cooling

- It is expected that the existing hotel is served by an air condition (AC) system that will be extended to serve the proposed additional hotel rooms. Due to the limited opportunity to provide openable windows for the proposed apart-hotel, it is expected that the air source heat pumps (ASHPs) employed to deliver space and water heating will be reversible, to therefore also provide space cooling where required.

Overheating Criteria

A2.4 TM52 'The limits of thermal comfort: avoiding overheating in European buildings' is a design methodology for the assessment of overheating risk in buildings, published by the Chartered Institution of Building Services Engineers (CIBSE), in 2013.

A2.5 This is a standardised approach to predicting overheating risk for building designs using dynamic thermal analysis. It provides a baseline which includes specific weather files, defined internal gains and a set of profiles that represent reasonable usage patterns for a building suitable for evaluating overheating risk.

A2.6 Non-residential buildings should be assessed against the following three criteria as set out in TM52 based on the adaptive thermal comfort model. Those rooms that fail any two of the three criteria are classed as overheating:

- **Criterion 1: Hours of exceedance (H_e).** The number of hours (H_e) during which ΔT, the difference between the actual operative temperature in the room at any time (Top) and T_{max} the limiting maximum acceptable temperature, is greater than or equal to one degree (K) during he period May to September inclusive shall not be more than 3% of occupied hours.

- **Criterion 2: Daily weighted exceedance (W_e).** to allow for the severity of overheating, the weighted exceedance (W_e) shall be less than or equal to 6 in any one day where:

  $$W_e = (\Sigma h_e) \times WF = (h_e0 \times 0) + (h_e1 \times 1) + (h_e2 \times 2) + (h_e3 \times 3),$$

  where the weighting factor WF = 0 if $\Delta T \leq 0$, otherwise WF = ΔT, and h_{ey} is the time (h) when WF = y.

- **Criterion 3: Upper limit temperature (T_{upp}).** To set an absolute maximum value for the indoor operative temperature the value of ΔT shall not exceed 4 K.

A2.7 Criterion 1 provides an understanding of how often a building is likely to exceed its comfort range during the summer months, which is a good first assessment of acceptability. The second criterion sets an acceptable level for the severity of overheating during a day. The value of 6 is an initial assessment of what constitutes an acceptable limit of overheating on any single day. Finally, Criterion 3 sets a limit beyond which normal adaptive actions will be insufficient to restore personal comfort and the vast majority of occupants will complain of being 'too hot'.

A2.8 The CIBSE Guide A 'Environmental Design' (2015) gives general guidance and recommendations for air-conditioned buildings on suitable winter and summer temperatures for a range of room and building types. The table below summarises the comfort criteria in terms of dry resultant temperature for bedroom and occupied front of house (FOH) spaces, as these are the spaces for which comfort cooling is proposed.

Table A2.1 CIBSE Guide A Thermal Comfort Criteria

	Winter (Oct – Apr)	**Summer (May – Apr)**
Hotel Bathrooms		
Dry Resultant Temperature	20 – 22	23 – 25
Activity	1.2	1.2
Clothing	0.25	0.25
Hotel Bedrooms		
Dry Resultant Temperature	19 – 21	21 – 23
Activity	1.0	1.0
Clothing	1.0	1.2
Bars / Lounges		
Dry Resultant Temperature	20 – 22	22 – 24
Activity	1.3	1.3
Clothing	1.0	0.65
Corridors		
Dry Resultant Temperature	19 – 21	21 – 23

	Winter (Oct – Apr)	Summer (May – Apr)
Activity	1.4	1.4
Clothing	1.0	0.65
Entrance Halls / Lobbies		
Dry Resultant Temperature	19 – 21	21 – 23
Activity	1.4	1.4
Clothing	1.0	0.65

Methodology

A2.9 The TM52 methodology provides a baseline and guidance for non-domestic overheating risk assessment. In line with this methodology, this section includes model inputs used to assess overheating risks to the buildings to be delivered as part of the redevelopment of the Ariel Hotel.

A2.10 The images shown in Figures 2.8 to 2.13 above show the floorplans of the buildings.

A2.11 The model was created in EDSL TAS to simulate the internal conditions in the bedroom and occupied FOH spaces and the geometry has been modelled based on planning submission issue drawings from Ackroyd Lowrie.

A2.12 The weather files used for the simulation have been based on the guidance contained within CIBSE TM49:2014 (Design Summer Years for London) as follows:

- Design summer year weather file for London Heathrow, based on a peri-urban location for 1989 (DSY1), has been used on the simulations as required by TM49 methodology. The CIBSE DSY1 represents a moderately warm summer under 2020s high emissions scenario, 50th percentile.
- Design summer year weather file for London Heathrow, based on a peri-urban location for 1976 (DSY2), has been used on the simulations as required by TM49 methodology. The CIBSE DSY2 represents summer with a long period of persistent warmth under 2020s high emissions scenario, 50th percentile.
- Design summer year weather file for London Heathrow, based on a peri-urban location for 2003 (DSY3), has been used on the simulations as required by TM49 methodology. The CIBSE DSY3 represents a summer with a single intense warm spell under 2020s high emissions scenario, 50th percentile.

A2.13 The building fabric parameters have been based on the same level of performance as that details in the energy strategy. A summary of the thermal envelope values used in the assessment is shown in Tables 5.2 and 5.3.

A2.14 In line with the TM52 methodology, and based on the National Calculation Methodology (NCM) profiles for hotel areas, the following internal gains and time periods have been employed for this analysis.

Table A2.2 Internal gains

	Hotel Reception	Banquet / Conference	Restaurant / Dining	Bars / Lounges
Occupancy rate	0.1 people/sqm 20 W/person (Sensible) 15 W/person (Latent)	1.2 people/sqm 67 W/person (Sensible) 50 W/person (Latent)	3 people/sqm 27 W/person (Sensible) 20 W/person (Latent)	3 people/sqm 27 W/person (Sensible) 20 W/person (Latent)
Lighting	15 W/sqm as per CIBSE Guide A	15 W/sqm as per CIBSE Guide A	15 W/sqm as per CIBSE Guide A	15 W/sqm as per CIBSE Guide A
Small power	5 W/sqm as per CIBSE Guide A	3 W/sqm as per CIBSE Guide A	5 W/sqm as per CIBSE Guide A	5 W/sqm as per CIBSE Guide A

A2.15 Due to the location of the proposed development in close proximity to road and air traffic noise sources, it has been assumed that the proposed spaces will not be provided with openable windows.

A2.16 An infiltration rate of 0.10 air changes per hours has been used for the tested spaces, and has been derived from CIBSE Guide A (2015) for hotels with an air permeability of 3 m^3/hr per m^2 @ 50Pa for five storey buildings.

A2.17 Background mechanical ventilation will be provided by MVHR units, as required by Part F of the Building Regulations. The ventilation rate included in the model is 1.5 air changes per hour for the tested spaces.

A2.18 Cooling will be provided using a variable refrigerant volume (VRV) / variable refrigerant flow (VRF) system, utilising ducted Fan Coil Units (FCUs). It has been assumed that a similar system is present within the existing Ariel Hotel building, and this will be employed to serve the new hotel rooms to be delivered as part of the ground floor reconfiguration and the upward extension. Further details of the proposed and existing systems will be provided during the detailed design stage.

Results

A2.19 The following table provides a summary of the results obtained when not including for the proposed cooling systems. The full results are provided in Appendix A2.1.

Table A2.3 Summary of results when not accounting for proposed cooling systems

Weather Scenario	Number of Spaces Assessed	Number of Spaces Failing			Overall Compliance
		Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	
DSY1	246	246	238	243	Fail
DSY2	246	246	238	245	Fail
DSY3	246	246	238	245	Fail

A2.20 The above demonstrates that, when relying on mechanical ventilation alone, due to the fact that non-openable windows will be provided, the spaces for which cooling is proposed would be at risk of overheating. This is due to the fact that mechanical ventilation with heat recovery does not have enough cooling capacity to remove excessive heat gains and provide thermal comfort.

A2.21 As detailed above, it is intended that comfort cooling be provided via a VRV / VRF system, using ducted FCUs. Further details of the systems to be specified will be provided during the detailed design stage, however it is noted that staff can control comfort within the hotel spaces by switching on the proposed cooling system when the internal air temperature exceeds 22°C. mechanical ventilation, which is intended to be employed within all occupied spaces, will also provide an additional level of cooling to further remove excessive heat gains.

A2.22 The following table provides a summary of the results obtained when including for the proposed cooling systems. The full results are provided in Appendix A2.2.

Table A2.4 Summary of results when accounting for proposed cooling systems

Weather Scenario	Number of Spaces Assessed	Number of Spaces Failing			Overall Compliance
		Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	
DSY1	246	0	11	0	Pass
DSY2	246	1	20	0	Fail
DSY3	246	0	4	0	Pass

A2.23 The results show that the internal dry resultant temperatures within the tested spaces fall within the recommended CIBSE Guide A summer comfort range when including for the proposed cooling system under the DSY1 and DSY3 weather files. All the tested spaces are demonstrated to comply with all TM52 criteria under these climate scenarios and, as all the spaces pass under the DSY1 weather scenario, with the requirements of the GLA.

A2.24 The only space projected to fail under the DSY2 weather file is the proposed restaurant space, which is projected to overheat according to Criteria 1 and 2. It is noted, however, that the GLA guidance acknowledges that this can be expected given the more extreme temperatures required to be assessed in the DSY2 weather file.

A2.25 The above strategy allows staff and guests to manually control comfort levels within specific hotel spaces, by making use of the comfort cooling system to be provided. Therefore, the proposed comfort cooling system is expected to be switched on only during limited periods, when internal air temperatures are high, and the mechanical ventilation system cannot provide adequate cooling. The proposed systems will be of high efficiency to ensure that energy consumption for cooling is low, and will be adequately sized to provide enough capacity by taking into consideration the climate change impact on ambient temperature over its lifespan. As a result, the buildings comply with the overheating criteria, i.e. the risk of overheating has been eliminated while reducing energy consumption in comparison to a fully air-conditioned building.

Conclusion

A2.26 This study has shown how the proposed development at Ariel Hotel has been designed to minimise the risk of overheating. The strategy has followed the cooling hierarchy in Policy SI4 of the London Plan.

A2.27 TM52:2013 has been adopted for this overheating study as it is the recommended methodology for the assessment of overheating risk in non-residential buildings.

A2.28 The methodology aims to produce a test that encourages good design that is comfortable within sensible limits, without being so stringent that it over-promotes the use of mechanical cooling.

A2.29 A dynamic thermal model was created in EDSL TAS to simulate the internal conditions in the occupied spaces for which the use of active cooling is intended within the proposed development.

A2.30 The modelling incorporated inputs provided within the TM52 methodology guidance and information provided by Ackroyd Lowrie.

A2.31 The proposed development has been designed to minimise the risk of overheating, in accordance with the London Plan Policy SI4 ‘cooling hierarchy’. Passive cooling design measures have, however, been constrained by the location of the proposed development within proximity to elevated levels of road and air traffic. To ensure the comfort and wellbeing of future occupants and guests is safeguarded, the application has not implemented openable windows. Nevertheless, the building fabric and building services designs have maximised all available measure to minimise heat generation within the tested spaces, to reduce the amount of heat entering the building, and to mechanically ventilate these spaces in line with the cooling hierarchy in Policy SI4 of the London Plan.

A2.32 The results were then compared to the CIBSE TM52 overheating criteria for the three weather files specified in CIBSE TM49, as required by the GLA.

A2.33 When discounting the proposed cooling systems, the tested spaces are demonstrated to fail the TM52 overheating criteria for all three tested weather files.

A2.34 However, when including for the proposed cooling system, the tested spaces are shown to pass the TM52 criteria for the DSY1 and DSY3 weather files, therefore meeting the requirements of the GLA. It is noted that one tested space is projected to fail the TM52 criteria for the DSY2 weather file, however the GLA guidance acknowledges that this can be expected given the more extreme temperatures required to be assessed in the DSY2 weather file.

A2.35 In this way, despite the adoption of an approach employing the cooling hierarchy, overheating of the buildings is a realistic prospect when not including for active cooling, and there is therefore a clear need for air conditioning in this instance.

A2.36 Overall, the proposals for the scheme are in line with the policy requirements of the planning authority for mitigating the risk of overheating and will provide a development that seeks to promote these principles in operation.

A2.1 FULL OVERHEATING REUSLTS WITH NO COOLING

Table A2.1.1 Results when not accounting for proposed cooling – DSY1

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Circulation 1	78	2585	48.0	2230	Fail
Circulation 2	78	2595	46.0	2335	Fail
Circulation 3	78	2588	50.0	2265	Fail
Circulation 4	78	2601	0.0	2601	Fail
Circulation 5	78	2601	0.0	2601	Fail
Circulation 6	78	2601	0.0	2601	Fail
Circulation 7	78	2006	49.0	424	Fail
Circulation 8	78	2584	48.0	2233	Fail
Circulation 9	78	2588	43.0	2235	Fail
Circulation 10	78	2592	47.0	2339	Fail
Circulation 11	78	2592	45.0	2225	Fail
Circulation 12	78	2600	41.0	2465	Fail
Circulation 13	78	2598	44.0	2416	Fail
Circulation 14	78	2596	45.0	2415	Fail
Circulation 15	78	2596	50.0	2369	Fail
Circulation 16	78	2587	43.0	2207	Fail
Circulation 17	78	2588	47.0	2315	Fail
Circulation 18	78	2587	49.0	2096	Fail
Circulation 19	78	2591	46.0	2226	Fail
Circulation 20	78	2591	47.0	2291	Fail
Circulation 21	78	2596	47.0	2308	Fail
Circulation 22	78	2593	47.0	2346	Fail
Circulation 23	78	2550	50.0	1738	Fail
Circulation 24	78	2567	50.0	1953	Fail
Circulation 25	78	2532	51.0	1626	Fail
Circulation 26	78	2550	50.0	1703	Fail
Circulation 27	78	2545	51.0	1683	Fail
Circulation 28	78	2519	50.0	1610	Fail
Circulation 29	78	2567	50.0	1947	Fail
Circulation 30	78	2307	45.0	1411	Fail
Circulation 31	78	2302	50.0	985	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Restaurant 1	73	2448	0.0	2448	Fail
Hotel Room 1	55	787	30.0	75	Fail
Hotel Room 2	55	759	29.0	61	Fail
Hotel Room 3	55	736	27.0	46	Fail
Hotel Room 4	55	719	29.0	33	Fail
Hotel Room 5	55	739	27.0	35	Fail
Hotel Room 6	55	740	31.0	29	Fail
Hotel Room 7	55	716	32.0	20	Fail
Hotel Room 8	55	502	25.0	0	Fail
Hotel Room 9	55	534	27.0	0	Fail
Hotel Room 10	55	568	27.0	0	Fail
Hotel Room 11	55	639	29.0	2	Fail
Hotel Room 12	55	766	30.0	12	Fail
Hotel Room 13	55	956	24.0	288	Fail
Hotel Room 14	55	1104	24.0	474	Fail
Hotel Room 15	55	1159	25.0	517	Fail
Hotel Room 16	55	1168	26.0	517	Fail
Hotel Room 17	55	1148	26.0	495	Fail
Hotel Room 18	55	1146	30.0	479	Fail
Hotel Room 19	55	1134	29.0	476	Fail
Hotel Room 20	55	1150	30.0	487	Fail
Hotel Room 21	55	1173	30.0	524	Fail
Hotel Room 22	55	1193	30.0	554	Fail
Hotel Room 23	55	1229	28.0	593	Fail
Hotel Room 24	55	1259	27.0	640	Fail
Hotel Room 25	55	1291	28.0	676	Fail
Hotel Room 26	55	1304	26.0	711	Fail
Hotel Room 27	55	1316	25.0	736	Fail
Hotel Room 28	55	1328	25.0	750	Fail
Hotel Room 29	55	1335	26.0	757	Fail
Hotel Room 30	55	1347	26.0	755	Fail
Hotel Room 31	55	1337	26.0	741	Fail
Hotel Room 32	55	1325	25.0	711	Fail
Hotel Room 33	55	1318	25.0	685	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 34	55	1304	25.0	661	Fail
Hotel Room 35	55	1284	25.0	632	Fail
Hotel Room 36	55	1277	23.0	630	Fail
Hotel Room 37	55	1276	23.0	641	Fail
Hotel Room 38	55	1279	23.0	654	Fail
Hotel Room 39	55	1281	23.0	675	Fail
Hotel Room 40	55	1292	23.0	690	Fail
Hotel Room 41	55	1295	23.0	696	Fail
Hotel Room 42	55	1288	23.0	695	Fail
Hotel Room 43	55	1271	23.0	678	Fail
Hotel Room 44	55	1198	23.0	602	Fail
Hotel Room 45	55	1038	24.0	401	Fail
Hotel Room 46	55	1140	29.0	321	Fail
Hotel Room 47	55	1262	30.0	531	Fail
Hotel Room 48	55	1313	28.0	616	Fail
Hotel Room 49	55	1329	26.0	646	Fail
Hotel Room 50	55	1336	27.0	649	Fail
Hotel Room 51	55	1333	27.0	640	Fail
Hotel Room 52	55	1317	26.0	608	Fail
Hotel Room 53	55	1303	26.0	598	Fail
Hotel Room 54	55	1276	26.0	548	Fail
Hotel Room 55	55	1224	26.0	468	Fail
Hotel Room 56	55	999	29.0	213	Fail
Hotel Room 57	55	1069	25.0	313	Fail
Hotel Room 58	55	1241	25.0	503	Fail
Hotel Room 59	55	1269	26.0	550	Fail
Hotel Room 60	55	1267	26.0	544	Fail
Hotel Room 61	55	1244	26.0	500	Fail
Hotel Room 62	55	1190	28.0	420	Fail
Hotel Room 63	55	1050	26.0	245	Fail
Hotel Room 64	55	970	31.0	145	Fail
Hotel Room 65	55	1096	35.0	276	Fail
Hotel Room 66	55	1106	33.0	304	Fail
Hotel Room 67	55	1088	33.0	285	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 68	55	1069	33.0	272	Fail
Hotel Room 69	55	1068	33.0	264	Fail
Hotel Room 70	55	1078	33.0	276	Fail
Hotel Room 71	55	1109	33.0	337	Fail
Hotel Room 72	55	1156	31.0	393	Fail
Hotel Room 73	55	1227	31.0	474	Fail
Hotel Room 74	55	1271	31.0	547	Fail
Hotel Room 75	55	1325	33.0	610	Fail
Hotel Room 76	55	1370	32.0	687	Fail
Hotel Room 77	55	1408	34.0	731	Fail
Hotel Room 78	55	1435	32.0	761	Fail
Hotel Room 79	55	1458	33.0	782	Fail
Hotel Room 80	55	1480	32.0	780	Fail
Hotel Room 81	55	1487	31.0	770	Fail
Hotel Room 82	55	1482	32.0	732	Fail
Hotel Room 83	55	1466	31.0	691	Fail
Hotel Room 84	55	1452	29.0	642	Fail
Hotel Room 85	55	1435	30.0	587	Fail
Hotel Room 86	55	1421	31.0	552	Fail
Hotel Room 87	55	1411	31.0	547	Fail
Hotel Room 88	55	1408	31.0	560	Fail
Hotel Room 89	55	1419	33.0	590	Fail
Hotel Room 90	55	1433	31.0	610	Fail
Hotel Room 91	55	1426	32.0	629	Fail
Hotel Room 92	55	1407	31.0	626	Fail
Hotel Room 93	55	1380	30.0	585	Fail
Hotel Room 94	55	1309	30.0	489	Fail
Hotel Room 95	55	1083	32.0	215	Fail
Hotel Room 96	55	954	33.0	52	Fail
Hotel Room 97	55	1173	34.0	259	Fail
Hotel Room 98	55	1258	30.0	376	Fail
Hotel Room 99	55	1300	34.0	429	Fail
Hotel Room 100	55	1320	33.0	441	Fail
Hotel Room 101	55	1318	33.0	428	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 102	55	1299	30.0	384	Fail
Hotel Room 103	55	1275	35.0	337	Fail
Hotel Room 104	55	1232	33.0	278	Fail
Hotel Room 105	55	1152	35.0	183	Fail
Hotel Room 106	55	795	33.0	24	Fail
Hotel Room 107	55	889	31.0	42	Fail
Hotel Room 108	55	1125	35.0	200	Fail
Hotel Room 109	55	1160	36.0	251	Fail
Hotel Room 110	55	1145	33.0	245	Fail
Hotel Room 111	55	1091	35.0	203	Fail
Hotel Room 112	55	1016	35.0	132	Fail
Hotel Room 113	55	783	33.0	23	Fail
Gym 1	55	1836	0.0	1836	Fail
Function Room 1	55	1836	0.0	1836	Fail
Reception 1	78	2601	0.0	2601	Fail
Apart-hotel 1	55	1495	35.0	612	Fail
Apart-hotel 2	55	1617	35.0	689	Fail
Apart-hotel 3	55	1670	32.0	856	Fail
Apart-hotel 4	55	1785	33.0	1328	Fail
Apart-hotel 5	55	1836	0.0	1836	Fail
Apart-hotel 6	55	1810	35.0	1481	Fail
Apart-hotel 7	55	1676	34.0	904	Fail
Apart-hotel 8	55	1612	34.0	724	Fail
Apart-hotel 9	55	1594	34.0	645	Fail
Apart-hotel 10	55	1584	35.0	679	Fail
Apart-hotel 11	55	1549	35.0	785	Fail
Apart-hotel 12	55	1635	33.0	902	Fail
Apart-hotel 13	55	1694	34.0	935	Fail
Apart-hotel 14	55	1729	34.0	1028	Fail
Apart-hotel 15	55	1774	36.0	1217	Fail
Apart-hotel 16	55	1836	21.0	1757	Fail
Apart-hotel 17	55	1745	35.0	607	Fail
Apart-hotel 18	55	1723	33.0	871	Fail
Apart-hotel 19	55	1700	35.0	887	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 20	55	1583	36.0	747	Fail
Apart-hotel 21	55	1673	32.0	953	Fail
Apart-hotel 22	55	1714	32.0	986	Fail
Apart-hotel 23	55	1734	33.0	982	Fail
Apart-hotel 24	55	1768	35.0	1045	Fail
Apart-hotel 25	55	1799	34.0	1118	Fail
Apart-hotel 26	55	1822	33.0	1312	Fail
Apart-hotel 27	55	1823	31.0	1380	Fail
Apart-hotel 28	55	1807	32.0	1187	Fail
Apart-hotel 29	55	1791	36.0	1090	Fail
Apart-hotel 30	55	1777	35.0	1065	Fail
Apart-hotel 31	55	1762	32.0	1036	Fail
Apart-hotel 32	55	1760	33.0	1037	Fail
Apart-hotel 33	55	1738	34.0	1084	Fail
Apart-hotel 34	55	1761	35.0	1166	Fail
Apart-hotel 35	55	1790	31.0	1179	Fail
Apart-hotel 36	55	1798	30.0	1181	Fail
Apart-hotel 37	55	1782	31.0	1133	Fail
Apart-hotel 38	55	1784	31.0	1127	Fail
Apart-hotel 39	55	1798	32.0	1153	Fail
Apart-hotel 40	55	1811	32.0	1217	Fail
Apart-hotel 41	55	1808	32.0	1212	Fail
Apart-hotel 42	55	1779	32.0	1103	Fail
Apart-hotel 43	55	1755	33.0	1040	Fail
Apart-hotel 44	55	1752	32.0	1055	Fail
Apart-hotel 45	55	1769	29.0	1129	Fail
Apart-hotel 46	55	1755	29.0	1126	Fail
Apart-hotel 47	55	1696	35.0	1042	Fail
Apart-hotel 48	55	1667	33.0	956	Fail
Apart-hotel 49	55	1696	32.0	967	Fail
Apart-hotel 50	55	1688	34.0	937	Fail
Apart-hotel 51	55	1701	33.0	955	Fail
Apart-hotel 52	55	1706	34.0	959	Fail
Apart-hotel 53	55	1742	32.0	1005	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 54	55	1762	33.0	1065	Fail
Apart-hotel 55	55	1770	33.0	1075	Fail
Apart-hotel 56	55	1747	33.0	1017	Fail
Apart-hotel 57	55	1732	32.0	998	Fail
Apart-hotel 58	55	1712	33.0	963	Fail
Apart-hotel 59	55	1724	32.0	992	Fail
Apart-hotel 60	55	1711	33.0	1069	Fail
Apart-hotel 61	55	1740	34.0	1158	Fail
Apart-hotel 62	55	1771	32.0	1141	Fail
Apart-hotel 63	55	1769	31.0	1136	Fail
Apart-hotel 64	55	1756	35.0	1084	Fail
Apart-hotel 65	55	1747	33.0	1057	Fail
Apart-hotel 66	55	1745	32.0	1049	Fail
Apart-hotel 67	55	1747	32.0	1052	Fail
Apart-hotel 68	55	1743	32.0	1048	Fail
Apart-hotel 69	55	1735	32.0	1034	Fail
Apart-hotel 70	55	1727	33.0	1025	Fail
Apart-hotel 71	55	1731	35.0	1045	Fail
Apart-hotel 72	55	1752	31.0	1116	Fail
Apart-hotel 73	55	1743	29.0	1122	Fail
Apart-hotel 74	55	1691	35.0	1048	Fail
Apart-hotel 75	55	1459	36.0	789	Fail
Apart-hotel 76	55	1464	36.0	722	Fail
Apart-hotel 77	55	1406	36.0	607	Fail
Apart-hotel 78	55	1368	36.0	519	Fail
Apart-hotel 79	55	1338	36.0	455	Fail
Apart-hotel 80	55	1389	36.0	549	Fail
Apart-hotel 81	55	1501	36.0	699	Fail
Apart-hotel 82	55	1519	36.0	719	Fail
Apart-hotel 83	55	1422	36.0	606	Fail
Apart-hotel 84	55	1432	36.0	621	Fail
Apart-hotel 85	55	1450	36.0	668	Fail
Apart-hotel 86	55	1492	36.0	781	Fail
Apart-hotel 87	55	1552	36.0	925	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 88	55	1654	36.0	1002	Fail
Apart-hotel 89	55	1700	36.0	979	Fail
Apart-hotel 90	55	1697	36.0	951	Fail
Apart-hotel 91	55	1667	36.0	937	Fail
Apart-hotel 92	55	1673	36.0	944	Fail
Apart-hotel 93	55	1672	36.0	950	Fail
Apart-hotel 94	55	1647	36.0	928	Fail
Apart-hotel 95	55	1625	36.0	889	Fail
Apart-hotel 96	55	1671	36.0	921	Fail
Apart-hotel 97	55	1678	36.0	952	Fail
Apart-hotel 98	55	1589	36.0	901	Fail

Table A2.1.2 Results when not accounting for proposed cooling – DSY2

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Circulation 1	78	2592	50.0	2025	Fail
Circulation 2	78	2596	50.0	2197	Fail
Circulation 3	78	2592	49.0	2077	Fail
Circulation 4	78	2601	0.0	2601	Fail
Circulation 5	78	2601	0.0	2601	Fail
Circulation 6	78	2601	0.0	2601	Fail
Circulation 7	78	1791	46.0	698	Fail
Circulation 8	78	2586	50.0	2000	Fail
Circulation 9	78	2560	46.0	2069	Fail
Circulation 10	78	2572	38.0	2225	Fail
Circulation 11	78	2562	49.0	2046	Fail
Circulation 12	78	2592	43.0	2329	Fail
Circulation 13	78	2582	45.0	2300	Fail
Circulation 14	78	2583	46.0	2308	Fail
Circulation 15	78	2582	49.0	2219	Fail
Circulation 16	78	2545	43.0	2029	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Circulation 17	78	2565	47.0	2175	Fail
Circulation 18	78	2535	47.0	1948	Fail
Circulation 19	78	2551	46.0	2055	Fail
Circulation 20	78	2564	48.0	2133	Fail
Circulation 21	78	2569	45.0	2145	Fail
Circulation 22	78	2570	43.0	2209	Fail
Circulation 23	78	2418	49.0	1523	Fail
Circulation 24	78	2496	50.0	1653	Fail
Circulation 25	78	2346	49.0	1482	Fail
Circulation 26	78	2418	50.0	1522	Fail
Circulation 27	78	2436	50.0	1525	Fail
Circulation 28	78	2385	48.0	1488	Fail
Circulation 29	78	2499	50.0	1672	Fail
Circulation 30	78	2222	39.0	1374	Fail
Circulation 31	78	2092	49.0	1062	Fail
Restaurant 1	73	2448	0.0	2448	Fail
Hotel Room 1	55	843	31.0	142	Fail
Hotel Room 2	55	826	30.0	134	Fail
Hotel Room 3	55	800	28.0	117	Fail
Hotel Room 4	55	782	28.0	100	Fail
Hotel Room 5	55	805	29.0	99	Fail
Hotel Room 6	55	812	30.0	85	Fail
Hotel Room 7	55	805	32.0	70	Fail
Hotel Room 8	55	624	29.0	0	Fail
Hotel Room 9	55	648	29.0	1	Fail
Hotel Room 10	55	673	30.0	3	Fail
Hotel Room 11	55	740	32.0	13	Fail
Hotel Room 12	55	840	32.0	59	Fail
Hotel Room 13	55	952	27.0	312	Fail
Hotel Room 14	55	1092	24.0	501	Fail
Hotel Room 15	55	1131	27.0	568	Fail
Hotel Room 16	55	1141	25.0	576	Fail
Hotel Room 17	55	1133	25.0	562	Fail
Hotel Room 18	55	1132	25.0	550	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 19	55	1131	25.0	535	Fail
Hotel Room 20	55	1137	25.0	529	Fail
Hotel Room 21	55	1150	23.0	559	Fail
Hotel Room 22	55	1172	23.0	606	Fail
Hotel Room 23	55	1195	23.0	645	Fail
Hotel Room 24	55	1217	24.0	676	Fail
Hotel Room 25	55	1236	25.0	699	Fail
Hotel Room 26	55	1244	25.0	728	Fail
Hotel Room 27	55	1251	25.0	744	Fail
Hotel Room 28	55	1255	26.0	761	Fail
Hotel Room 29	55	1261	27.0	767	Fail
Hotel Room 30	55	1269	27.0	766	Fail
Hotel Room 31	55	1270	27.0	757	Fail
Hotel Room 32	55	1265	26.0	725	Fail
Hotel Room 33	55	1253	25.0	696	Fail
Hotel Room 34	55	1243	25.0	677	Fail
Hotel Room 35	55	1227	24.0	661	Fail
Hotel Room 36	55	1218	26.0	642	Fail
Hotel Room 37	55	1219	26.0	646	Fail
Hotel Room 38	55	1222	26.0	659	Fail
Hotel Room 39	55	1229	26.0	672	Fail
Hotel Room 40	55	1234	26.0	683	Fail
Hotel Room 41	55	1234	26.0	696	Fail
Hotel Room 42	55	1230	25.0	696	Fail
Hotel Room 43	55	1219	25.0	677	Fail
Hotel Room 44	55	1166	25.0	616	Fail
Hotel Room 45	55	1017	27.0	414	Fail
Hotel Room 46	55	1108	30.0	353	Fail
Hotel Room 47	55	1199	29.0	553	Fail
Hotel Room 48	55	1231	26.0	637	Fail
Hotel Room 49	55	1250	24.0	674	Fail
Hotel Room 50	55	1257	25.0	673	Fail
Hotel Room 51	55	1251	25.0	665	Fail
Hotel Room 52	55	1237	26.0	642	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 53	55	1223	25.0	618	Fail
Hotel Room 54	55	1204	27.0	585	Fail
Hotel Room 55	55	1168	26.0	494	Fail
Hotel Room 56	55	979	29.0	249	Fail
Hotel Room 57	55	1052	28.0	334	Fail
Hotel Room 58	55	1175	28.0	530	Fail
Hotel Room 59	55	1195	27.0	588	Fail
Hotel Room 60	55	1195	27.0	586	Fail
Hotel Room 61	55	1180	25.0	551	Fail
Hotel Room 62	55	1147	28.0	459	Fail
Hotel Room 63	55	1044	32.0	282	Fail
Hotel Room 64	55	969	30.0	219	Fail
Hotel Room 65	55	1052	30.0	343	Fail
Hotel Room 66	55	1059	32.0	361	Fail
Hotel Room 67	55	1046	31.0	346	Fail
Hotel Room 68	55	1040	32.0	330	Fail
Hotel Room 69	55	1034	33.0	326	Fail
Hotel Room 70	55	1046	33.0	336	Fail
Hotel Room 71	55	1066	33.0	368	Fail
Hotel Room 72	55	1085	31.0	426	Fail
Hotel Room 73	55	1135	33.0	491	Fail
Hotel Room 74	55	1173	33.0	555	Fail
Hotel Room 75	55	1212	30.0	616	Fail
Hotel Room 76	55	1243	32.0	674	Fail
Hotel Room 77	55	1274	31.0	720	Fail
Hotel Room 78	55	1289	31.0	752	Fail
Hotel Room 79	55	1299	32.0	766	Fail
Hotel Room 80	55	1301	32.0	767	Fail
Hotel Room 81	55	1303	32.0	763	Fail
Hotel Room 82	55	1282	33.0	732	Fail
Hotel Room 83	55	1260	32.0	696	Fail
Hotel Room 84	55	1239	31.0	654	Fail
Hotel Room 85	55	1215	30.0	618	Fail
Hotel Room 86	55	1197	31.0	593	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 87	55	1188	33.0	579	Fail
Hotel Room 88	55	1194	33.0	584	Fail
Hotel Room 89	55	1213	34.0	620	Fail
Hotel Room 90	55	1227	32.0	646	Fail
Hotel Room 91	55	1223	32.0	656	Fail
Hotel Room 92	55	1217	34.0	650	Fail
Hotel Room 93	55	1195	33.0	633	Fail
Hotel Room 94	55	1140	31.0	516	Fail
Hotel Room 95	55	1027	31.0	283	Fail
Hotel Room 96	55	931	36.0	165	Fail
Hotel Room 97	55	1050	33.0	309	Fail
Hotel Room 98	55	1108	33.0	403	Fail
Hotel Room 99	55	1132	32.0	455	Fail
Hotel Room 100	55	1140	32.0	464	Fail
Hotel Room 101	55	1130	32.0	447	Fail
Hotel Room 102	55	1112	32.0	428	Fail
Hotel Room 103	55	1093	33.0	395	Fail
Hotel Room 104	55	1071	36.0	342	Fail
Hotel Room 105	55	1023	36.0	263	Fail
Hotel Room 106	55	807	32.0	77	Fail
Hotel Room 107	55	874	32.0	127	Fail
Hotel Room 108	55	1027	33.0	270	Fail
Hotel Room 109	55	1052	33.0	324	Fail
Hotel Room 110	55	1048	33.0	308	Fail
Hotel Room 111	55	1026	34.0	275	Fail
Hotel Room 112	55	978	36.0	214	Fail
Hotel Room 113	55	807	31.0	89	Fail
Gym 1	55	1836	0.0	1836	Fail
Function Room 1	55	1836	0.0	1836	Fail
Reception 1	78	2601	0.0	2601	Fail
Apart-hotel 1	55	1342	36.0	703	Fail
Apart-hotel 2	55	1467	36.0	773	Fail
Apart-hotel 3	55	1600	33.0	899	Fail
Apart-hotel 4	55	1792	36.0	1204	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 5	55	1836	0.0	1836	Fail
Apart-hotel 6	55	1806	33.0	1346	Fail
Apart-hotel 7	55	1603	31.0	937	Fail
Apart-hotel 8	55	1469	36.0	793	Fail
Apart-hotel 9	55	1428	36.0	727	Fail
Apart-hotel 10	55	1423	34.0	751	Fail
Apart-hotel 11	55	1416	35.0	828	Fail
Apart-hotel 12	55	1478	36.0	901	Fail
Apart-hotel 13	55	1583	34.0	934	Fail
Apart-hotel 14	55	1705	32.0	1012	Fail
Apart-hotel 15	55	1775	34.0	1143	Fail
Apart-hotel 16	55	1836	22.0	1746	Fail
Apart-hotel 17	55	1735	36.0	700	Fail
Apart-hotel 18	55	1693	32.0	908	Fail
Apart-hotel 19	55	1587	32.0	921	Fail
Apart-hotel 20	55	1427	36.0	838	Fail
Apart-hotel 21	55	1500	33.0	977	Fail
Apart-hotel 22	55	1576	31.0	1000	Fail
Apart-hotel 23	55	1602	33.0	1004	Fail
Apart-hotel 24	55	1656	32.0	1064	Fail
Apart-hotel 25	55	1706	34.0	1133	Fail
Apart-hotel 26	55	1763	31.0	1277	Fail
Apart-hotel 27	55	1774	32.0	1323	Fail
Apart-hotel 28	55	1726	31.0	1181	Fail
Apart-hotel 29	55	1690	31.0	1114	Fail
Apart-hotel 30	55	1672	30.0	1091	Fail
Apart-hotel 31	55	1651	33.0	1034	Fail
Apart-hotel 32	55	1632	33.0	1028	Fail
Apart-hotel 33	55	1586	33.0	1051	Fail
Apart-hotel 34	55	1631	33.0	1084	Fail
Apart-hotel 35	55	1701	32.0	1103	Fail
Apart-hotel 36	55	1711	30.0	1120	Fail
Apart-hotel 37	55	1693	32.0	1089	Fail
Apart-hotel 38	55	1692	30.0	1090	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 39	55	1705	30.0	1122	Fail
Apart-hotel 40	55	1731	32.0	1173	Fail
Apart-hotel 41	55	1729	32.0	1162	Fail
Apart-hotel 42	55	1690	32.0	1081	Fail
Apart-hotel 43	55	1651	33.0	1036	Fail
Apart-hotel 44	55	1653	30.0	1038	Fail
Apart-hotel 45	55	1684	32.0	1068	Fail
Apart-hotel 46	55	1658	31.0	1055	Fail
Apart-hotel 47	55	1568	31.0	1007	Fail
Apart-hotel 48	55	1484	33.0	971	Fail
Apart-hotel 49	55	1538	31.0	980	Fail
Apart-hotel 50	55	1538	31.0	968	Fail
Apart-hotel 51	55	1558	32.0	979	Fail
Apart-hotel 52	55	1571	32.0	982	Fail
Apart-hotel 53	55	1608	30.0	1025	Fail
Apart-hotel 54	55	1650	29.0	1074	Fail
Apart-hotel 55	55	1657	30.0	1093	Fail
Apart-hotel 56	55	1617	31.0	1034	Fail
Apart-hotel 57	55	1600	30.0	1016	Fail
Apart-hotel 58	55	1562	32.0	987	Fail
Apart-hotel 59	55	1560	33.0	993	Fail
Apart-hotel 60	55	1550	35.0	1023	Fail
Apart-hotel 61	55	1600	33.0	1064	Fail
Apart-hotel 62	55	1661	30.0	1055	Fail
Apart-hotel 63	55	1671	32.0	1060	Fail
Apart-hotel 64	55	1643	33.0	1032	Fail
Apart-hotel 65	55	1630	34.0	1022	Fail
Apart-hotel 66	55	1619	33.0	1019	Fail
Apart-hotel 67	55	1620	33.0	1021	Fail
Apart-hotel 68	55	1618	33.0	1019	Fail
Apart-hotel 69	55	1604	33.0	1011	Fail
Apart-hotel 70	55	1598	32.0	1003	Fail
Apart-hotel 71	55	1617	33.0	1011	Fail
Apart-hotel 72	55	1655	31.0	1041	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 73	55	1639	30.0	1045	Fail
Apart-hotel 74	55	1556	32.0	1005	Fail
Apart-hotel 75	55	1313	33.0	850	Fail
Apart-hotel 76	55	1290	36.0	782	Fail
Apart-hotel 77	55	1219	36.0	672	Fail
Apart-hotel 78	55	1170	36.0	582	Fail
Apart-hotel 79	55	1143	35.0	534	Fail
Apart-hotel 80	55	1180	36.0	596	Fail
Apart-hotel 81	55	1284	36.0	747	Fail
Apart-hotel 82	55	1301	36.0	763	Fail
Apart-hotel 83	55	1219	36.0	666	Fail
Apart-hotel 84	55	1232	36.0	686	Fail
Apart-hotel 85	55	1271	36.0	713	Fail
Apart-hotel 86	55	1334	36.0	799	Fail
Apart-hotel 87	55	1436	33.0	902	Fail
Apart-hotel 88	55	1493	36.0	951	Fail
Apart-hotel 89	55	1494	33.0	946	Fail
Apart-hotel 90	55	1480	36.0	930	Fail
Apart-hotel 91	55	1472	36.0	916	Fail
Apart-hotel 92	55	1477	36.0	927	Fail
Apart-hotel 93	55	1474	36.0	933	Fail
Apart-hotel 94	55	1460	35.0	908	Fail
Apart-hotel 95	55	1426	35.0	878	Fail
Apart-hotel 96	55	1467	36.0	908	Fail
Apart-hotel 97	55	1480	36.0	938	Fail
Apart-hotel 98	55	1418	36.0	933	Fail

Table A2.1.3 Results when not accounting for proposed cooling – DSY3

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Circulation 1	78	2599	48.0	2086	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Circulation 2	78	2601	49.0	2207	Fail
Circulation 3	78	2598	47.0	2131	Fail
Circulation 4	78	2601	0.0	2601	Fail
Circulation 5	78	2601	0.0	2601	Fail
Circulation 6	78	2601	0.0	2601	Fail
Circulation 7	78	1908	48.0	526	Fail
Circulation 8	78	2596	48.0	2091	Fail
Circulation 9	78	2559	45.0	2068	Fail
Circulation 10	78	2572	43.0	2229	Fail
Circulation 11	78	2573	46.0	2058	Fail
Circulation 12	78	2598	40.0	2329	Fail
Circulation 13	78	2589	44.0	2302	Fail
Circulation 14	78	2583	43.0	2330	Fail
Circulation 15	78	2589	45.0	2205	Fail
Circulation 16	78	2547	44.0	2039	Fail
Circulation 17	78	2561	43.0	2190	Fail
Circulation 18	78	2544	49.0	1977	Fail
Circulation 19	78	2568	43.0	2068	Fail
Circulation 20	78	2566	42.0	2119	Fail
Circulation 21	78	2582	39.0	2149	Fail
Circulation 22	78	2571	42.0	2226	Fail
Circulation 23	78	2342	49.0	1820	Fail
Circulation 24	78	2501	49.0	1972	Fail
Circulation 25	78	2272	50.0	1710	Fail
Circulation 26	78	2353	50.0	1847	Fail
Circulation 27	78	2363	50.0	1821	Fail
Circulation 28	78	2293	49.0	1683	Fail
Circulation 29	78	2516	49.0	1977	Fail
Circulation 30	78	2264	47.0	1263	Fail
Circulation 31	78	2072	50.0	883	Fail
Restaurant 1	73	2448	0.0	2448	Fail
Hotel Room 1	55	863	31.0	60	Fail
Hotel Room 2	55	840	31.0	54	Fail
Hotel Room 3	55	828	31.0	46	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 4	55	812	31.0	41	Fail
Hotel Room 5	55	850	31.0	42	Fail
Hotel Room 6	55	840	31.0	41	Fail
Hotel Room 7	55	807	31.0	40	Fail
Hotel Room 8	55	591	29.0	0	Fail
Hotel Room 9	55	637	29.0	1	Fail
Hotel Room 10	55	667	29.0	3	Fail
Hotel Room 11	55	739	30.0	6	Fail
Hotel Room 12	55	874	31.0	27	Fail
Hotel Room 13	55	851	29.0	230	Fail
Hotel Room 14	55	1047	26.0	405	Fail
Hotel Room 15	55	1109	28.0	455	Fail
Hotel Room 16	55	1128	28.0	458	Fail
Hotel Room 17	55	1122	28.0	446	Fail
Hotel Room 18	55	1134	28.0	429	Fail
Hotel Room 19	55	1130	28.0	420	Fail
Hotel Room 20	55	1138	28.0	430	Fail
Hotel Room 21	55	1158	30.0	447	Fail
Hotel Room 22	55	1173	29.0	467	Fail
Hotel Room 23	55	1205	27.0	498	Fail
Hotel Room 24	55	1230	27.0	518	Fail
Hotel Room 25	55	1249	27.0	548	Fail
Hotel Room 26	55	1261	29.0	576	Fail
Hotel Room 27	55	1275	29.0	601	Fail
Hotel Room 28	55	1284	29.0	615	Fail
Hotel Room 29	55	1293	30.0	626	Fail
Hotel Room 30	55	1298	30.0	628	Fail
Hotel Room 31	55	1293	30.0	624	Fail
Hotel Room 32	55	1292	29.0	605	Fail
Hotel Room 33	55	1271	29.0	577	Fail
Hotel Room 34	55	1261	27.0	563	Fail
Hotel Room 35	55	1246	27.0	536	Fail
Hotel Room 36	55	1235	28.0	539	Fail
Hotel Room 37	55	1235	28.0	548	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 38	55	1229	28.0	566	Fail
Hotel Room 39	55	1229	28.0	586	Fail
Hotel Room 40	55	1232	28.0	593	Fail
Hotel Room 41	55	1232	28.0	598	Fail
Hotel Room 42	55	1225	27.0	593	Fail
Hotel Room 43	55	1204	25.0	575	Fail
Hotel Room 44	55	1135	28.0	509	Fail
Hotel Room 45	55	944	30.0	331	Fail
Hotel Room 46	55	1079	30.0	281	Fail
Hotel Room 47	55	1230	31.0	417	Fail
Hotel Room 48	55	1284	31.0	485	Fail
Hotel Room 49	55	1304	31.0	514	Fail
Hotel Room 50	55	1310	32.0	523	Fail
Hotel Room 51	55	1302	30.0	520	Fail
Hotel Room 52	55	1291	30.0	504	Fail
Hotel Room 53	55	1272	31.0	490	Fail
Hotel Room 54	55	1247	31.0	462	Fail
Hotel Room 55	55	1178	31.0	392	Fail
Hotel Room 56	55	913	32.0	203	Fail
Hotel Room 57	55	1007	27.0	253	Fail
Hotel Room 58	55	1180	29.0	419	Fail
Hotel Room 59	55	1220	29.0	460	Fail
Hotel Room 60	55	1222	29.0	454	Fail
Hotel Room 61	55	1212	29.0	425	Fail
Hotel Room 62	55	1154	31.0	358	Fail
Hotel Room 63	55	993	30.0	228	Fail
Hotel Room 64	55	912	32.0	138	Fail
Hotel Room 65	55	1067	36.0	248	Fail
Hotel Room 66	55	1093	35.0	267	Fail
Hotel Room 67	55	1085	35.0	253	Fail
Hotel Room 68	55	1085	35.0	246	Fail
Hotel Room 69	55	1091	34.0	252	Fail
Hotel Room 70	55	1103	34.0	274	Fail
Hotel Room 71	55	1122	36.0	311	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 72	55	1137	36.0	355	Fail
Hotel Room 73	55	1168	36.0	398	Fail
Hotel Room 74	55	1211	36.0	447	Fail
Hotel Room 75	55	1247	33.0	498	Fail
Hotel Room 76	55	1292	33.0	550	Fail
Hotel Room 77	55	1324	33.0	584	Fail
Hotel Room 78	55	1353	32.0	617	Fail
Hotel Room 79	55	1375	32.0	626	Fail
Hotel Room 80	55	1393	32.0	638	Fail
Hotel Room 81	55	1405	34.0	637	Fail
Hotel Room 82	55	1402	34.0	608	Fail
Hotel Room 83	55	1389	35.0	579	Fail
Hotel Room 84	55	1378	36.0	543	Fail
Hotel Room 85	55	1358	36.0	510	Fail
Hotel Room 86	55	1341	33.0	484	Fail
Hotel Room 87	55	1327	34.0	475	Fail
Hotel Room 88	55	1315	34.0	482	Fail
Hotel Room 89	55	1310	33.0	509	Fail
Hotel Room 90	55	1304	33.0	536	Fail
Hotel Room 91	55	1291	33.0	543	Fail
Hotel Room 92	55	1273	33.0	531	Fail
Hotel Room 93	55	1246	33.0	486	Fail
Hotel Room 94	55	1184	34.0	389	Fail
Hotel Room 95	55	991	33.0	193	Fail
Hotel Room 96	55	854	33.0	92	Fail
Hotel Room 97	55	1118	36.0	244	Fail
Hotel Room 98	55	1208	36.0	321	Fail
Hotel Room 99	55	1242	36.0	357	Fail
Hotel Room 100	55	1257	35.0	371	Fail
Hotel Room 101	55	1256	36.0	362	Fail
Hotel Room 102	55	1240	36.0	332	Fail
Hotel Room 103	55	1226	36.0	300	Fail
Hotel Room 104	55	1185	36.0	254	Fail
Hotel Room 105	55	1095	36.0	196	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 106	55	742	34.0	54	Fail
Hotel Room 107	55	804	30.0	76	Fail
Hotel Room 108	55	1074	36.0	203	Fail
Hotel Room 109	55	1123	34.0	238	Fail
Hotel Room 110	55	1116	35.0	233	Fail
Hotel Room 111	55	1082	36.0	205	Fail
Hotel Room 112	55	987	36.0	149	Fail
Hotel Room 113	55	734	36.0	49	Fail
Gym 1	55	1836	0.0	1836	Fail
Function Room 1	55	1836	0.0	1836	Fail
Reception 1	78	2601	0.0	2601	Fail
Apart-hotel 1	55	1416	36.0	636	Fail
Apart-hotel 2	55	1475	36.0	763	Fail
Apart-hotel 3	55	1570	36.0	922	Fail
Apart-hotel 4	55	1829	31.0	1313	Fail
Apart-hotel 5	55	1836	0.0	1836	Fail
Apart-hotel 6	55	1836	35.0	1395	Fail
Apart-hotel 7	55	1585	34.0	974	Fail
Apart-hotel 8	55	1492	34.0	819	Fail
Apart-hotel 9	55	1459	33.0	730	Fail
Apart-hotel 10	55	1456	36.0	714	Fail
Apart-hotel 11	55	1472	36.0	734	Fail
Apart-hotel 12	55	1540	35.0	841	Fail
Apart-hotel 13	55	1586	33.0	956	Fail
Apart-hotel 14	55	1677	29.0	1098	Fail
Apart-hotel 15	55	1802	30.0	1268	Fail
Apart-hotel 16	55	1836	21.0	1733	Fail
Apart-hotel 17	55	1708	34.0	689	Fail
Apart-hotel 18	55	1651	31.0	921	Fail
Apart-hotel 19	55	1576	33.0	915	Fail
Apart-hotel 20	55	1477	33.0	721	Fail
Apart-hotel 21	55	1478	30.0	954	Fail
Apart-hotel 22	55	1524	31.0	1032	Fail
Apart-hotel 23	55	1548	30.0	1056	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 24	55	1610	31.0	1126	Fail
Apart-hotel 25	55	1669	33.0	1191	Fail
Apart-hotel 26	55	1778	30.0	1303	Fail
Apart-hotel 27	55	1789	30.0	1350	Fail
Apart-hotel 28	55	1707	28.0	1233	Fail
Apart-hotel 29	55	1657	31.0	1171	Fail
Apart-hotel 30	55	1632	32.0	1148	Fail
Apart-hotel 31	55	1590	32.0	1101	Fail
Apart-hotel 32	55	1585	31.0	1091	Fail
Apart-hotel 33	55	1577	28.0	1087	Fail
Apart-hotel 34	55	1623	30.0	1165	Fail
Apart-hotel 35	55	1666	32.0	1210	Fail
Apart-hotel 36	55	1677	32.0	1222	Fail
Apart-hotel 37	55	1653	32.0	1177	Fail
Apart-hotel 38	55	1654	32.0	1184	Fail
Apart-hotel 39	55	1679	32.0	1207	Fail
Apart-hotel 40	55	1717	30.0	1251	Fail
Apart-hotel 41	55	1714	30.0	1242	Fail
Apart-hotel 42	55	1660	31.0	1155	Fail
Apart-hotel 43	55	1613	31.0	1105	Fail
Apart-hotel 44	55	1613	31.0	1108	Fail
Apart-hotel 45	55	1635	31.0	1149	Fail
Apart-hotel 46	55	1610	30.0	1130	Fail
Apart-hotel 47	55	1537	32.0	1028	Fail
Apart-hotel 48	55	1470	32.0	947	Fail
Apart-hotel 49	55	1504	33.0	994	Fail
Apart-hotel 50	55	1503	33.0	991	Fail
Apart-hotel 51	55	1520	31.0	1018	Fail
Apart-hotel 52	55	1527	31.0	1034	Fail
Apart-hotel 53	55	1554	30.0	1079	Fail
Apart-hotel 54	55	1605	30.0	1129	Fail
Apart-hotel 55	55	1611	30.0	1139	Fail
Apart-hotel 56	55	1563	31.0	1086	Fail
Apart-hotel 57	55	1548	30.0	1068	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 58	55	1521	32.0	1021	Fail
Apart-hotel 59	55	1526	33.0	1015	Fail
Apart-hotel 60	55	1552	30.0	1036	Fail
Apart-hotel 61	55	1598	29.0	1128	Fail
Apart-hotel 62	55	1617	31.0	1159	Fail
Apart-hotel 63	55	1616	32.0	1157	Fail
Apart-hotel 64	55	1587	31.0	1111	Fail
Apart-hotel 65	55	1573	31.0	1088	Fail
Apart-hotel 66	55	1568	31.0	1083	Fail
Apart-hotel 67	55	1569	31.0	1083	Fail
Apart-hotel 68	55	1566	31.0	1078	Fail
Apart-hotel 69	55	1560	30.0	1064	Fail
Apart-hotel 70	55	1554	30.0	1052	Fail
Apart-hotel 71	55	1568	31.0	1073	Fail
Apart-hotel 72	55	1601	31.0	1130	Fail
Apart-hotel 73	55	1594	30.0	1124	Fail
Apart-hotel 74	55	1533	29.0	1031	Fail
Apart-hotel 75	55	1388	36.0	743	Fail
Apart-hotel 76	55	1392	36.0	706	Fail
Apart-hotel 77	55	1380	36.0	622	Fail
Apart-hotel 78	55	1377	36.0	531	Fail
Apart-hotel 79	55	1368	36.0	497	Fail
Apart-hotel 80	55	1384	36.0	552	Fail
Apart-hotel 81	55	1419	36.0	686	Fail
Apart-hotel 82	55	1420	36.0	706	Fail
Apart-hotel 83	55	1396	36.0	602	Fail
Apart-hotel 84	55	1401	36.0	620	Fail
Apart-hotel 85	55	1399	36.0	660	Fail
Apart-hotel 86	55	1415	36.0	711	Fail
Apart-hotel 87	55	1457	36.0	792	Fail
Apart-hotel 88	55	1524	36.0	899	Fail
Apart-hotel 89	55	1507	36.0	901	Fail
Apart-hotel 90	55	1496	36.0	869	Fail
Apart-hotel 91	55	1488	36.0	871	Fail

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 92	55	1484	35.0	885	Fail
Apart-hotel 93	55	1476	36.0	891	Fail
Apart-hotel 94	55	1480	36.0	862	Fail
Apart-hotel 95	55	1482	36.0	819	Fail
Apart-hotel 96	55	1487	36.0	850	Fail
Apart-hotel 97	55	1495	36.0	871	Fail
Apart-hotel 98	55	1462	36.0	800	Fail

A2.2 FULL OVERHEATING REUSLTS WITH COOLING

Table A2.2.1 Results when accounting for proposed cooling – DSY1

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Circulation 1	78	0	0.0	0	Pass
Circulation 2	78	0	0.0	0	Pass
Circulation 3	78	0	0.0	0	Pass
Circulation 4	78	0	0.0	0	Pass
Circulation 5	78	0	0.0	0	Pass
Circulation 6	78	0	0.0	0	Pass
Circulation 7	78	0	0.0	0	Pass
Circulation 8	78	0	0.0	0	Pass
Circulation 9	78	0	0.0	0	Pass
Circulation 10	78	0	0.0	0	Pass
Circulation 11	78	0	0.0	0	Pass
Circulation 12	78	0	0.0	0	Pass
Circulation 13	78	0	0.0	0	Pass
Circulation 14	78	0	0.0	0	Pass
Circulation 15	78	0	0.0	0	Pass
Circulation 16	78	0	0.0	0	Pass
Circulation 17	78	0	0.0	0	Pass
Circulation 18	78	0	0.0	0	Pass
Circulation 19	78	0	0.0	0	Pass
Circulation 20	78	0	0.0	0	Pass
Circulation 21	78	0	0.0	0	Pass
Circulation 22	78	0	0.0	0	Pass
Circulation 23	78	0	0.0	0	Pass
Circulation 24	78	0	0.0	0	Pass
Circulation 25	78	0	0.0	0	Pass
Circulation 26	78	0	0.0	0	Pass
Circulation 27	78	0	0.0	0	Pass
Circulation 28	78	0	0.0	0	Pass
Circulation 29	78	0	0.0	0	Pass
Circulation 30	78	0	0.0	0	Pass
Circulation 31	78	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Restaurant 1	73	60	19.0	0	Pass
Hotel Room 1	55	0	0.0	0	Pass
Hotel Room 2	55	0	0.0	0	Pass
Hotel Room 3	55	0	0.0	0	Pass
Hotel Room 4	55	0	0.0	0	Pass
Hotel Room 5	55	0	0.0	0	Pass
Hotel Room 6	55	0	0.0	0	Pass
Hotel Room 7	55	0	0.0	0	Pass
Hotel Room 8	55	0	0.0	0	Pass
Hotel Room 9	55	0	0.0	0	Pass
Hotel Room 10	55	0	0.0	0	Pass
Hotel Room 11	55	0	0.0	0	Pass
Hotel Room 12	55	0	0.0	0	Pass
Hotel Room 13	55	0	0.0	0	Pass
Hotel Room 14	55	0	0.0	0	Pass
Hotel Room 15	55	0	0.0	0	Pass
Hotel Room 16	55	0	0.0	0	Pass
Hotel Room 17	55	0	0.0	0	Pass
Hotel Room 18	55	0	0.0	0	Pass
Hotel Room 19	55	0	0.0	0	Pass
Hotel Room 20	55	0	0.0	0	Pass
Hotel Room 21	55	0	0.0	0	Pass
Hotel Room 22	55	0	0.0	0	Pass
Hotel Room 23	55	0	0.0	0	Pass
Hotel Room 24	55	0	0.0	0	Pass
Hotel Room 25	55	2	1.0	0	Pass
Hotel Room 26	55	2	1.0	0	Pass
Hotel Room 27	55	3	2.0	0	Pass
Hotel Room 28	55	3	2.0	0	Pass
Hotel Room 29	55	3	2.0	0	Pass
Hotel Room 30	55	2	1.0	0	Pass
Hotel Room 31	55	2	1.0	0	Pass
Hotel Room 32	55	2	1.0	0	Pass
Hotel Room 33	55	2	1.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 34	55	0	0.0	0	Pass
Hotel Room 35	55	0	0.0	0	Pass
Hotel Room 36	55	0	0.0	0	Pass
Hotel Room 37	55	0	0.0	0	Pass
Hotel Room 38	55	0	0.0	0	Pass
Hotel Room 39	55	0	0.0	0	Pass
Hotel Room 40	55	0	0.0	0	Pass
Hotel Room 41	55	0	0.0	0	Pass
Hotel Room 42	55	0	0.0	0	Pass
Hotel Room 43	55	0	0.0	0	Pass
Hotel Room 44	55	0	0.0	0	Pass
Hotel Room 45	55	0	0.0	0	Pass
Hotel Room 46	55	0	0.0	0	Pass
Hotel Room 47	55	0	0.0	0	Pass
Hotel Room 48	55	0	0.0	0	Pass
Hotel Room 49	55	0	0.0	0	Pass
Hotel Room 50	55	0	0.0	0	Pass
Hotel Room 51	55	0	0.0	0	Pass
Hotel Room 52	55	0	0.0	0	Pass
Hotel Room 53	55	0	0.0	0	Pass
Hotel Room 54	55	0	0.0	0	Pass
Hotel Room 55	55	0	0.0	0	Pass
Hotel Room 56	55	0	0.0	0	Pass
Hotel Room 57	55	0	0.0	0	Pass
Hotel Room 58	55	0	0.0	0	Pass
Hotel Room 59	55	0	0.0	0	Pass
Hotel Room 60	55	0	0.0	0	Pass
Hotel Room 61	55	0	0.0	0	Pass
Hotel Room 62	55	0	0.0	0	Pass
Hotel Room 63	55	0	0.0	0	Pass
Hotel Room 64	55	0	0.0	0	Pass
Hotel Room 65	55	0	0.0	0	Pass
Hotel Room 66	55	0	0.0	0	Pass
Hotel Room 67	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 68	55	0	0.0	0	Pass
Hotel Room 69	55	0	0.0	0	Pass
Hotel Room 70	55	0	0.0	0	Pass
Hotel Room 71	55	0	0.0	0	Pass
Hotel Room 72	55	0	0.0	0	Pass
Hotel Room 73	55	0	0.0	0	Pass
Hotel Room 74	55	0	0.0	0	Pass
Hotel Room 75	55	0	0.0	0	Pass
Hotel Room 76	55	0	0.0	0	Pass
Hotel Room 77	55	0	0.0	0	Pass
Hotel Room 78	55	0	0.0	0	Pass
Hotel Room 79	55	0	0.0	0	Pass
Hotel Room 80	55	0	0.0	0	Pass
Hotel Room 81	55	0	0.0	0	Pass
Hotel Room 82	55	0	0.0	0	Pass
Hotel Room 83	55	0	0.0	0	Pass
Hotel Room 84	55	0	0.0	0	Pass
Hotel Room 85	55	0	0.0	0	Pass
Hotel Room 86	55	0	0.0	0	Pass
Hotel Room 87	55	0	0.0	0	Pass
Hotel Room 88	55	0	0.0	0	Pass
Hotel Room 89	55	0	0.0	0	Pass
Hotel Room 90	55	0	0.0	0	Pass
Hotel Room 91	55	0	0.0	0	Pass
Hotel Room 92	55	0	0.0	0	Pass
Hotel Room 93	55	0	0.0	0	Pass
Hotel Room 94	55	0	0.0	0	Pass
Hotel Room 95	55	0	0.0	0	Pass
Hotel Room 96	55	0	0.0	0	Pass
Hotel Room 97	55	0	0.0	0	Pass
Hotel Room 98	55	0	0.0	0	Pass
Hotel Room 99	55	0	0.0	0	Pass
Hotel Room 100	55	0	0.0	0	Pass
Hotel Room 101	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 102	55	0	0.0	0	Pass
Hotel Room 103	55	0	0.0	0	Pass
Hotel Room 104	55	0	0.0	0	Pass
Hotel Room 105	55	0	0.0	0	Pass
Hotel Room 106	55	0	0.0	0	Pass
Hotel Room 107	55	0	0.0	0	Pass
Hotel Room 108	55	0	0.0	0	Pass
Hotel Room 109	55	0	0.0	0	Pass
Hotel Room 110	55	0	0.0	0	Pass
Hotel Room 111	55	0	0.0	0	Pass
Hotel Room 112	55	0	0.0	0	Pass
Hotel Room 113	55	0	0.0	0	Pass
Gym 1	55	0	0.0	0	Pass
Function Room 1	55	0	0.0	0	Pass
Reception 1	78	0	0.0	0	Pass
Apart-hotel 1	55	0	0.0	0	Pass
Apart-hotel 2	55	0	0.0	0	Pass
Apart-hotel 3	55	0	0.0	0	Pass
Apart-hotel 4	55	0	0.0	0	Pass
Apart-hotel 5	55	19	12.0	0	Pass
Apart-hotel 6	55	0	0.0	0	Pass
Apart-hotel 7	55	0	0.0	0	Pass
Apart-hotel 8	55	0	0.0	0	Pass
Apart-hotel 9	55	0	0.0	0	Pass
Apart-hotel 10	55	0	0.0	0	Pass
Apart-hotel 11	55	0	0.0	0	Pass
Apart-hotel 12	55	0	0.0	0	Pass
Apart-hotel 13	55	0	0.0	0	Pass
Apart-hotel 14	55	0	0.0	0	Pass
Apart-hotel 15	55	0	0.0	0	Pass
Apart-hotel 16	55	0	0.0	0	Pass
Apart-hotel 17	55	0	0.0	0	Pass
Apart-hotel 18	55	0	0.0	0	Pass
Apart-hotel 19	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 20	55	0	0.0	0	Pass
Apart-hotel 21	55	0	0.0	0	Pass
Apart-hotel 22	55	0	0.0	0	Pass
Apart-hotel 23	55	0	0.0	0	Pass
Apart-hotel 24	55	0	0.0	0	Pass
Apart-hotel 25	55	0	0.0	0	Pass
Apart-hotel 26	55	0	0.0	0	Pass
Apart-hotel 27	55	0	0.0	0	Pass
Apart-hotel 28	55	0	0.0	0	Pass
Apart-hotel 29	55	0	0.0	0	Pass
Apart-hotel 30	55	0	0.0	0	Pass
Apart-hotel 31	55	0	0.0	0	Pass
Apart-hotel 32	55	0	0.0	0	Pass
Apart-hotel 33	55	0	0.0	0	Pass
Apart-hotel 34	55	0	0.0	0	Pass
Apart-hotel 35	55	0	0.0	0	Pass
Apart-hotel 36	55	0	0.0	0	Pass
Apart-hotel 37	55	0	0.0	0	Pass
Apart-hotel 38	55	0	0.0	0	Pass
Apart-hotel 39	55	0	0.0	0	Pass
Apart-hotel 40	55	0	0.0	0	Pass
Apart-hotel 41	55	0	0.0	0	Pass
Apart-hotel 42	55	0	0.0	0	Pass
Apart-hotel 43	55	0	0.0	0	Pass
Apart-hotel 44	55	0	0.0	0	Pass
Apart-hotel 45	55	0	0.0	0	Pass
Apart-hotel 46	55	0	0.0	0	Pass
Apart-hotel 47	55	0	0.0	0	Pass
Apart-hotel 48	55	0	0.0	0	Pass
Apart-hotel 49	55	0	0.0	0	Pass
Apart-hotel 50	55	0	0.0	0	Pass
Apart-hotel 51	55	0	0.0	0	Pass
Apart-hotel 52	55	0	0.0	0	Pass
Apart-hotel 53	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 54	55	0	0.0	0	Pass
Apart-hotel 55	55	0	0.0	0	Pass
Apart-hotel 56	55	0	0.0	0	Pass
Apart-hotel 57	55	0	0.0	0	Pass
Apart-hotel 58	55	0	0.0	0	Pass
Apart-hotel 59	55	0	0.0	0	Pass
Apart-hotel 60	55	0	0.0	0	Pass
Apart-hotel 61	55	0	0.0	0	Pass
Apart-hotel 62	55	0	0.0	0	Pass
Apart-hotel 63	55	0	0.0	0	Pass
Apart-hotel 64	55	0	0.0	0	Pass
Apart-hotel 65	55	0	0.0	0	Pass
Apart-hotel 66	55	0	0.0	0	Pass
Apart-hotel 67	55	0	0.0	0	Pass
Apart-hotel 68	55	0	0.0	0	Pass
Apart-hotel 69	55	0	0.0	0	Pass
Apart-hotel 70	55	0	0.0	0	Pass
Apart-hotel 71	55	0	0.0	0	Pass
Apart-hotel 72	55	0	0.0	0	Pass
Apart-hotel 73	55	0	0.0	0	Pass
Apart-hotel 74	55	0	0.0	0	Pass
Apart-hotel 75	55	0	0.0	0	Pass
Apart-hotel 76	55	0	0.0	0	Pass
Apart-hotel 77	55	0	0.0	0	Pass
Apart-hotel 78	55	0	0.0	0	Pass
Apart-hotel 79	55	0	0.0	0	Pass
Apart-hotel 80	55	0	0.0	0	Pass
Apart-hotel 81	55	0	0.0	0	Pass
Apart-hotel 82	55	0	0.0	0	Pass
Apart-hotel 83	55	0	0.0	0	Pass
Apart-hotel 84	55	0	0.0	0	Pass
Apart-hotel 85	55	0	0.0	0	Pass
Apart-hotel 86	55	0	0.0	0	Pass
Apart-hotel 87	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 88	55	0	0.0	0	Pass
Apart-hotel 89	55	0	0.0	0	Pass
Apart-hotel 90	55	0	0.0	0	Pass
Apart-hotel 91	55	0	0.0	0	Pass
Apart-hotel 92	55	0	0.0	0	Pass
Apart-hotel 93	55	0	0.0	0	Pass
Apart-hotel 94	55	0	0.0	0	Pass
Apart-hotel 95	55	0	0.0	0	Pass
Apart-hotel 96	55	0	0.0	0	Pass
Apart-hotel 97	55	0	0.0	0	Pass
Apart-hotel 98	55	0	0.0	0	Pass

Table A2.2.2 Results when accounting for proposed cooling – DSY2

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Circulation 1	78	0	0.0	0	Pass
Circulation 2	78	0	0.0	0	Pass
Circulation 3	78	0	0.0	0	Pass
Circulation 4	78	0	0.0	0	Pass
Circulation 5	78	0	0.0	0	Pass
Circulation 6	78	0	0.0	0	Pass
Circulation 7	78	0	0.0	0	Pass
Circulation 8	78	0	0.0	0	Pass
Circulation 9	78	0	0.0	0	Pass
Circulation 10	78	0	0.0	0	Pass
Circulation 11	78	0	0.0	0	Pass
Circulation 12	78	0	0.0	0	Pass
Circulation 13	78	0	0.0	0	Pass
Circulation 14	78	0	0.0	0	Pass
Circulation 15	78	0	0.0	0	Pass
Circulation 16	78	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Circulation 17	78	0	0.0	0	Pass
Circulation 18	78	0	0.0	0	Pass
Circulation 19	78	0	0.0	0	Pass
Circulation 20	78	0	0.0	0	Pass
Circulation 21	78	0	0.0	0	Pass
Circulation 22	78	0	0.0	0	Pass
Circulation 23	78	0	0.0	0	Pass
Circulation 24	78	0	0.0	0	Pass
Circulation 25	78	0	0.0	0	Pass
Circulation 26	78	0	0.0	0	Pass
Circulation 27	78	0	0.0	0	Pass
Circulation 28	78	0	0.0	0	Pass
Circulation 29	78	0	0.0	0	Pass
Circulation 30	78	0	0.0	0	Pass
Circulation 31	78	0	0.0	0	Pass
Restaurant 1	73	98	22.0	0	Fail
Hotel Room 1	55	0	0.0	0	Pass
Hotel Room 2	55	0	0.0	0	Pass
Hotel Room 3	55	0	0.0	0	Pass
Hotel Room 4	55	0	0.0	0	Pass
Hotel Room 5	55	0	0.0	0	Pass
Hotel Room 6	55	0	0.0	0	Pass
Hotel Room 7	55	0	0.0	0	Pass
Hotel Room 8	55	0	0.0	0	Pass
Hotel Room 9	55	0	0.0	0	Pass
Hotel Room 10	55	0	0.0	0	Pass
Hotel Room 11	55	0	0.0	0	Pass
Hotel Room 12	55	0	0.0	0	Pass
Hotel Room 13	55	0	0.0	0	Pass
Hotel Room 14	55	0	0.0	0	Pass
Hotel Room 15	55	0	0.0	0	Pass
Hotel Room 16	55	0	0.0	0	Pass
Hotel Room 17	55	0	0.0	0	Pass
Hotel Room 18	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 19	55	0	0.0	0	Pass
Hotel Room 20	55	0	0.0	0	Pass
Hotel Room 21	55	0	0.0	0	Pass
Hotel Room 22	55	0	0.0	0	Pass
Hotel Room 23	55	0	0.0	0	Pass
Hotel Room 24	55	1	1.0	0	Pass
Hotel Room 25	55	2	1.0	0	Pass
Hotel Room 26	55	5	2.0	0	Pass
Hotel Room 27	55	6	2.0	0	Pass
Hotel Room 28	55	6	2.0	0	Pass
Hotel Room 29	55	6	2.0	0	Pass
Hotel Room 30	55	5	2.0	0	Pass
Hotel Room 31	55	4	2.0	0	Pass
Hotel Room 32	55	2	1.0	0	Pass
Hotel Room 33	55	1	1.0	0	Pass
Hotel Room 34	55	0	0.0	0	Pass
Hotel Room 35	55	0	0.0	0	Pass
Hotel Room 36	55	0	0.0	0	Pass
Hotel Room 37	55	0	0.0	0	Pass
Hotel Room 38	55	0	0.0	0	Pass
Hotel Room 39	55	0	0.0	0	Pass
Hotel Room 40	55	0	0.0	0	Pass
Hotel Room 41	55	0	0.0	0	Pass
Hotel Room 42	55	0	0.0	0	Pass
Hotel Room 43	55	0	0.0	0	Pass
Hotel Room 44	55	0	0.0	0	Pass
Hotel Room 45	55	0	0.0	0	Pass
Hotel Room 46	55	0	0.0	0	Pass
Hotel Room 47	55	0	0.0	0	Pass
Hotel Room 48	55	0	0.0	0	Pass
Hotel Room 49	55	0	0.0	0	Pass
Hotel Room 50	55	0	0.0	0	Pass
Hotel Room 51	55	0	0.0	0	Pass
Hotel Room 52	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 53	55	0	0.0	0	Pass
Hotel Room 54	55	0	0.0	0	Pass
Hotel Room 55	55	0	0.0	0	Pass
Hotel Room 56	55	0	0.0	0	Pass
Hotel Room 57	55	0	0.0	0	Pass
Hotel Room 58	55	0	0.0	0	Pass
Hotel Room 59	55	0	0.0	0	Pass
Hotel Room 60	55	0	0.0	0	Pass
Hotel Room 61	55	0	0.0	0	Pass
Hotel Room 62	55	0	0.0	0	Pass
Hotel Room 63	55	0	0.0	0	Pass
Hotel Room 64	55	0	0.0	0	Pass
Hotel Room 65	55	0	0.0	0	Pass
Hotel Room 66	55	0	0.0	0	Pass
Hotel Room 67	55	0	0.0	0	Pass
Hotel Room 68	55	0	0.0	0	Pass
Hotel Room 69	55	0	0.0	0	Pass
Hotel Room 70	55	0	0.0	0	Pass
Hotel Room 71	55	0	0.0	0	Pass
Hotel Room 72	55	0	0.0	0	Pass
Hotel Room 73	55	0	0.0	0	Pass
Hotel Room 74	55	0	0.0	0	Pass
Hotel Room 75	55	0	0.0	0	Pass
Hotel Room 76	55	0	0.0	0	Pass
Hotel Room 77	55	0	0.0	0	Pass
Hotel Room 78	55	1	1.0	0	Pass
Hotel Room 79	55	1	1.0	0	Pass
Hotel Room 80	55	1	1.0	0	Pass
Hotel Room 81	55	1	1.0	0	Pass
Hotel Room 82	55	0	0.0	0	Pass
Hotel Room 83	55	0	0.0	0	Pass
Hotel Room 84	55	0	0.0	0	Pass
Hotel Room 85	55	0	0.0	0	Pass
Hotel Room 86	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 87	55	0	0.0	0	Pass
Hotel Room 88	55	0	0.0	0	Pass
Hotel Room 89	55	0	0.0	0	Pass
Hotel Room 90	55	0	0.0	0	Pass
Hotel Room 91	55	0	0.0	0	Pass
Hotel Room 92	55	0	0.0	0	Pass
Hotel Room 93	55	0	0.0	0	Pass
Hotel Room 94	55	0	0.0	0	Pass
Hotel Room 95	55	0	0.0	0	Pass
Hotel Room 96	55	0	0.0	0	Pass
Hotel Room 97	55	0	0.0	0	Pass
Hotel Room 98	55	0	0.0	0	Pass
Hotel Room 99	55	0	0.0	0	Pass
Hotel Room 100	55	0	0.0	0	Pass
Hotel Room 101	55	0	0.0	0	Pass
Hotel Room 102	55	0	0.0	0	Pass
Hotel Room 103	55	0	0.0	0	Pass
Hotel Room 104	55	0	0.0	0	Pass
Hotel Room 105	55	0	0.0	0	Pass
Hotel Room 106	55	0	0.0	0	Pass
Hotel Room 107	55	0	0.0	0	Pass
Hotel Room 108	55	0	0.0	0	Pass
Hotel Room 109	55	0	0.0	0	Pass
Hotel Room 110	55	0	0.0	0	Pass
Hotel Room 111	55	0	0.0	0	Pass
Hotel Room 112	55	0	0.0	0	Pass
Hotel Room 113	55	0	0.0	0	Pass
Gym 1	55	0	0.0	0	Pass
Function Room 1	55	0	0.0	0	Pass
Reception 1	78	0	0.0	0	Pass
Apart-hotel 1	55	0	0.0	0	Pass
Apart-hotel 2	55	0	0.0	0	Pass
Apart-hotel 3	55	0	0.0	0	Pass
Apart-hotel 4	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 5	55	28	12.0	0	Pass
Apart-hotel 6	55	0	0.0	0	Pass
Apart-hotel 7	55	0	0.0	0	Pass
Apart-hotel 8	55	0	0.0	0	Pass
Apart-hotel 9	55	0	0.0	0	Pass
Apart-hotel 10	55	0	0.0	0	Pass
Apart-hotel 11	55	0	0.0	0	Pass
Apart-hotel 12	55	0	0.0	0	Pass
Apart-hotel 13	55	0	0.0	0	Pass
Apart-hotel 14	55	0	0.0	0	Pass
Apart-hotel 15	55	0	0.0	0	Pass
Apart-hotel 16	55	0	0.0	0	Pass
Apart-hotel 17	55	0	0.0	0	Pass
Apart-hotel 18	55	0	0.0	0	Pass
Apart-hotel 19	55	0	0.0	0	Pass
Apart-hotel 20	55	0	0.0	0	Pass
Apart-hotel 21	55	0	0.0	0	Pass
Apart-hotel 22	55	0	0.0	0	Pass
Apart-hotel 23	55	0	0.0	0	Pass
Apart-hotel 24	55	0	0.0	0	Pass
Apart-hotel 25	55	0	0.0	0	Pass
Apart-hotel 26	55	0	0.0	0	Pass
Apart-hotel 27	55	0	0.0	0	Pass
Apart-hotel 28	55	0	0.0	0	Pass
Apart-hotel 29	55	0	0.0	0	Pass
Apart-hotel 30	55	0	0.0	0	Pass
Apart-hotel 31	55	0	0.0	0	Pass
Apart-hotel 32	55	0	0.0	0	Pass
Apart-hotel 33	55	1	1.0	0	Pass
Apart-hotel 34	55	1	1.0	0	Pass
Apart-hotel 35	55	0	0.0	0	Pass
Apart-hotel 36	55	0	0.0	0	Pass
Apart-hotel 37	55	0	0.0	0	Pass
Apart-hotel 38	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 39	55	0	0.0	0	Pass
Apart-hotel 40	55	0	0.0	0	Pass
Apart-hotel 41	55	0	0.0	0	Pass
Apart-hotel 42	55	0	0.0	0	Pass
Apart-hotel 43	55	0	0.0	0	Pass
Apart-hotel 44	55	0	0.0	0	Pass
Apart-hotel 45	55	0	0.0	0	Pass
Apart-hotel 46	55	0	0.0	0	Pass
Apart-hotel 47	55	0	0.0	0	Pass
Apart-hotel 48	55	0	0.0	0	Pass
Apart-hotel 49	55	0	0.0	0	Pass
Apart-hotel 50	55	0	0.0	0	Pass
Apart-hotel 51	55	0	0.0	0	Pass
Apart-hotel 52	55	0	0.0	0	Pass
Apart-hotel 53	55	0	0.0	0	Pass
Apart-hotel 54	55	0	0.0	0	Pass
Apart-hotel 55	55	0	0.0	0	Pass
Apart-hotel 56	55	0	0.0	0	Pass
Apart-hotel 57	55	0	0.0	0	Pass
Apart-hotel 58	55	0	0.0	0	Pass
Apart-hotel 59	55	0	0.0	0	Pass
Apart-hotel 60	55	1	1.0	0	Pass
Apart-hotel 61	55	1	1.0	0	Pass
Apart-hotel 62	55	0	0.0	0	Pass
Apart-hotel 63	55	0	0.0	0	Pass
Apart-hotel 64	55	0	0.0	0	Pass
Apart-hotel 65	55	0	0.0	0	Pass
Apart-hotel 66	55	0	0.0	0	Pass
Apart-hotel 67	55	0	0.0	0	Pass
Apart-hotel 68	55	0	0.0	0	Pass
Apart-hotel 69	55	0	0.0	0	Pass
Apart-hotel 70	55	0	0.0	0	Pass
Apart-hotel 71	55	0	0.0	0	Pass
Apart-hotel 72	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 73	55	0	0.0	0	Pass
Apart-hotel 74	55	0	0.0	0	Pass
Apart-hotel 75	55	0	0.0	0	Pass
Apart-hotel 76	55	0	0.0	0	Pass
Apart-hotel 77	55	0	0.0	0	Pass
Apart-hotel 78	55	0	0.0	0	Pass
Apart-hotel 79	55	0	0.0	0	Pass
Apart-hotel 80	55	0	0.0	0	Pass
Apart-hotel 81	55	0	0.0	0	Pass
Apart-hotel 82	55	0	0.0	0	Pass
Apart-hotel 83	55	0	0.0	0	Pass
Apart-hotel 84	55	0	0.0	0	Pass
Apart-hotel 85	55	0	0.0	0	Pass
Apart-hotel 86	55	0	0.0	0	Pass
Apart-hotel 87	55	0	0.0	0	Pass
Apart-hotel 88	55	0	0.0	0	Pass
Apart-hotel 89	55	0	0.0	0	Pass
Apart-hotel 90	55	0	0.0	0	Pass
Apart-hotel 91	55	0	0.0	0	Pass
Apart-hotel 92	55	0	0.0	0	Pass
Apart-hotel 93	55	0	0.0	0	Pass
Apart-hotel 94	55	0	0.0	0	Pass
Apart-hotel 95	55	0	0.0	0	Pass
Apart-hotel 96	55	0	0.0	0	Pass
Apart-hotel 97	55	0	0.0	0	Pass
Apart-hotel 98	55	0	0.0	0	Pass

Table A2.2.3 Results when accounting for proposed cooling – DSY3

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Circulation 1	78	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Circulation 2	78	0	0.0	0	Pass
Circulation 3	78	0	0.0	0	Pass
Circulation 4	78	0	0.0	0	Pass
Circulation 5	78	0	0.0	0	Pass
Circulation 6	78	0	0.0	0	Pass
Circulation 7	78	0	0.0	0	Pass
Circulation 8	78	0	0.0	0	Pass
Circulation 9	78	0	0.0	0	Pass
Circulation 10	78	0	0.0	0	Pass
Circulation 11	78	0	0.0	0	Pass
Circulation 12	78	0	0.0	0	Pass
Circulation 13	78	0	0.0	0	Pass
Circulation 14	78	0	0.0	0	Pass
Circulation 15	78	0	0.0	0	Pass
Circulation 16	78	0	0.0	0	Pass
Circulation 17	78	0	0.0	0	Pass
Circulation 18	78	0	0.0	0	Pass
Circulation 19	78	0	0.0	0	Pass
Circulation 20	78	0	0.0	0	Pass
Circulation 21	78	0	0.0	0	Pass
Circulation 22	78	0	0.0	0	Pass
Circulation 23	78	0	0.0	0	Pass
Circulation 24	78	0	0.0	0	Pass
Circulation 25	78	0	0.0	0	Pass
Circulation 26	78	0	0.0	0	Pass
Circulation 27	78	0	0.0	0	Pass
Circulation 28	78	0	0.0	0	Pass
Circulation 29	78	0	0.0	0	Pass
Circulation 30	78	0	0.0	0	Pass
Circulation 31	78	0	0.0	0	Pass
Restaurant 1	73	15	7.0	0	Pass
Hotel Room 1	55	0	0.0	0	Pass
Hotel Room 2	55	0	0.0	0	Pass
Hotel Room 3	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 4	55	0	0.0	0	Pass
Hotel Room 5	55	0	0.0	0	Pass
Hotel Room 6	55	0	0.0	0	Pass
Hotel Room 7	55	0	0.0	0	Pass
Hotel Room 8	55	0	0.0	0	Pass
Hotel Room 9	55	0	0.0	0	Pass
Hotel Room 10	55	0	0.0	0	Pass
Hotel Room 11	55	0	0.0	0	Pass
Hotel Room 12	55	0	0.0	0	Pass
Hotel Room 13	55	0	0.0	0	Pass
Hotel Room 14	55	0	0.0	0	Pass
Hotel Room 15	55	0	0.0	0	Pass
Hotel Room 16	55	0	0.0	0	Pass
Hotel Room 17	55	0	0.0	0	Pass
Hotel Room 18	55	0	0.0	0	Pass
Hotel Room 19	55	0	0.0	0	Pass
Hotel Room 20	55	0	0.0	0	Pass
Hotel Room 21	55	0	0.0	0	Pass
Hotel Room 22	55	0	0.0	0	Pass
Hotel Room 23	55	0	0.0	0	Pass
Hotel Room 24	55	0	0.0	0	Pass
Hotel Room 25	55	0	0.0	0	Pass
Hotel Room 26	55	0	0.0	0	Pass
Hotel Room 27	55	1	1.0	0	Pass
Hotel Room 28	55	1	1.0	0	Pass
Hotel Room 29	55	1	1.0	0	Pass
Hotel Room 30	55	0	0.0	0	Pass
Hotel Room 31	55	0	0.0	0	Pass
Hotel Room 32	55	0	0.0	0	Pass
Hotel Room 33	55	0	0.0	0	Pass
Hotel Room 34	55	0	0.0	0	Pass
Hotel Room 35	55	0	0.0	0	Pass
Hotel Room 36	55	0	0.0	0	Pass
Hotel Room 37	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 38	55	0	0.0	0	Pass
Hotel Room 39	55	0	0.0	0	Pass
Hotel Room 40	55	0	0.0	0	Pass
Hotel Room 41	55	0	0.0	0	Pass
Hotel Room 42	55	0	0.0	0	Pass
Hotel Room 43	55	0	0.0	0	Pass
Hotel Room 44	55	0	0.0	0	Pass
Hotel Room 45	55	0	0.0	0	Pass
Hotel Room 46	55	0	0.0	0	Pass
Hotel Room 47	55	0	0.0	0	Pass
Hotel Room 48	55	0	0.0	0	Pass
Hotel Room 49	55	0	0.0	0	Pass
Hotel Room 50	55	0	0.0	0	Pass
Hotel Room 51	55	0	0.0	0	Pass
Hotel Room 52	55	0	0.0	0	Pass
Hotel Room 53	55	0	0.0	0	Pass
Hotel Room 54	55	0	0.0	0	Pass
Hotel Room 55	55	0	0.0	0	Pass
Hotel Room 56	55	0	0.0	0	Pass
Hotel Room 57	55	0	0.0	0	Pass
Hotel Room 58	55	0	0.0	0	Pass
Hotel Room 59	55	0	0.0	0	Pass
Hotel Room 60	55	0	0.0	0	Pass
Hotel Room 61	55	0	0.0	0	Pass
Hotel Room 62	55	0	0.0	0	Pass
Hotel Room 63	55	0	0.0	0	Pass
Hotel Room 64	55	0	0.0	0	Pass
Hotel Room 65	55	0	0.0	0	Pass
Hotel Room 66	55	0	0.0	0	Pass
Hotel Room 67	55	0	0.0	0	Pass
Hotel Room 68	55	0	0.0	0	Pass
Hotel Room 69	55	0	0.0	0	Pass
Hotel Room 70	55	0	0.0	0	Pass
Hotel Room 71	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 72	55	0	0.0	0	Pass
Hotel Room 73	55	0	0.0	0	Pass
Hotel Room 74	55	0	0.0	0	Pass
Hotel Room 75	55	0	0.0	0	Pass
Hotel Room 76	55	0	0.0	0	Pass
Hotel Room 77	55	0	0.0	0	Pass
Hotel Room 78	55	0	0.0	0	Pass
Hotel Room 79	55	0	0.0	0	Pass
Hotel Room 80	55	0	0.0	0	Pass
Hotel Room 81	55	0	0.0	0	Pass
Hotel Room 82	55	0	0.0	0	Pass
Hotel Room 83	55	0	0.0	0	Pass
Hotel Room 84	55	0	0.0	0	Pass
Hotel Room 85	55	0	0.0	0	Pass
Hotel Room 86	55	0	0.0	0	Pass
Hotel Room 87	55	0	0.0	0	Pass
Hotel Room 88	55	0	0.0	0	Pass
Hotel Room 89	55	0	0.0	0	Pass
Hotel Room 90	55	0	0.0	0	Pass
Hotel Room 91	55	0	0.0	0	Pass
Hotel Room 92	55	0	0.0	0	Pass
Hotel Room 93	55	0	0.0	0	Pass
Hotel Room 94	55	0	0.0	0	Pass
Hotel Room 95	55	0	0.0	0	Pass
Hotel Room 96	55	0	0.0	0	Pass
Hotel Room 97	55	0	0.0	0	Pass
Hotel Room 98	55	0	0.0	0	Pass
Hotel Room 99	55	0	0.0	0	Pass
Hotel Room 100	55	0	0.0	0	Pass
Hotel Room 101	55	0	0.0	0	Pass
Hotel Room 102	55	0	0.0	0	Pass
Hotel Room 103	55	0	0.0	0	Pass
Hotel Room 104	55	0	0.0	0	Pass
Hotel Room 105	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Hotel Room 106	55	0	0.0	0	Pass
Hotel Room 107	55	0	0.0	0	Pass
Hotel Room 108	55	0	0.0	0	Pass
Hotel Room 109	55	0	0.0	0	Pass
Hotel Room 110	55	0	0.0	0	Pass
Hotel Room 111	55	0	0.0	0	Pass
Hotel Room 112	55	0	0.0	0	Pass
Hotel Room 113	55	0	0.0	0	Pass
Gym 1	55	0	0.0	0	Pass
Function Room 1	55	0	0.0	0	Pass
Reception 1	78	0	0.0	0	Pass
Apart-hotel 1	55	0	0.0	0	Pass
Apart-hotel 2	55	0	0.0	0	Pass
Apart-hotel 3	55	0	0.0	0	Pass
Apart-hotel 4	55	0	0.0	0	Pass
Apart-hotel 5	55	0	0.0	0	Pass
Apart-hotel 6	55	0	0.0	0	Pass
Apart-hotel 7	55	0	0.0	0	Pass
Apart-hotel 8	55	0	0.0	0	Pass
Apart-hotel 9	55	0	0.0	0	Pass
Apart-hotel 10	55	0	0.0	0	Pass
Apart-hotel 11	55	0	0.0	0	Pass
Apart-hotel 12	55	0	0.0	0	Pass
Apart-hotel 13	55	0	0.0	0	Pass
Apart-hotel 14	55	0	0.0	0	Pass
Apart-hotel 15	55	0	0.0	0	Pass
Apart-hotel 16	55	0	0.0	0	Pass
Apart-hotel 17	55	0	0.0	0	Pass
Apart-hotel 18	55	0	0.0	0	Pass
Apart-hotel 19	55	0	0.0	0	Pass
Apart-hotel 20	55	0	0.0	0	Pass
Apart-hotel 21	55	0	0.0	0	Pass
Apart-hotel 22	55	0	0.0	0	Pass
Apart-hotel 23	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 24	55	0	0.0	0	Pass
Apart-hotel 25	55	0	0.0	0	Pass
Apart-hotel 26	55	0	0.0	0	Pass
Apart-hotel 27	55	0	0.0	0	Pass
Apart-hotel 28	55	0	0.0	0	Pass
Apart-hotel 29	55	0	0.0	0	Pass
Apart-hotel 30	55	0	0.0	0	Pass
Apart-hotel 31	55	0	0.0	0	Pass
Apart-hotel 32	55	0	0.0	0	Pass
Apart-hotel 33	55	0	0.0	0	Pass
Apart-hotel 34	55	0	0.0	0	Pass
Apart-hotel 35	55	0	0.0	0	Pass
Apart-hotel 36	55	0	0.0	0	Pass
Apart-hotel 37	55	0	0.0	0	Pass
Apart-hotel 38	55	0	0.0	0	Pass
Apart-hotel 39	55	0	0.0	0	Pass
Apart-hotel 40	55	0	0.0	0	Pass
Apart-hotel 41	55	0	0.0	0	Pass
Apart-hotel 42	55	0	0.0	0	Pass
Apart-hotel 43	55	0	0.0	0	Pass
Apart-hotel 44	55	0	0.0	0	Pass
Apart-hotel 45	55	0	0.0	0	Pass
Apart-hotel 46	55	0	0.0	0	Pass
Apart-hotel 47	55	0	0.0	0	Pass
Apart-hotel 48	55	0	0.0	0	Pass
Apart-hotel 49	55	0	0.0	0	Pass
Apart-hotel 50	55	0	0.0	0	Pass
Apart-hotel 51	55	0	0.0	0	Pass
Apart-hotel 52	55	0	0.0	0	Pass
Apart-hotel 53	55	0	0.0	0	Pass
Apart-hotel 54	55	0	0.0	0	Pass
Apart-hotel 55	55	0	0.0	0	Pass
Apart-hotel 56	55	0	0.0	0	Pass
Apart-hotel 57	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 58	55	0	0.0	0	Pass
Apart-hotel 59	55	0	0.0	0	Pass
Apart-hotel 60	55	0	0.0	0	Pass
Apart-hotel 61	55	0	0.0	0	Pass
Apart-hotel 62	55	0	0.0	0	Pass
Apart-hotel 63	55	0	0.0	0	Pass
Apart-hotel 64	55	0	0.0	0	Pass
Apart-hotel 65	55	0	0.0	0	Pass
Apart-hotel 66	55	0	0.0	0	Pass
Apart-hotel 67	55	0	0.0	0	Pass
Apart-hotel 68	55	0	0.0	0	Pass
Apart-hotel 69	55	0	0.0	0	Pass
Apart-hotel 70	55	0	0.0	0	Pass
Apart-hotel 71	55	0	0.0	0	Pass
Apart-hotel 72	55	0	0.0	0	Pass
Apart-hotel 73	55	0	0.0	0	Pass
Apart-hotel 74	55	0	0.0	0	Pass
Apart-hotel 75	55	0	0.0	0	Pass
Apart-hotel 76	55	0	0.0	0	Pass
Apart-hotel 77	55	0	0.0	0	Pass
Apart-hotel 78	55	0	0.0	0	Pass
Apart-hotel 79	55	0	0.0	0	Pass
Apart-hotel 80	55	0	0.0	0	Pass
Apart-hotel 81	55	0	0.0	0	Pass
Apart-hotel 82	55	0	0.0	0	Pass
Apart-hotel 83	55	0	0.0	0	Pass
Apart-hotel 84	55	0	0.0	0	Pass
Apart-hotel 85	55	0	0.0	0	Pass
Apart-hotel 86	55	0	0.0	0	Pass
Apart-hotel 87	55	0	0.0	0	Pass
Apart-hotel 88	55	0	0.0	0	Pass
Apart-hotel 89	55	0	0.0	0	Pass
Apart-hotel 90	55	0	0.0	0	Pass
Apart-hotel 91	55	0	0.0	0	Pass

	Max Exceedable Hours	Criteria 1 (%Hrs Top – T_{max} >= 1K) ≤ 3%	Criteria 2 (Max. Daily Deg. Hrs) ≤ 6	Criteria 3 (Max ΔT) ≤ 4	Overall Compliance
Apart-hotel 92	55	0	0.0	0	Pass
Apart-hotel 93	55	0	0.0	0	Pass
Apart-hotel 94	55	0	0.0	0	Pass
Apart-hotel 95	55	0	0.0	0	Pass
Apart-hotel 96	55	0	0.0	0	Pass
Apart-hotel 97	55	0	0.0	0	Pass
Apart-hotel 98	55	0	0.0	0	Pass

A3. BRUKL REPORTS

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Ariel Hotel - Proposed Extension - Be Lean

As designed

Date: Mon Nov 27 16:31:21 2023

Administrative information

Building Details

Address:

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.4"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.4

BRUKL compliance check version: v6.1.b.0

Certifier details

Name:

Telephone number:

Address: , ,

Foundation area [m^2]: 1487.87

The CO_2 emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	52.68	
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	51.78	
Target primary energy rate (TPER), kWh/m^2.annum	278.23	
Building primary energy rate (BPER), kWh/m^2.annum	285.76	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER > TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.1	0.1	Existing External Wall
Floors	0.18	0.1	0.1	Exposed Floor
Pitched roofs	0.16	0.1	0.1	Roof
Flat roofs	0.18	-	-	No flat roofs in project
Windows** and roof windows	1.6	1.17	1.25	New Window (4)
Rooflights***	2.2	-	-	No rooflights in project
Personnel doors^	1.6	-	-	No personnel doors in project
Vehicle access & similar large doors	1.3	-	-	No vehicle access or similar large doors in project
High usage entrance doors	3	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

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	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	1

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

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

1- Nat Vent

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

2- VRF (101 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4	-	-	1.1	0.7
Standard value	2.5*	N/A	N/A	1.5^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

1- New HWS Circuit

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	4	0
Standard value	0.91	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**General luminaire**	**Display light source**	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_EnsuiteBedroom 13	-	-	-
C1_EnsuiteBedroom 14	-	-	-
C1_EnsuiteBedroom 15	-	-	-
C1_EnsuiteBedroom 16	-	-	-
C1_EnsuiteBedroom 17	-	-	-
C1_EnsuiteBedroom 18	-	-	-
C1_EnsuiteBedroom 19	-	-	-
C1_EnsuiteBedroom 20	-	-	-
C1_EnsuiteBedroom 21	-	-	-
C1_EnsuiteBedroom 22	-	-	-
C1_EnsuiteBedroom 23	-	-	-
C1_EnsuiteBedroom 24	-	-	-
C1_EnsuiteBedroom 25	-	-	-
C1_EnsuiteBedroom 26	-	-	-
C1_EnsuiteBedroom 27	-	-	-
C1_EnsuiteBedroom 28	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_EnsuiteBedroom 29	-	-	-
C1_EnsuiteBedroom 30	-	-	-
C1_EnsuiteBedroom 31	-	-	-
C1_EnsuiteBedroom 32	-	-	-
C1_EnsuiteBedroom 33	-	-	-
C1_EnsuiteBedroom 34	-	-	-
C1_EnsuiteBedroom 35	-	-	-
C1_EnsuiteBedroom 36	-	-	-
C1_EnsuiteBedroom 37	-	-	-
C1_EnsuiteBedroom 38	-	-	-
C1_EnsuiteBedroom 39	-	-	-
C1_EnsuiteBedroom 40	-	-	-
C1_EnsuiteBedroom 41	-	-	-
C1_EnsuiteBedroom 42	-	-	-
C1_EnsuiteBedroom 43	-	-	-
C1_EnsuiteBedroom 44	-	-	-
C1_EnsuiteBedroom 45	-	-	-
C1_EnsuiteBedroom 46	-	-	-
C1_EnsuiteBedroom 47	-	-	-
C1_EnsuiteBedroom 48	-	-	-
C1_EnsuiteBedroom 49	-	-	-
C1_EnsuiteBedroom 50	-	-	-
C1_EnsuiteBedroom 51	-	-	-
C1_EnsuiteBedroom 52	-	-	-
C1_EnsuiteBedroom 53	-	-	-
C1_EnsuiteBedroom 54	-	-	-
C1_EnsuiteBedroom 55	-	-	-
C1_EnsuiteBedroom 56	-	-	-
C1_EnsuiteBedroom 57	-	-	-
C1_EnsuiteBedroom 58	-	-	-
C1_EnsuiteBedroom 59	-	-	-
C1_EnsuiteBedroom 60	-	-	-
C1_EnsuiteBedroom 61	-	-	-
C1_EnsuiteBedroom 62	-	-	-
C1_EnsuiteBedroom 63	-	-	-
C1_EnsuiteBedroom 64	-	-	-
C1_EnsuiteBedroom 65	-	-	-
C1_EnsuiteBedroom 66	-	-	-
C1_EnsuiteBedroom 67	-	-	-
C1_EnsuiteBedroom 68	-	-	-
C1_EnsuiteBedroom 69	-	-	-
C1_EnsuiteBedroom 70	-	-	-
C1_EnsuiteBedroom 71	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_EnsuiteBedroom 72	-	-	-
C1_EnsuiteBedroom 73	-	-	-
C1_EnsuiteBedroom 74	-	-	-
C1_EnsuiteBedroom 75	-	-	-
C1_EnsuiteBedroom 76	-	-	-
C1_EnsuiteBedroom 77	-	-	-
C1_EnsuiteBedroom 78	-	-	-
C1_EnsuiteBedroom 79	-	-	-
C1_EnsuiteBedroom 80	-	-	-
C1_EnsuiteBedroom 81	-	-	-
C1_EnsuiteBedroom 82	-	-	-
C1_EnsuiteBedroom 83	-	-	-
C1_EnsuiteBedroom 84	-	-	-
C1_EnsuiteBedroom 85	-	-	-
C1_EnsuiteBedroom 86	-	-	-
C1_EnsuiteBedroom 87	-	-	-
C1_EnsuiteBedroom 88	-	-	-
C1_EnsuiteBedroom 89	-	-	-
C1_EnsuiteBedroom 90	-	-	-
C1_EnsuiteBedroom 91	-	-	-
C1_EnsuiteBedroom 92	-	-	-
C1_EnsuiteBedroom 93	-	-	-
C1_EnsuiteBedroom 94	-	-	-
C1_EnsuiteBedroom 95	-	-	-
C1_EnsuiteBedroom 96	-	-	-
C1_EnsuiteBedroom 97	-	-	-
C1_EnsuiteBedroom 98	-	-	-
C1_EnsuiteBedroom 99	-	-	-
C1_EnsuiteBedroom 100	-	-	-
C1_EnsuiteBedroom 101	-	-	-
C1_EnsuiteBedroom 102	-	-	-
C1_EnsuiteBedroom 103	-	-	-
C1_EnsuiteBedroom 104	-	-	-
C1_EnsuiteBedroom 105	-	-	-
C1_EnsuiteBedroom 106	-	-	-
C1_EnsuiteBedroom 107	-	-	-
C1_EnsuiteBedroom 108	-	-	-
C1_EnsuiteBedroom 109	-	-	-
C1_EnsuiteBedroom 110	-	-	-
C1_EnsuiteBedroom 111	-	-	-
C1_EnsuiteBedroom 112	-	-	-
C1_EnsuiteBedroom 113	-	-	-
C1_Circulation 30	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_Circulation 31	-	-	-
C1_Store 3	-	-	-
C1_Store 4	-	-	-
C1_Store 5	-	-	-
C1_Store 6	-	-	-
C1_Store 7	-	-	-
C1_Store 8	-	-	-
C1_Store 9	-	-	-
C1_Store 10	-	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_EnsuiteBedroom 13	YES (+4%)	NO
C1_EnsuiteBedroom 14	NO (-23%)	NO
C1_EnsuiteBedroom 15	NO (-32%)	NO
C1_EnsuiteBedroom 16	NO (-33%)	NO
C1_EnsuiteBedroom 17	NO (-40%)	NO
C1_EnsuiteBedroom 18	NO (-41%)	NO
C1_EnsuiteBedroom 19	NO (-44%)	NO
C1_EnsuiteBedroom 20	NO (-42%)	NO
C1_EnsuiteBedroom 21	NO (-39%)	NO
C1_EnsuiteBedroom 22	NO (-40%)	NO
C1_EnsuiteBedroom 23	NO (-32%)	NO
C1_EnsuiteBedroom 24	NO (-29%)	NO
C1_EnsuiteBedroom 25	NO (-24%)	NO
C1_EnsuiteBedroom 26	NO (-19%)	NO
C1_EnsuiteBedroom 27	NO (-16%)	NO
C1_EnsuiteBedroom 28	NO (-14%)	NO
C1_EnsuiteBedroom 29	NO (-12%)	NO
C1_EnsuiteBedroom 30	NO (-12%)	NO
C1_EnsuiteBedroom 31	NO (-8%)	NO
C1_EnsuiteBedroom 32	NO (-14%)	NO
C1_EnsuiteBedroom 33	NO (-15%)	NO
C1_EnsuiteBedroom 34	NO (-17%)	NO
C1_EnsuiteBedroom 35	NO (-19%)	NO
C1_EnsuiteBedroom 36	NO (-20%)	NO
C1_EnsuiteBedroom 37	NO (-20%)	NO
C1_EnsuiteBedroom 38	NO (-22%)	NO
C1_EnsuiteBedroom 39	NO (-13%)	NO
C1_EnsuiteBedroom 40	NO (-9%)	NO
C1_EnsuiteBedroom 41	NO (-7%)	NO
C1_EnsuiteBedroom 42	NO (-10%)	NO
C1_EnsuiteBedroom 43	NO (-5%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_EnsuiteBedroom 44	NO (-11%)	NO
C1_EnsuiteBedroom 45	NO (-2%)	NO
C1_EnsuiteBedroom 46	NO (-69%)	NO
C1_EnsuiteBedroom 47	NO (-53%)	NO
C1_EnsuiteBedroom 48	NO (-48%)	NO
C1_EnsuiteBedroom 49	NO (-46%)	NO
C1_EnsuiteBedroom 50	NO (-43%)	NO
C1_EnsuiteBedroom 51	NO (-44%)	NO
C1_EnsuiteBedroom 52	NO (-46%)	NO
C1_EnsuiteBedroom 53	NO (-44%)	NO
C1_EnsuiteBedroom 54	NO (-51%)	NO
C1_EnsuiteBedroom 55	NO (-46%)	NO
C1_EnsuiteBedroom 56	NO (-47%)	NO
C1_EnsuiteBedroom 57	NO (-58%)	NO
C1_EnsuiteBedroom 58	NO (-45%)	NO
C1_EnsuiteBedroom 59	NO (-53%)	NO
C1_EnsuiteBedroom 60	NO (-54%)	NO
C1_EnsuiteBedroom 61	NO (-61%)	NO
C1_EnsuiteBedroom 62	NO (-63%)	NO
C1_EnsuiteBedroom 63	NO (-65%)	NO
C1_EnsuiteBedroom 64	NO (-13%)	NO
C1_EnsuiteBedroom 65	NO (-32%)	NO
C1_EnsuiteBedroom 66	NO (-33%)	NO
C1_EnsuiteBedroom 67	NO (-40%)	NO
C1_EnsuiteBedroom 68	NO (-41%)	NO
C1_EnsuiteBedroom 69	NO (-44%)	NO
C1_EnsuiteBedroom 70	NO (-42%)	NO
C1_EnsuiteBedroom 71	NO (-39%)	NO
C1_EnsuiteBedroom 72	NO (-40%)	NO
C1_EnsuiteBedroom 73	NO (-32%)	NO
C1_EnsuiteBedroom 74	NO (-29%)	NO
C1_EnsuiteBedroom 75	NO (-24%)	NO
C1_EnsuiteBedroom 76	NO (-19%)	NO
C1_EnsuiteBedroom 77	NO (-16%)	NO
C1_EnsuiteBedroom 78	NO (-14%)	NO
C1_EnsuiteBedroom 79	NO (-12%)	NO
C1_EnsuiteBedroom 80	NO (-12%)	NO
C1_EnsuiteBedroom 81	NO (-8%)	NO
C1_EnsuiteBedroom 82	NO (-14%)	NO
C1_EnsuiteBedroom 83	NO (-15%)	NO
C1_EnsuiteBedroom 84	NO (-17%)	NO
C1_EnsuiteBedroom 85	NO (-19%)	NO
C1_EnsuiteBedroom 86	NO (-20%)	NO
C1_EnsuiteBedroom 87	NO (-20%)	NO
C1_EnsuiteBedroom 88	NO (-22%)	NO
C1_EnsuiteBedroom 89	NO (-13%)	NO
C1_EnsuiteBedroom 90	NO (-9%)	NO
C1_EnsuiteBedroom 91	NO (-7%)	NO
C1_EnsuiteBedroom 92	NO (-10%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_EnsuiteBedroom 93	NO (-5%)	NO
C1_EnsuiteBedroom 94	NO (-11%)	NO
C1_EnsuiteBedroom 95	NO (-2%)	NO
C1_EnsuiteBedroom 96	NO (-66%)	NO
C1_EnsuiteBedroom 97	NO (-49%)	NO
C1_EnsuiteBedroom 98	NO (-44%)	NO
C1_EnsuiteBedroom 99	NO (-42%)	NO
C1_EnsuiteBedroom 100	NO (-39%)	NO
C1_EnsuiteBedroom 101	NO (-41%)	NO
C1_EnsuiteBedroom 102	NO (-45%)	NO
C1_EnsuiteBedroom 103	NO (-43%)	NO
C1_EnsuiteBedroom 104	NO (-50%)	NO
C1_EnsuiteBedroom 105	NO (-45%)	NO
C1_EnsuiteBedroom 106	NO (-46%)	NO
C1_EnsuiteBedroom 107	NO (-55%)	NO
C1_EnsuiteBedroom 108	NO (-42%)	NO
C1_EnsuiteBedroom 109	NO (-49%)	NO
C1_EnsuiteBedroom 110	NO (-50%)	NO
C1_EnsuiteBedroom 111	NO (-57%)	NO
C1_EnsuiteBedroom 112	NO (-60%)	NO
C1_EnsuiteBedroom 113	NO (-65%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	3164	3164
External area [m^2]	3429	3429
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	1	3
Average conductance [W/K]	606	1266
Average U-value [W/m^2K]	0.18	0.37
Alpha value* [%]	23.11	8.11

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
100	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	5.78	18.8
Cooling	1.19	1.11
Auxiliary	7.46	5.23
Lighting	2.12	4.21
Hot water	233.97	234.96
Equipment*	8.82	8.82
TOTAL**	**250.52**	**264.32**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	15.6
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*15.6*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	45.25	79.81
Primary energy [kWh/m^2]	285.76	278.23
Total emissions [kg/m^2]	51.78	52.68

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	7.2	0	0.5	0	2.1	3.84	0	4	0
	Notional	41.2	0	4.3	0	2.1	2.64	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	20	32.2	1.4	1.6	9.5	3.84	5.7	4	6
	Notional	69.1	23.2	7.3	1.5	5.9	2.64	4.4	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Ariel Hotel - Aparthotel - Be Lean

As designed

Date: Mon Nov 27 11:57:13 2023

Administrative information

Building Details

Address:

Certifier details

Name:

Telephone number:

Address: , ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.4"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.4

BRUKL compliance check version: v6.1.b.0

Foundation area [m^2]: 994.35

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	52.57	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	50.31	
Target primary energy rate (TPER), $kWh/m^2.annum$	284.46	
Building primary energy rate (BPER), $kWh/m^2.annum$	278.64	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.1	0.1	External Wall
Floors	0.18	0.11	0.11	Ground Floor
Pitched roofs	0.16	0.1	0.1	Roof
Flat roofs	0.18	-	-	No flat roofs in project
Windows** and roof windows	1.6	1.23	1.27	New Window (5)
Rooflights***	2.2	-	-	No rooflights in project
Personnel doors^	1.6	-	-	No personnel doors in project
Vehicle access & similar large doors	1.3	-	-	No vehicle access or similar large doors in project
High usage entrance doors	3	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

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	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	1

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

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

1- Nat Vent

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.93	-	-	-	-
Standard value	0.93*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output and overall for multi-boiler systems. For single boiler systems >2 MW or any individual boiler in a multi-boiler system, limiting efficiency is 0.88.

2- VRF (99 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.93	-	-	1.1	0.9
Standard value	0.93*	N/A	N/A	1.5^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output and overall for multi-boiler systems. For single boiler systems >2 MW or any individual boiler in a multi-boiler system, limiting efficiency is 0.88.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

1- New HWS Circuit

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	0.93	0
Standard value	0.91	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**General luminaire**	**Display light source**	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_Aparthotel 1	-	-	-
C1_Aparthotel 2	-	-	-
C1_Aparthotel 3	-	-	-
C1_Aparthotel 4	-	-	-
C1_Aparthotel 5	-	-	-
C1_Aparthotel 6	-	-	-
C1_Aparthotel 7	-	-	-
C1_Aparthotel 8	-	-	-
C1_Aparthotel 9	-	-	-
C1_Aparthotel 10	-	-	-
C1_Aparthotel 11	-	-	-
C1_Aparthotel 12	-	-	-
C1_Aparthotel 13	-	-	-
C1_Aparthotel 14	-	-	-
C1_Aparthotel 15	-	-	-
C1_Aparthotel 16	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_Aparthotel 17	-	-	-
C1_Aparthotel 18	-	-	-
C1_Aparthotel 19	-	-	-
C1_Aparthotel 20	-	-	-
C1_Aparthotel 21	-	-	-
C1_Aparthotel 22	-	-	-
C1_Aparthotel 23	-	-	-
C1_Aparthotel 24	-	-	-
C1_Aparthotel 25	-	-	-
C1_Aparthotel 26	-	-	-
C1_Aparthotel 27	-	-	-
C1_Aparthotel 28	-	-	-
C1_Aparthotel 29	-	-	-
C1_Aparthotel 30	-	-	-
C1_Aparthotel 31	-	-	-
C1_Aparthotel 32	-	-	-
C1_Aparthotel 33	-	-	-
C1_Aparthotel 34	-	-	-
C1_Aparthotel 35	-	-	-
C1_Aparthotel 36	-	-	-
C1_Aparthotel 37	-	-	-
C1_Aparthotel 38	-	-	-
C1_Aparthotel 39	-	-	-
C1_Aparthotel 40	-	-	-
C1_Aparthotel 41	-	-	-
C1_Aparthotel 42	-	-	-
C1_Aparthotel 43	-	-	-
C1_Aparthotel 44	-	-	-
C1_Aparthotel 45	-	-	-
C1_Aparthotel 46	-	-	-
C1_Aparthotel 47	-	-	-
C1_Aparthotel 48	-	-	-
C1_Aparthotel 49	-	-	-
C1_Aparthotel 50	-	-	-
C1_Aparthotel 51	-	-	-
C1_Aparthotel 52	-	-	-
C1_Aparthotel 53	-	-	-
C1_Aparthotel 54	-	-	-
C1_Aparthotel 55	-	-	-
C1_Aparthotel 56	-	-	-
C1_Aparthotel 57	-	-	-
C1_Aparthotel 58	-	-	-
C1_Aparthotel 59	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_Aparthotel 60	-	-	-
C1_Aparthotel 61	-	-	-
C1_Aparthotel 62	-	-	-
C1_Aparthotel 63	-	-	-
C1_Aparthotel 64	-	-	-
C1_Aparthotel 65	-	-	-
C1_Aparthotel 66	-	-	-
C1_Aparthotel 67	-	-	-
C1_Aparthotel 68	-	-	-
C1_Aparthotel 69	-	-	-
C1_Aparthotel 70	-	-	-
C1_Aparthotel 71	-	-	-
C1_Aparthotel 72	-	-	-
C1_Aparthotel 73	-	-	-
C1_Aparthotel 74	-	-	-
C1_Aparthotel 75	-	-	-
C1_Aparthotel 76	-	-	-
C1_Aparthotel 77	-	-	-
C1_Aparthotel 78	-	-	-
C1_Aparthotel 79	-	-	-
C1_Aparthotel 80	-	-	-
C1_Aparthotel 81	-	-	-
C1_Aparthotel 82	-	-	-
C1_Aparthotel 83	-	-	-
C1_Aparthotel 84	-	-	-
C1_Aparthotel 85	-	-	-
C1_Aparthotel 86	-	-	-
C1_Aparthotel 87	-	-	-
C1_Aparthotel 88	-	-	-
C1_Aparthotel 89	-	-	-
C1_Aparthotel 90	-	-	-
C1_Aparthotel 91	-	-	-
C1_Aparthotel 92	-	-	-
C1_Aparthotel 93	-	-	-
C1_Aparthotel 94	-	-	-
C1_Aparthotel 95	-	-	-
C1_Aparthotel 96	-	-	-
C1_Aparthotel 97	-	-	-
C1_Aparthotel 98	-	-	-
C1_Plant 1	-	-	-
C1_Reception 1	-	95	-
C1_Circulation 1	-	-	-
C1_Circulation 2	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_Circulation 3	-	-	-
C1_Circulation 4	-	-	-
C1_Circulation 5	-	-	-
C1_Circulation 8	-	-	-
C1_Circulation 9	-	-	-
C1_Laund 1	-	-	-
C1_Store 2	-	-	-
C1_Circulation 10	-	-	-
C1_Circulation 11	-	-	-
C1_Circulation 12	-	-	-
C1_Circulation 13	-	-	-
C1_Circulation 14	-	-	-
C1_Circulation 15	-	-	-
C1_Circulation 16	-	-	-
C1_Circulation 17	-	-	-
C1_Circulation 18	-	-	-
C1_Circulation 19	-	-	-
C1_Circulation 20	-	-	-
C1_Circulation 21	-	-	-
C1_Circulation 22	-	-	-
C1_Circulation 23	-	-	-
C1_Circulation 24	-	-	-
C1_Circulation 25	-	-	-
C1_Circulation 26	-	-	-
C1_Circulation 27	-	-	-
C1_Circulation 28	-	-	-
C1_Circulation 29	-	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_Aparthotel 1	NO (-37%)	NO
C1_Aparthotel 2	NO (-47%)	NO
C1_Aparthotel 3	NO (-50%)	NO
C1_Aparthotel 4	YES (+1%)	NO
C1_Aparthotel 5	NO (-6%)	NO
C1_Aparthotel 6	NO (-2%)	NO
C1_Aparthotel 7	NO (-4%)	NO
C1_Aparthotel 8	YES (+2%)	NO
C1_Aparthotel 9	NO (-50%)	NO
C1_Aparthotel 10	NO (-47%)	NO
C1_Aparthotel 11	NO (-37%)	NO
C1_Aparthotel 12	NO (-32%)	NO
C1_Aparthotel 13	NO (-33%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_Aparthotel 14	NO (-25%)	NO
C1_Aparthotel 15	NO (-30%)	NO
C1_Aparthotel 16	NO (-31%)	NO
C1_Aparthotel 17	NO (-30%)	NO
C1_Aparthotel 18	NO (-24%)	NO
C1_Aparthotel 19	NO (-32%)	NO
C1_Aparthotel 20	NO (-31%)	NO
C1_Aparthotel 21	NO (-37%)	NO
C1_Aparthotel 22	NO (-47%)	NO
C1_Aparthotel 23	NO (-50%)	NO
C1_Aparthotel 24	NO (-24%)	NO
C1_Aparthotel 25	NO (-31%)	NO
C1_Aparthotel 26	NO (-29%)	NO
C1_Aparthotel 27	NO (-30%)	NO
C1_Aparthotel 28	NO (-30%)	NO
C1_Aparthotel 29	NO (-28%)	NO
C1_Aparthotel 30	NO (-27%)	NO
C1_Aparthotel 31	NO (-50%)	NO
C1_Aparthotel 32	NO (-47%)	NO
C1_Aparthotel 33	NO (-37%)	NO
C1_Aparthotel 34	NO (-31%)	NO
C1_Aparthotel 35	NO (-32%)	NO
C1_Aparthotel 36	NO (-38%)	NO
C1_Aparthotel 37	NO (-22%)	NO
C1_Aparthotel 38	NO (-28%)	NO
C1_Aparthotel 39	NO (-29%)	NO
C1_Aparthotel 40	NO (-32%)	NO
C1_Aparthotel 41	NO (-30%)	NO
C1_Aparthotel 42	NO (-30%)	NO
C1_Aparthotel 43	NO (-27%)	NO
C1_Aparthotel 44	NO (-21%)	NO
C1_Aparthotel 45	NO (-36%)	NO
C1_Aparthotel 46	NO (-30%)	NO
C1_Aparthotel 47	NO (-30%)	NO
C1_Aparthotel 48	NO (-37%)	NO
C1_Aparthotel 49	NO (-47%)	NO
C1_Aparthotel 50	NO (-50%)	NO
C1_Aparthotel 51	NO (-24%)	NO
C1_Aparthotel 52	NO (-31%)	NO
C1_Aparthotel 53	NO (-29%)	NO
C1_Aparthotel 54	NO (-30%)	NO
C1_Aparthotel 55	NO (-30%)	NO
C1_Aparthotel 56	NO (-28%)	NO
C1_Aparthotel 57	NO (-27%)	NO
C1_Aparthotel 58	NO (-50%)	NO
C1_Aparthotel 59	NO (-47%)	NO
C1_Aparthotel 60	NO (-37%)	NO
C1_Aparthotel 61	NO (-31%)	NO
C1_Aparthotel 62	NO (-29%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_Aparthotel 63	NO (-37%)	NO
C1_Aparthotel 64	NO (-19%)	NO
C1_Aparthotel 65	NO (-26%)	NO
C1_Aparthotel 66	NO (-27%)	NO
C1_Aparthotel 67	NO (-27%)	NO
C1_Aparthotel 68	NO (-26%)	NO
C1_Aparthotel 69	NO (-27%)	NO
C1_Aparthotel 70	NO (-24%)	NO
C1_Aparthotel 71	NO (-17%)	NO
C1_Aparthotel 72	NO (-34%)	NO
C1_Aparthotel 73	NO (-29%)	NO
C1_Aparthotel 74	NO (-30%)	NO
C1_Aparthotel 75	NO (-37%)	NO
C1_Aparthotel 76	NO (-47%)	NO
C1_Aparthotel 77	NO (-50%)	NO
C1_Aparthotel 78	NO (-62%)	NO
C1_Aparthotel 79	NO (-62%)	NO
C1_Aparthotel 80	NO (-60%)	NO
C1_Aparthotel 81	NO (-57%)	NO
C1_Aparthotel 82	NO (-56%)	NO
C1_Aparthotel 83	NO (-56%)	NO
C1_Aparthotel 84	NO (-53%)	NO
C1_Aparthotel 85	NO (-50%)	NO
C1_Aparthotel 86	NO (-47%)	NO
C1_Aparthotel 87	NO (-37%)	NO
C1_Aparthotel 88	NO (-30%)	NO
C1_Aparthotel 89	NO (-27%)	NO
C1_Aparthotel 90	NO (-51%)	NO
C1_Aparthotel 91	NO (-17%)	NO
C1_Aparthotel 92	NO (-21%)	NO
C1_Aparthotel 93	NO (-21%)	NO
C1_Aparthotel 94	NO (-20%)	NO
C1_Aparthotel 95	NO (-19%)	NO
C1_Aparthotel 96	NO (-51%)	NO
C1_Aparthotel 97	NO (-28%)	NO
C1_Aparthotel 98	NO (-30%)	NO
C1_Reception 1	YES (+52%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	4069	4069
External area [m^2]	4911	4911
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	1	3
Average conductance [W/K]	978	1831
Average U-value [W/m^2K]	0.2	0.37
Alpha value* [%]	29.89	14.89

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
100	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	3.66	18.93
Cooling	1.62	1.47
Auxiliary	7.52	5.21
Lighting	2.67	5.14
Hot water	228.43	228.9
Equipment*	17.19	17.19
TOTAL**	**243.9**	**259.65**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	8.11
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*8.11*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	47.38	86.15
Primary energy [kWh/m^2]	278.64	284.46
Total emissions [kg/m^2]	50.31	52.57

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	9.7	0	3	0	2.1	0.89	0	0.93	0
	Notional	41.1	0	13.3	0	2.1	0.86	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	13.3	43.7	4.1	2.1	9.4	0.89	5.7	0.93	6
	Notional	67.7	30.5	21.9	1.9	5.9	0.86	4.4	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Ariel Hotel - Proposed Extension - Be Green

As designed

Date: Mon Nov 27 14:09:19 2023

Administrative information

Building Details

Address:

Certifier details

Name:

Telephone number:

Address: , ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.4"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.4

BRUKL compliance check version: v6.1.b.0

Foundation area [m^2]: 1487.87

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	12.68	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	5.03	
Target primary energy rate (TPER), $kWh/m^2.annum$	137.64	
Building primary energy rate (BPER), $kWh/m^2.annum$	52.28	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.1	0.1	Existing External Wall
Floors	0.18	0.1	0.1	Exposed Floor
Pitched roofs	0.16	0.1	0.1	Roof
Flat roofs	0.18	-	-	No flat roofs in project
Windows** and roof windows	1.6	1.17	1.25	New Window (4)
Rooflights***	2.2	-	-	No rooflights in project
Personnel doors^	1.6	-	-	No personnel doors in project
Vehicle access & similar large doors	1.3	-	-	No vehicle access or similar large doors in project
High usage entrance doors	3	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

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	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	1

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

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

1- Nat Vent

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

2- VRF (101 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4	-	-	1.1	0.7
Standard value	2.5*	N/A	N/A	1.5^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

1- New HWS Circuit

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	4	0
Standard value	0.91	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**General luminaire**	**Display light source**	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_EnsuiteBedroom 13	-	-	-
C1_EnsuiteBedroom 14	-	-	-
C1_EnsuiteBedroom 15	-	-	-
C1_EnsuiteBedroom 16	-	-	-
C1_EnsuiteBedroom 17	-	-	-
C1_EnsuiteBedroom 18	-	-	-
C1_EnsuiteBedroom 19	-	-	-
C1_EnsuiteBedroom 20	-	-	-
C1_EnsuiteBedroom 21	-	-	-
C1_EnsuiteBedroom 22	-	-	-
C1_EnsuiteBedroom 23	-	-	-
C1_EnsuiteBedroom 24	-	-	-
C1_EnsuiteBedroom 25	-	-	-
C1_EnsuiteBedroom 26	-	-	-
C1_EnsuiteBedroom 27	-	-	-
C1_EnsuiteBedroom 28	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_EnsuiteBedroom 29	-	-	-
C1_EnsuiteBedroom 30	-	-	-
C1_EnsuiteBedroom 31	-	-	-
C1_EnsuiteBedroom 32	-	-	-
C1_EnsuiteBedroom 33	-	-	-
C1_EnsuiteBedroom 34	-	-	-
C1_EnsuiteBedroom 35	-	-	-
C1_EnsuiteBedroom 36	-	-	-
C1_EnsuiteBedroom 37	-	-	-
C1_EnsuiteBedroom 38	-	-	-
C1_EnsuiteBedroom 39	-	-	-
C1_EnsuiteBedroom 40	-	-	-
C1_EnsuiteBedroom 41	-	-	-
C1_EnsuiteBedroom 42	-	-	-
C1_EnsuiteBedroom 43	-	-	-
C1_EnsuiteBedroom 44	-	-	-
C1_EnsuiteBedroom 45	-	-	-
C1_EnsuiteBedroom 46	-	-	-
C1_EnsuiteBedroom 47	-	-	-
C1_EnsuiteBedroom 48	-	-	-
C1_EnsuiteBedroom 49	-	-	-
C1_EnsuiteBedroom 50	-	-	-
C1_EnsuiteBedroom 51	-	-	-
C1_EnsuiteBedroom 52	-	-	-
C1_EnsuiteBedroom 53	-	-	-
C1_EnsuiteBedroom 54	-	-	-
C1_EnsuiteBedroom 55	-	-	-
C1_EnsuiteBedroom 56	-	-	-
C1_EnsuiteBedroom 57	-	-	-
C1_EnsuiteBedroom 58	-	-	-
C1_EnsuiteBedroom 59	-	-	-
C1_EnsuiteBedroom 60	-	-	-
C1_EnsuiteBedroom 61	-	-	-
C1_EnsuiteBedroom 62	-	-	-
C1_EnsuiteBedroom 63	-	-	-
C1_EnsuiteBedroom 64	-	-	-
C1_EnsuiteBedroom 65	-	-	-
C1_EnsuiteBedroom 66	-	-	-
C1_EnsuiteBedroom 67	-	-	-
C1_EnsuiteBedroom 68	-	-	-
C1_EnsuiteBedroom 69	-	-	-
C1_EnsuiteBedroom 70	-	-	-
C1_EnsuiteBedroom 71	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_EnsuiteBedroom 72	-	-	-
C1_EnsuiteBedroom 73	-	-	-
C1_EnsuiteBedroom 74	-	-	-
C1_EnsuiteBedroom 75	-	-	-
C1_EnsuiteBedroom 76	-	-	-
C1_EnsuiteBedroom 77	-	-	-
C1_EnsuiteBedroom 78	-	-	-
C1_EnsuiteBedroom 79	-	-	-
C1_EnsuiteBedroom 80	-	-	-
C1_EnsuiteBedroom 81	-	-	-
C1_EnsuiteBedroom 82	-	-	-
C1_EnsuiteBedroom 83	-	-	-
C1_EnsuiteBedroom 84	-	-	-
C1_EnsuiteBedroom 85	-	-	-
C1_EnsuiteBedroom 86	-	-	-
C1_EnsuiteBedroom 87	-	-	-
C1_EnsuiteBedroom 88	-	-	-
C1_EnsuiteBedroom 89	-	-	-
C1_EnsuiteBedroom 90	-	-	-
C1_EnsuiteBedroom 91	-	-	-
C1_EnsuiteBedroom 92	-	-	-
C1_EnsuiteBedroom 93	-	-	-
C1_EnsuiteBedroom 94	-	-	-
C1_EnsuiteBedroom 95	-	-	-
C1_EnsuiteBedroom 96	-	-	-
C1_EnsuiteBedroom 97	-	-	-
C1_EnsuiteBedroom 98	-	-	-
C1_EnsuiteBedroom 99	-	-	-
C1_EnsuiteBedroom 100	-	-	-
C1_EnsuiteBedroom 101	-	-	-
C1_EnsuiteBedroom 102	-	-	-
C1_EnsuiteBedroom 103	-	-	-
C1_EnsuiteBedroom 104	-	-	-
C1_EnsuiteBedroom 105	-	-	-
C1_EnsuiteBedroom 106	-	-	-
C1_EnsuiteBedroom 107	-	-	-
C1_EnsuiteBedroom 108	-	-	-
C1_EnsuiteBedroom 109	-	-	-
C1_EnsuiteBedroom 110	-	-	-
C1_EnsuiteBedroom 111	-	-	-
C1_EnsuiteBedroom 112	-	-	-
C1_EnsuiteBedroom 113	-	-	-
C1_Circulation 30	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_Circulation 31	-	-	-
C1_Store 3	-	-	-
C1_Store 4	-	-	-
C1_Store 5	-	-	-
C1_Store 6	-	-	-
C1_Store 7	-	-	-
C1_Store 8	-	-	-
C1_Store 9	-	-	-
C1_Store 10	-	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_EnsuiteBedroom 13	YES (+4%)	NO
C1_EnsuiteBedroom 14	NO (-23%)	NO
C1_EnsuiteBedroom 15	NO (-32%)	NO
C1_EnsuiteBedroom 16	NO (-33%)	NO
C1_EnsuiteBedroom 17	NO (-40%)	NO
C1_EnsuiteBedroom 18	NO (-41%)	NO
C1_EnsuiteBedroom 19	NO (-44%)	NO
C1_EnsuiteBedroom 20	NO (-42%)	NO
C1_EnsuiteBedroom 21	NO (-39%)	NO
C1_EnsuiteBedroom 22	NO (-40%)	NO
C1_EnsuiteBedroom 23	NO (-32%)	NO
C1_EnsuiteBedroom 24	NO (-29%)	NO
C1_EnsuiteBedroom 25	NO (-24%)	NO
C1_EnsuiteBedroom 26	NO (-19%)	NO
C1_EnsuiteBedroom 27	NO (-16%)	NO
C1_EnsuiteBedroom 28	NO (-14%)	NO
C1_EnsuiteBedroom 29	NO (-12%)	NO
C1_EnsuiteBedroom 30	NO (-12%)	NO
C1_EnsuiteBedroom 31	NO (-8%)	NO
C1_EnsuiteBedroom 32	NO (-14%)	NO
C1_EnsuiteBedroom 33	NO (-15%)	NO
C1_EnsuiteBedroom 34	NO (-17%)	NO
C1_EnsuiteBedroom 35	NO (-19%)	NO
C1_EnsuiteBedroom 36	NO (-20%)	NO
C1_EnsuiteBedroom 37	NO (-20%)	NO
C1_EnsuiteBedroom 38	NO (-22%)	NO
C1_EnsuiteBedroom 39	NO (-13%)	NO
C1_EnsuiteBedroom 40	NO (-9%)	NO
C1_EnsuiteBedroom 41	NO (-7%)	NO
C1_EnsuiteBedroom 42	NO (-10%)	NO
C1_EnsuiteBedroom 43	NO (-5%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_EnsuiteBedroom 44	NO (-11%)	NO
C1_EnsuiteBedroom 45	NO (-2%)	NO
C1_EnsuiteBedroom 46	NO (-69%)	NO
C1_EnsuiteBedroom 47	NO (-53%)	NO
C1_EnsuiteBedroom 48	NO (-48%)	NO
C1_EnsuiteBedroom 49	NO (-46%)	NO
C1_EnsuiteBedroom 50	NO (-43%)	NO
C1_EnsuiteBedroom 51	NO (-44%)	NO
C1_EnsuiteBedroom 52	NO (-46%)	NO
C1_EnsuiteBedroom 53	NO (-44%)	NO
C1_EnsuiteBedroom 54	NO (-51%)	NO
C1_EnsuiteBedroom 55	NO (-46%)	NO
C1_EnsuiteBedroom 56	NO (-47%)	NO
C1_EnsuiteBedroom 57	NO (-58%)	NO
C1_EnsuiteBedroom 58	NO (-45%)	NO
C1_EnsuiteBedroom 59	NO (-53%)	NO
C1_EnsuiteBedroom 60	NO (-54%)	NO
C1_EnsuiteBedroom 61	NO (-61%)	NO
C1_EnsuiteBedroom 62	NO (-63%)	NO
C1_EnsuiteBedroom 63	NO (-65%)	NO
C1_EnsuiteBedroom 64	NO (-13%)	NO
C1_EnsuiteBedroom 65	NO (-32%)	NO
C1_EnsuiteBedroom 66	NO (-33%)	NO
C1_EnsuiteBedroom 67	NO (-40%)	NO
C1_EnsuiteBedroom 68	NO (-41%)	NO
C1_EnsuiteBedroom 69	NO (-44%)	NO
C1_EnsuiteBedroom 70	NO (-42%)	NO
C1_EnsuiteBedroom 71	NO (-39%)	NO
C1_EnsuiteBedroom 72	NO (-40%)	NO
C1_EnsuiteBedroom 73	NO (-32%)	NO
C1_EnsuiteBedroom 74	NO (-29%)	NO
C1_EnsuiteBedroom 75	NO (-24%)	NO
C1_EnsuiteBedroom 76	NO (-19%)	NO
C1_EnsuiteBedroom 77	NO (-16%)	NO
C1_EnsuiteBedroom 78	NO (-14%)	NO
C1_EnsuiteBedroom 79	NO (-12%)	NO
C1_EnsuiteBedroom 80	NO (-12%)	NO
C1_EnsuiteBedroom 81	NO (-8%)	NO
C1_EnsuiteBedroom 82	NO (-14%)	NO
C1_EnsuiteBedroom 83	NO (-15%)	NO
C1_EnsuiteBedroom 84	NO (-17%)	NO
C1_EnsuiteBedroom 85	NO (-19%)	NO
C1_EnsuiteBedroom 86	NO (-20%)	NO
C1_EnsuiteBedroom 87	NO (-20%)	NO
C1_EnsuiteBedroom 88	NO (-22%)	NO
C1_EnsuiteBedroom 89	NO (-13%)	NO
C1_EnsuiteBedroom 90	NO (-9%)	NO
C1_EnsuiteBedroom 91	NO (-7%)	NO
C1_EnsuiteBedroom 92	NO (-10%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_EnsuiteBedroom 93	NO (-5%)	NO
C1_EnsuiteBedroom 94	NO (-11%)	NO
C1_EnsuiteBedroom 95	NO (-2%)	NO
C1_EnsuiteBedroom 96	NO (-66%)	NO
C1_EnsuiteBedroom 97	NO (-49%)	NO
C1_EnsuiteBedroom 98	NO (-44%)	NO
C1_EnsuiteBedroom 99	NO (-42%)	NO
C1_EnsuiteBedroom 100	NO (-39%)	NO
C1_EnsuiteBedroom 101	NO (-41%)	NO
C1_EnsuiteBedroom 102	NO (-45%)	NO
C1_EnsuiteBedroom 103	NO (-43%)	NO
C1_EnsuiteBedroom 104	NO (-50%)	NO
C1_EnsuiteBedroom 105	NO (-45%)	NO
C1_EnsuiteBedroom 106	NO (-46%)	NO
C1_EnsuiteBedroom 107	NO (-55%)	NO
C1_EnsuiteBedroom 108	NO (-42%)	NO
C1_EnsuiteBedroom 109	NO (-49%)	NO
C1_EnsuiteBedroom 110	NO (-50%)	NO
C1_EnsuiteBedroom 111	NO (-57%)	NO
C1_EnsuiteBedroom 112	NO (-60%)	NO
C1_EnsuiteBedroom 113	NO (-65%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	3164	3164
External area [m^2]	3429	3429
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	1	3
Average conductance [W/K]	606	1266
Average U-value [W/m^2K]	0.18	0.37
Alpha value* [%]	23.11	8.11

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
100	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	1.34	6.12
Cooling	1.19	1.11
Auxiliary	7.46	5.23
Lighting	2.12	4.21
Hot water	54.4	76.4
Equipment*	8.82	8.82
TOTAL**	**66.51**	**93.08**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	31.26	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*31.26*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	45.25	79.81
Primary energy [kWh/m^2]	52.28	137.64
Total emissions [kg/m^2]	5.03	12.68

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	7.2	0	0.5	0	2.1	3.84	0	4	0
	Notional	41.2	0	4.3	0	2.1	2.64	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	20	32.2	1.4	1.6	9.5	3.84	5.7	4	6
	Notional	69.1	23.2	7.3	1.5	5.9	2.64	4.4	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Ariel Hotel - Aparthotel - Be Green

As designed

Date: Mon Nov 27 15:52:55 2023

Administrative information

Building Details

Address:

Certifier details

Name:

Telephone number:

Address: , ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.4"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.4

BRUKL compliance check version: v6.1.b.0

Foundation area [m^2]: 994.35

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	12.59	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	5.59	
Target primary energy rate (TPER), $kWh/m^2.annum$	136.65	
Building primary energy rate (BPER), $kWh/m^2.annum$	58.81	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.1	0.1	External Wall
Floors	0.18	0.11	0.11	Ground Floor
Pitched roofs	0.16	0.1	0.1	Roof
Flat roofs	0.18	-	-	No flat roofs in project
Windows** and roof windows	1.6	1.23	1.27	New Window (5)
Rooflights***	2.2	-	-	No rooflights in project
Personnel doors^	1.6	-	-	No personnel doors in project
Vehicle access & similar large doors	1.3	-	-	No vehicle access or similar large doors in project
High usage entrance doors	3	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

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	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	1

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

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

1- Nat Vent

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

2- VRF (99 Zones)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4	-	-	1.1	0.9
Standard value	2.5*	N/A	N/A	1.5^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

1- New HWS Circuit

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	4	0
Standard value	0.91	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**General luminaire**	**Display light source**	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_Aparthotel 1	-	-	-
C1_Aparthotel 2	-	-	-
C1_Aparthotel 3	-	-	-
C1_Aparthotel 4	-	-	-
C1_Aparthotel 5	-	-	-
C1_Aparthotel 6	-	-	-
C1_Aparthotel 7	-	-	-
C1_Aparthotel 8	-	-	-
C1_Aparthotel 9	-	-	-
C1_Aparthotel 10	-	-	-
C1_Aparthotel 11	-	-	-
C1_Aparthotel 12	-	-	-
C1_Aparthotel 13	-	-	-
C1_Aparthotel 14	-	-	-
C1_Aparthotel 15	-	-	-
C1_Aparthotel 16	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_Aparthotel 17	-	-	-
C1_Aparthotel 18	-	-	-
C1_Aparthotel 19	-	-	-
C1_Aparthotel 20	-	-	-
C1_Aparthotel 21	-	-	-
C1_Aparthotel 22	-	-	-
C1_Aparthotel 23	-	-	-
C1_Aparthotel 24	-	-	-
C1_Aparthotel 25	-	-	-
C1_Aparthotel 26	-	-	-
C1_Aparthotel 27	-	-	-
C1_Aparthotel 28	-	-	-
C1_Aparthotel 29	-	-	-
C1_Aparthotel 30	-	-	-
C1_Aparthotel 31	-	-	-
C1_Aparthotel 32	-	-	-
C1_Aparthotel 33	-	-	-
C1_Aparthotel 34	-	-	-
C1_Aparthotel 35	-	-	-
C1_Aparthotel 36	-	-	-
C1_Aparthotel 37	-	-	-
C1_Aparthotel 38	-	-	-
C1_Aparthotel 39	-	-	-
C1_Aparthotel 40	-	-	-
C1_Aparthotel 41	-	-	-
C1_Aparthotel 42	-	-	-
C1_Aparthotel 43	-	-	-
C1_Aparthotel 44	-	-	-
C1_Aparthotel 45	-	-	-
C1_Aparthotel 46	-	-	-
C1_Aparthotel 47	-	-	-
C1_Aparthotel 48	-	-	-
C1_Aparthotel 49	-	-	-
C1_Aparthotel 50	-	-	-
C1_Aparthotel 51	-	-	-
C1_Aparthotel 52	-	-	-
C1_Aparthotel 53	-	-	-
C1_Aparthotel 54	-	-	-
C1_Aparthotel 55	-	-	-
C1_Aparthotel 56	-	-	-
C1_Aparthotel 57	-	-	-
C1_Aparthotel 58	-	-	-
C1_Aparthotel 59	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_Aparthotel 60	-	-	-
C1_Aparthotel 61	-	-	-
C1_Aparthotel 62	-	-	-
C1_Aparthotel 63	-	-	-
C1_Aparthotel 64	-	-	-
C1_Aparthotel 65	-	-	-
C1_Aparthotel 66	-	-	-
C1_Aparthotel 67	-	-	-
C1_Aparthotel 68	-	-	-
C1_Aparthotel 69	-	-	-
C1_Aparthotel 70	-	-	-
C1_Aparthotel 71	-	-	-
C1_Aparthotel 72	-	-	-
C1_Aparthotel 73	-	-	-
C1_Aparthotel 74	-	-	-
C1_Aparthotel 75	-	-	-
C1_Aparthotel 76	-	-	-
C1_Aparthotel 77	-	-	-
C1_Aparthotel 78	-	-	-
C1_Aparthotel 79	-	-	-
C1_Aparthotel 80	-	-	-
C1_Aparthotel 81	-	-	-
C1_Aparthotel 82	-	-	-
C1_Aparthotel 83	-	-	-
C1_Aparthotel 84	-	-	-
C1_Aparthotel 85	-	-	-
C1_Aparthotel 86	-	-	-
C1_Aparthotel 87	-	-	-
C1_Aparthotel 88	-	-	-
C1_Aparthotel 89	-	-	-
C1_Aparthotel 90	-	-	-
C1_Aparthotel 91	-	-	-
C1_Aparthotel 92	-	-	-
C1_Aparthotel 93	-	-	-
C1_Aparthotel 94	-	-	-
C1_Aparthotel 95	-	-	-
C1_Aparthotel 96	-	-	-
C1_Aparthotel 97	-	-	-
C1_Aparthotel 98	-	-	-
C1_Plant 1	-	-	-
C1_Reception 1	-	95	-
C1_Circulation 1	-	-	-
C1_Circulation 2	-	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
C1_Circulation 3	-	-	-
C1_Circulation 4	-	-	-
C1_Circulation 5	-	-	-
C1_Circulation 8	-	-	-
C1_Circulation 9	-	-	-
C1_Laund 1	-	-	-
C1_Store 2	-	-	-
C1_Circulation 10	-	-	-
C1_Circulation 11	-	-	-
C1_Circulation 12	-	-	-
C1_Circulation 13	-	-	-
C1_Circulation 14	-	-	-
C1_Circulation 15	-	-	-
C1_Circulation 16	-	-	-
C1_Circulation 17	-	-	-
C1_Circulation 18	-	-	-
C1_Circulation 19	-	-	-
C1_Circulation 20	-	-	-
C1_Circulation 21	-	-	-
C1_Circulation 22	-	-	-
C1_Circulation 23	-	-	-
C1_Circulation 24	-	-	-
C1_Circulation 25	-	-	-
C1_Circulation 26	-	-	-
C1_Circulation 27	-	-	-
C1_Circulation 28	-	-	-
C1_Circulation 29	-	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_Aparthotel 1	NO (-37%)	NO
C1_Aparthotel 2	NO (-47%)	NO
C1_Aparthotel 3	NO (-50%)	NO
C1_Aparthotel 4	YES (+1%)	NO
C1_Aparthotel 5	NO (-6%)	NO
C1_Aparthotel 6	NO (-2%)	NO
C1_Aparthotel 7	NO (-4%)	NO
C1_Aparthotel 8	YES (+2%)	NO
C1_Aparthotel 9	NO (-50%)	NO
C1_Aparthotel 10	NO (-47%)	NO
C1_Aparthotel 11	NO (-37%)	NO
C1_Aparthotel 12	NO (-32%)	NO
C1_Aparthotel 13	NO (-33%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_Aparthotel 14	NO (-25%)	NO
C1_Aparthotel 15	NO (-30%)	NO
C1_Aparthotel 16	NO (-31%)	NO
C1_Aparthotel 17	NO (-30%)	NO
C1_Aparthotel 18	NO (-24%)	NO
C1_Aparthotel 19	NO (-32%)	NO
C1_Aparthotel 20	NO (-31%)	NO
C1_Aparthotel 21	NO (-37%)	NO
C1_Aparthotel 22	NO (-47%)	NO
C1_Aparthotel 23	NO (-50%)	NO
C1_Aparthotel 24	NO (-24%)	NO
C1_Aparthotel 25	NO (-31%)	NO
C1_Aparthotel 26	NO (-29%)	NO
C1_Aparthotel 27	NO (-30%)	NO
C1_Aparthotel 28	NO (-30%)	NO
C1_Aparthotel 29	NO (-28%)	NO
C1_Aparthotel 30	NO (-27%)	NO
C1_Aparthotel 31	NO (-50%)	NO
C1_Aparthotel 32	NO (-47%)	NO
C1_Aparthotel 33	NO (-37%)	NO
C1_Aparthotel 34	NO (-31%)	NO
C1_Aparthotel 35	NO (-32%)	NO
C1_Aparthotel 36	NO (-38%)	NO
C1_Aparthotel 37	NO (-22%)	NO
C1_Aparthotel 38	NO (-28%)	NO
C1_Aparthotel 39	NO (-29%)	NO
C1_Aparthotel 40	NO (-32%)	NO
C1_Aparthotel 41	NO (-30%)	NO
C1_Aparthotel 42	NO (-30%)	NO
C1_Aparthotel 43	NO (-27%)	NO
C1_Aparthotel 44	NO (-21%)	NO
C1_Aparthotel 45	NO (-36%)	NO
C1_Aparthotel 46	NO (-30%)	NO
C1_Aparthotel 47	NO (-30%)	NO
C1_Aparthotel 48	NO (-37%)	NO
C1_Aparthotel 49	NO (-47%)	NO
C1_Aparthotel 50	NO (-50%)	NO
C1_Aparthotel 51	NO (-24%)	NO
C1_Aparthotel 52	NO (-31%)	NO
C1_Aparthotel 53	NO (-29%)	NO
C1_Aparthotel 54	NO (-30%)	NO
C1_Aparthotel 55	NO (-30%)	NO
C1_Aparthotel 56	NO (-28%)	NO
C1_Aparthotel 57	NO (-27%)	NO
C1_Aparthotel 58	NO (-50%)	NO
C1_Aparthotel 59	NO (-47%)	NO
C1_Aparthotel 60	NO (-37%)	NO
C1_Aparthotel 61	NO (-31%)	NO
C1_Aparthotel 62	NO (-29%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
C1_Aparthotel 63	NO (-37%)	NO
C1_Aparthotel 64	NO (-19%)	NO
C1_Aparthotel 65	NO (-26%)	NO
C1_Aparthotel 66	NO (-27%)	NO
C1_Aparthotel 67	NO (-27%)	NO
C1_Aparthotel 68	NO (-26%)	NO
C1_Aparthotel 69	NO (-27%)	NO
C1_Aparthotel 70	NO (-24%)	NO
C1_Aparthotel 71	NO (-17%)	NO
C1_Aparthotel 72	NO (-34%)	NO
C1_Aparthotel 73	NO (-29%)	NO
C1_Aparthotel 74	NO (-30%)	NO
C1_Aparthotel 75	NO (-37%)	NO
C1_Aparthotel 76	NO (-47%)	NO
C1_Aparthotel 77	NO (-50%)	NO
C1_Aparthotel 78	NO (-62%)	NO
C1_Aparthotel 79	NO (-62%)	NO
C1_Aparthotel 80	NO (-60%)	NO
C1_Aparthotel 81	NO (-57%)	NO
C1_Aparthotel 82	NO (-56%)	NO
C1_Aparthotel 83	NO (-56%)	NO
C1_Aparthotel 84	NO (-53%)	NO
C1_Aparthotel 85	NO (-50%)	NO
C1_Aparthotel 86	NO (-47%)	NO
C1_Aparthotel 87	NO (-37%)	NO
C1_Aparthotel 88	NO (-30%)	NO
C1_Aparthotel 89	NO (-27%)	NO
C1_Aparthotel 90	NO (-51%)	NO
C1_Aparthotel 91	NO (-17%)	NO
C1_Aparthotel 92	NO (-21%)	NO
C1_Aparthotel 93	NO (-21%)	NO
C1_Aparthotel 94	NO (-20%)	NO
C1_Aparthotel 95	NO (-19%)	NO
C1_Aparthotel 96	NO (-51%)	NO
C1_Aparthotel 97	NO (-28%)	NO
C1_Aparthotel 98	NO (-30%)	NO
C1_Reception 1	YES (+52%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	4069	4069
External area [m^2]	4911	4911
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	1	3
Average conductance [W/K]	978	1831
Average U-value [W/m^2K]	0.2	0.37
Alpha value* [%]	29.89	14.89

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
100	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	0.85	6.17
Cooling	1.62	1.47
Auxiliary	7.52	5.21
Lighting	2.67	5.14
Hot water	54.22	74.43
Equipment*	17.19	17.19
TOTAL**	**66.88**	**92.42**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	27.15	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*27.15*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	47.38	86.15
Primary energy [kWh/m^2]	58.81	136.65
Total emissions [kg/m^2]	5.59	12.59

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	9.7	0	0.7	0	2.1	3.84	0	4	0
	Notional	41.1	0	4.3	0	2.1	2.64	0	----	----
[ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	13.3	43.7	1	2.1	9.4	3.84	5.7	4	6
	Notional	67.7	30.5	7.1	1.9	5.9	2.64	4.4	----	----

Key to terms

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

A4. RENEWABLE ENERGY FEASIBILITY ASSESSMENT

Technology	Appraisal	Included in Development?
Biomass	This technology is not considered a practical solution for reducing carbon dioxide emissions, in the view of storage space requirements for the combustible material, accessibility of the site for regular deliveries of the material and the transport related carbon emissions which are not normally accounted for within energy modelling. Furthermore, high nitrous oxide (NO_x) and particulate matter (PM_x) emissions are associated with the use of biomass fuel, and as the proposed development falls within an Air Quality Management Area (AQMA), permitted emissions will be restricted.	✗
Air Source Heat Pump	This technology is deemed appropriate to provide space and water heating and space cooling to the proposed apart-hotel building. Full details of the proposed system efficiencies and associated carbon dioxide savings are provided in Section 5.	✓
Ground Source Heat Pump	Ground investigation and borehole drilling are likely to be cost prohibitive and may not yield a suitable energy source. In addition to this, the carbon dioxide and energy cost savings arising from the use of this technology are unlikely to be significant when compared to that of the energy efficient gas-fired boilers to be retained for the existing hotel, and the ASHP technology to be employed for the apart-hotel, particularly as high-grade heat is required to generate domestic hot water. The use of ground source heat pumps for the proposed development is therefore not considered viable.	✗

Photovoltaics (PV)	As detailed above in Section 5, the use of PV panels is considered appropriate for this scheme, and its use has been maximised in accordance with the roof space available following the incorporation of plant at the roof level. Full details of the proposed PV arrays, areas, locations, outputs and associated carbon dioxide savings are provided in Section 5.	
Solar Thermal Hot Water (STHW)	This technology is presently rejected as hot water is proposed to be provided by highly efficient air source heat pump (ASHP) hot water cylinders for the apart-hotel, and for the proposed additional hotel rooms via the existing system within the Ariel Hotel building. In addition to this, hot water demand is considered to be outside the energy generating period for the solar thermal panels, meaning its ability to significantly reduce carbon emissions during operation is limited. For the purposes of this Energy Strategy, the use of STHW technology has therefore not been specified. However, should this technology be incorporated in the future, details of its location, efficiency, outputs and associated carbon dioxide emissions savings should be provided as part of a Reserved Matters Application.	
Wind Turbines	This technology is rejected on the basis of its potential impact on visual amenity and relatively low efficiency from unpredictable, turbulent wind conditions in urban locations.	

A5. GENERAL NOTES

A5.1 The report is based on information available at the time of the writing and discussions with the client during any project meetings. Where any data supplied by the client or from other sources have been used it has been assumed that the information is correct. No responsibility can be accepted by Iceni Projects Ltd for inaccuracies in the data supplied by any other party.

A5.2 The review of planning policy and other requirements does not constitute a detailed review. Its purpose is as a guide to provide the context for the development and to determine the likely requirements of the Local Authority.

A5.3 No site visits have been carried out, unless otherwise specified.

A5.4 This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in guidance may necessitate a re-interpretation of the report in whole or in part after its original submission.

A5.5 The copyright in the written materials shall remain the property of Iceni Projects Ltd but with a royalty-free perpetual licence to the client deemed to be granted on payment in full to Iceni Projects Ltd by the client of the outstanding amounts.

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