



CAMPSFIELD IMMIGRATION  
REMOVAL CENTRE

Planning Application Energy Strategy Report and Statement  
243925\_15206-MZA-XXX-XX-RP-Z-0002-S3-B1110

Security Classification – Official

Revision Number – P09

S3(2) – 10/03/2026

## Document History

Rev	Date	Comment	Author	Checked
P09	10 March 2026	Minor Text Amendments	PB	DK
P08	19 February 2026	Minor Text Amendments	PB	DK
P07	21 January 2026	Front cover update	DK	DK
P06	16 January 2026	Further Comments Incorporated	PB	DK
P05	23 November 2025	Incorporated Report Comments	PB	DK
P04	21 July 2025	Architectural Revisions	PB	DK
P03	25 April 2025	Information	PB	DK
P02	27 August 2024	Information	PB	DK
P01	17 March 2024	Information	PB	DK

# Contents

<b>1.</b>	<b>INTRODUCTION .....</b>	<b>3</b>
1.1	Development Description .....	3
1.2	Report Purpose.....	3
1.3	Buildings Scope and Completed Analysis Outline .....	6
1.4	Key Findings Summary.....	7
1.5	ESD Planning Requirements .....	10
1.6	Building Regulations Part L 2021 (new buildings).....	11
<b>2.</b>	<b>ENERGY STRATEGY .....</b>	<b>13</b>
2.1	Planning ESD Requirements – Design Approach Commentary.....	13
2.2	As-Modelled Building Fabric Performances .....	20
2.3	Part L 2021 – Key Systems Inputs Summary .....	22
2.4	Part L 2021 - BRUKL Performance Outputs.....	26
<b>3.</b>	<b>THERMAL COMFORT (SUMMERTIME OVERHEATING).....</b>	<b>37</b>
3.1	Introduction .....	37
3.2	Moj Standards and BREEAM HEA04 Credit Requirements .....	38
3.3	Compliance Summary .....	41
<b>4.</b>	<b>INTERNAL DAYLIGHTING.....</b>	<b>50</b>
4.1	Key Modelling Inputs Summary .....	50
4.2	Analysis Outputs Summary .....	51
<b>5.</b>	<b>APPENDICES .....</b>	<b>54</b>
5.1	Proposed Photovoltaics Provision .....	54
5.2	IES Compliance Model Images .....	55
5.3	Main Building .....	55
5.4	Assigned Fabric U-value Visualisations.....	63
5.5	Overheating Analysis – Key Modelling Inputs .....	71
5.6	Internal Daylighting Calculation Visualisations .....	78

# **1. INTRODUCTION**

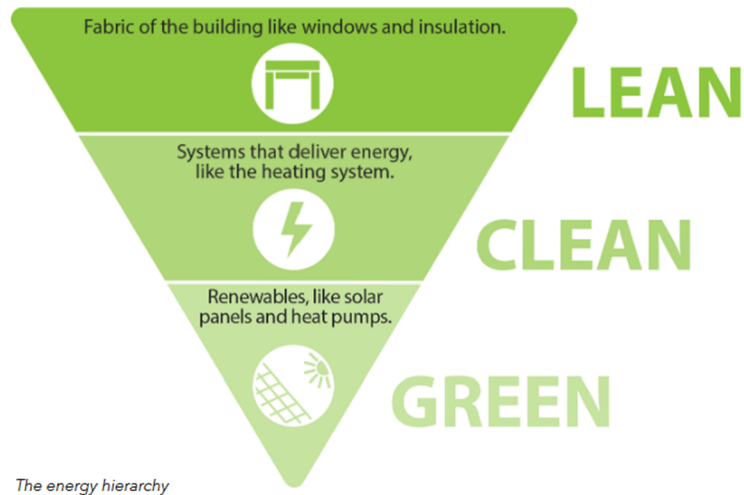
## **1.1 Development Description**

The proposed development comprises the following:

- Erection of Accommodation Blocks, Care and Separation Unit (CASU), Gate House, Visitors' Reception, Escorts' Rest Area and additional modular buildings
- Installation of lighting columns replacement of security fencing and CCTV
- Installation of a fence along the car park boundary. Erection of internal zonal fencing, vehicular and pedestrian gates
- Use of existing access, creation of internal roads and rearrangement of existing car parking and creation of additional parking (including EVC parking bays) for staff and visitors
- Removal of trees and vegetation around the site. Planting of replacement trees, vegetation and biodiversity enhancements
- Provision of additional external communal space
- Installation of solar PV panels above car parking spaces
- Groundworks including excavation associated with the proposed development and the creation of an earth bund on site using excavated material
- Creation of drainage features and installation of oil and drainage interceptors, as part of the site drainage strategy

## **1.2 Report Purpose**

MZA Consulting Engineers have been appointed to produce this Energy Statement to detail the proposed Low Carbon Energy Strategy. The purpose of this report is to support the planning application and to demonstrate preliminary compliance with the requirements of ESD policies 1 to 5 (see section 1.5) of the Cherwell Local Plan 2011 – 2031 (adopted 20<sup>th</sup> July 2015). To meet these requirements, the proposed scheme adopts the accepted industry best practice LEAN/CLEAN/GREEN design philosophy:



### Being **LEAN** – reduce the need for energy where possible

- The proposed specification of highly insulated building fabric, solar control glass and robust air permeability targets will successfully reduce the space conditioning energy demand of the development whilst also optimising occupant comfort levels

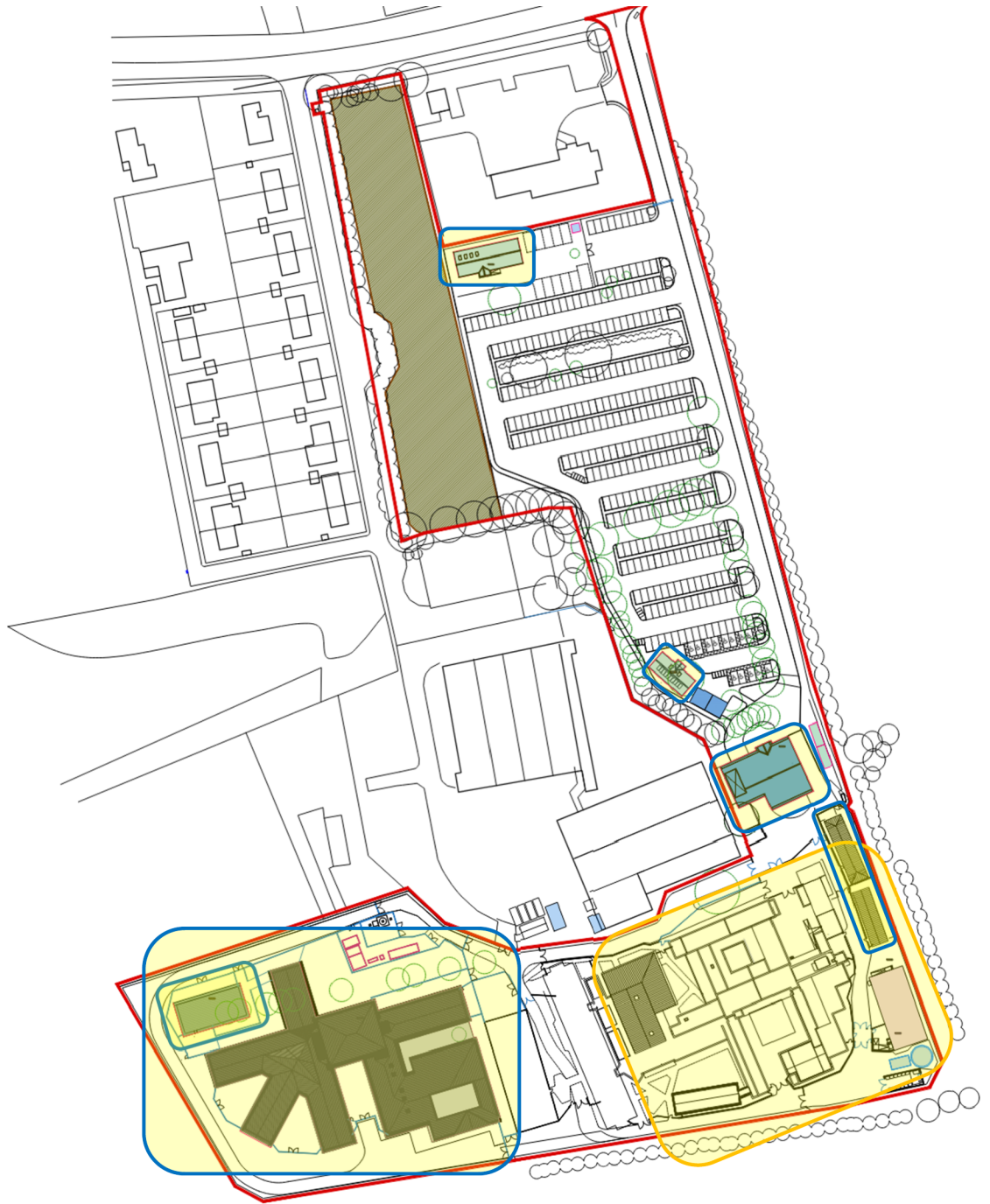
### Being **CLEAN** – use energy in the most efficient manner

- The adoption of a high-efficiency all-electric HVAC strategy and intelligently controlled LED lighting will serve to substantially reduce building energy demands and associated CO<sub>2</sub> emissions
- Highly efficient Air Source Heat Pumps (ASHP's) will meet 100% of the buildings LTHW demands and most DHW requirements
- Buildings are to be predominantly mechanically ventilated and will therefore harness the year-round energy savings and IAQ benefits associated with the careful control of fresh air ingress (via AHUs with heat recovery)
- All buildings will benefit from advanced Building Energy Management systems which will directly monitor and meter all significant HVAC/Lighting energy demands. High efficiency power factor correction is to be adopted site-wide

### Being **GREEN** – supply energy from renewable/low carbon sources

- A substantial site-wide photovoltaics provision is proposed

Following the energy hierarchy approach has resulted in a practical and effective energy strategy that will successfully reduce the ongoing regulated energy demands, lower operating energy costs, and successfully optimise year-round occupant comfort levels.



**Figure 1:** IRC Site Plan (Red Outline) with Proposed Buildings Highlighted (Blue Outlines)

**Note:** Existing Buildings (yellow outline areas only) are shown for information only and do not form part of the planning application.

### 1.3 Buildings Scope and Completed Analysis Outline

The planning stage 2 analysis detailed within this report specifically relates to the predicted performance of the following proposed buildings:

1. **Main Building** – [REDACTED] that includes the main residential areas and significant associated ancillary spaces – **BREEAM Excellent**
2. **North Building** – [REDACTED] residential building – **BREEAM Excellent**
3. **Gatehouse Building** – [REDACTED] building – **BREEAM Excellent**
4. **Escort Rest Building** – [REDACTED] building – **BREEAM Excellent**
5. **Visitors Building** – [REDACTED] building – **BREEAM Excellent**
6. Dojo and Property Store – Existing repurposed [REDACTED] building
7. FM Office and Workshop – Existing repurposed [REDACTED] building
8. Office Building – Existing repurposed [REDACTED] building

**Initial Stage 2 modelling calculations** have been undertaken to:

- Determine Part L 2021 compliance margins including the assessment of regulated energy demands, associated CO<sub>2</sub> emissions and achieved renewable technology offsets
- Where applicable, assess compliance with mandatory BREEAM Excellent Credit ENE01 requirements
- Analyse summertime adaptive thermal comfort (overheating) performances for both current and future climate resilience scenarios
- Calculate the extent of anticipated useful internal daylight ingress

**The developed Energy Strategy has been prepared in line with the following:**

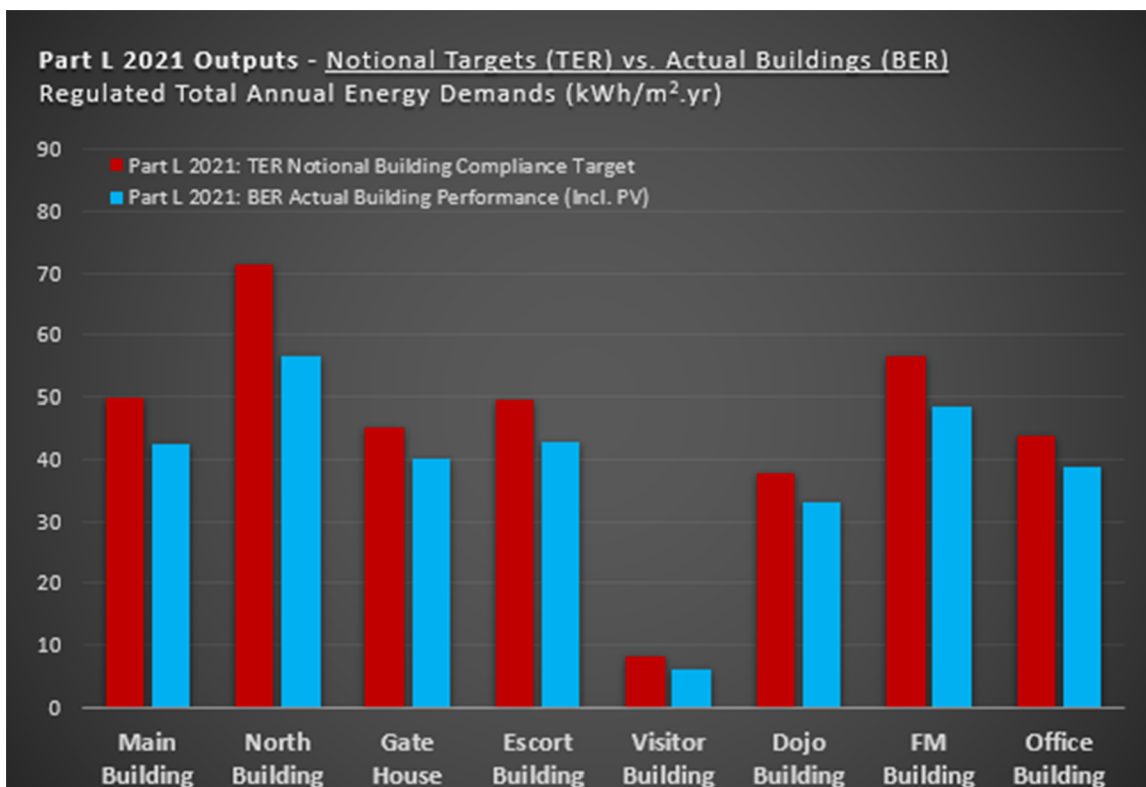
- Planning Sustainability requirements
- Ministry of Justice Technical Standards
- Building Regulations Part L 2021
- The aspiration to minimise operational energy demands/CO<sub>2</sub> emissions
- Targeting of BREEAM 'New Construction' Excellent Ratings – where applicable

All building energy/comfort modelling has been completed by an CIBSE Accredited Low Carbon Assessor (Level 5) and has followed industry standard guidance: the NCM Modelling Guide (2021), CIBSE AM11 Building energy and environmental modelling (2015) and CIBSE TM52/59 (Adaptive thermal comfort – 2013/2017).

## 1.4 Key Findings Summary

The details contained within this Energy Statement are intended to demonstrate:

- Alignment with the operational energy/CO<sub>2</sub> related 'sustainability' requirements as detailed within the **Cherwell Local Plan 2011 - 2031** - adopted 20<sup>th</sup> July 2015
- **For new buildings, Part L 2021 compliance** through the adoption of:
  - High performance building fabric specification
  - Highly efficient all-electric HVAC design which successfully leverages heat pump technologies and mechanical ventilation with heat recovery
  - Energy efficient and intelligently controlled internal lighting schemes
  - Substantial site-based photovoltaics provision
- Where applicable, compliance with energy/CO<sub>2</sub> performance targets as required to help achieve **BREEAM New Construction 'Excellent' ratings**
- Where applicable, compliance with **summertime thermal comfort (overheating avoidance) requirements** as per both MoJ Standards and BREEAM Excellent HEA04 credit
- **Useful natural daylight ingress** benefiting occupant wellbeing and reduced electrical lighting demands



**Figure 2:** Per Building Part L 2021 Compliance Performance Summary (incl. photovoltaics)

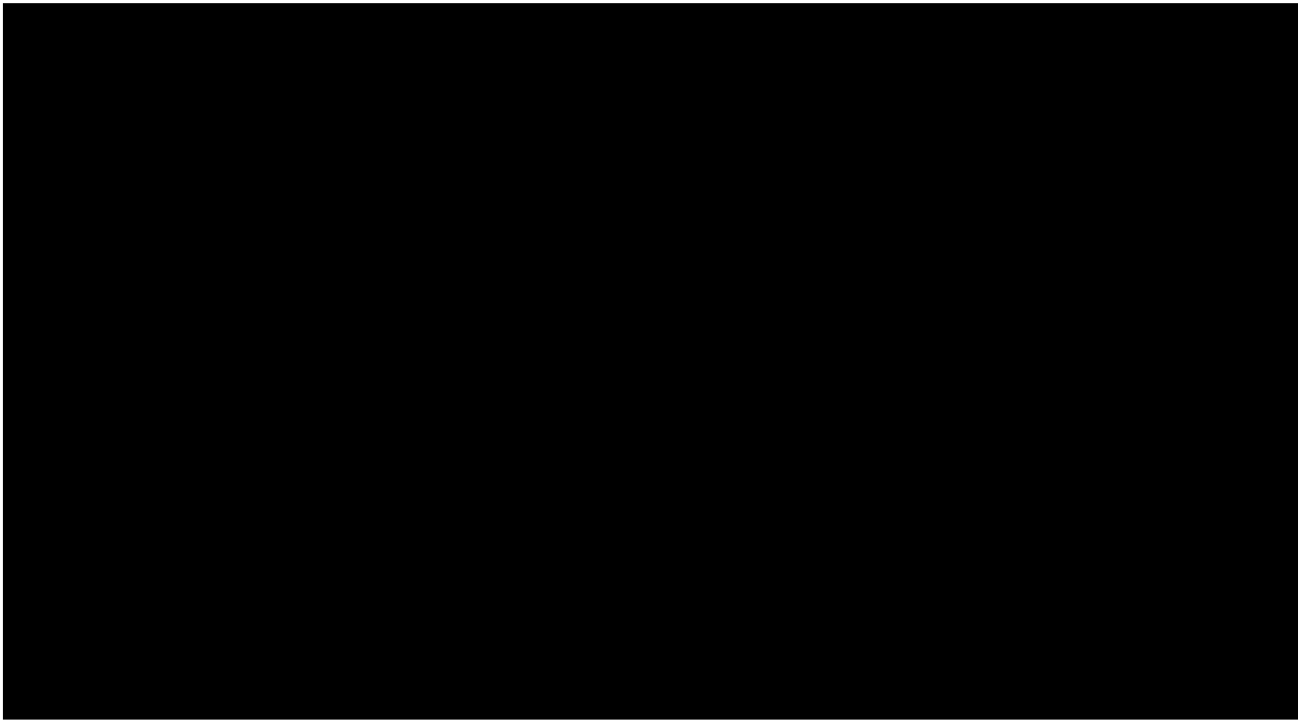
Building(s)	Notional Target Emission Rate kgCO <sub>2</sub> /m <sup>2</sup> .yr	Building Emission Rate kgCO <sub>2</sub> /m <sup>2</sup> .yr	Part L 2021 Margin	Specified Photovoltaics Requirements
Main Building	6.80	5.83	+14.3%	1,300m <sup>2</sup>
North (CASU)	9.81	8.07	+17.7%	47m <sup>2</sup>
Gatehouse	6.17	5.54	+10.2%	40m <sup>2</sup>
Escort Rest	6.94	6.13	+11.7%	28m <sup>2</sup>
Visitors Building	1.45	1.30	+10.3%	21m <sup>2</sup>
<i>Dojo/Property Store</i>	5.22	4.59	+12.1%	5m <sup>2</sup>
<i>FM Office/Workshop</i>	7.76	6.76	+12.9%	10m <sup>2</sup>
<i>Office Building</i>	5.99	5.39	+10.0%	17m <sup>2</sup>

**Table 1:** Tabulated Part L 2021 Compliance Performance Summary (incl. photovoltaics)

**All new build buildings have been demonstrated as able to achieve Part L 2021 compliance.**

**Note that Part L 2021 (new build) calculations have also been completed for the Dojo/Property Store (refurbishment), FM Office/Workshop (refurbishment) and Office (temporary) buildings to present a compliant strategies if deemed a Building Control requirement.**

**All buildings have been assessed to achieve a reasonable compliance margin (>10%)**



**Figure 3:** IES Thermal Model Visualisations - Main Building

## 1.5 ESD Planning Requirements

Excerpts as per the Cherwell Local Plan 2011 – 2031 – adopted 20<sup>th</sup> July 2015:

### 1.5.1 Policy ESD 1

#### **Policy ESD 1: Mitigating and Adapting to Climate Change**

Measures will be taken to mitigate the impact of development within the District on climate change. At a strategic level, this will include:

- Designing developments to reduce carbon emissions and use resources more efficiently, including water (see Policy ESD 3 Sustainable Construction)
- Promoting the use of decentralised and renewable or low carbon energy where appropriate (see Policies ESD 4 Decentralised Energy Systems and ESD 5 Renewable Energy).

The incorporation of suitable adaptation measures in new development to ensure that development is more resilient to climate change impacts will include consideration of the following:

- Demonstration of design approaches that are resilient to climate change impacts including the use of passive solar design for heating and cooling

### 1.5.2 Policy ESD 2

#### **Policy ESD 2: Energy Hierarchy and Allowable Solutions**

In seeking to achieve carbon emissions reductions, we will promote an 'energy hierarchy' as follows:

- Reducing energy use, in particular by the use of sustainable design and construction measures
- Supplying energy efficiently and giving priority to decentralised energy supply
- Making use of renewable energy
- Making use of allowable solutions.

### 1.5.3 Policy ESD3

#### **Policy ESD 3: Sustainable Construction**

All new residential development will be expected to incorporate sustainable design and construction technology to achieve zero carbon development through a combination of fabric energy efficiency, carbon compliance and allowable solutions in line with Government policy.

All new non-residential development will be expected to meet at least BREEAM 'Very Good' with immediate effect, subject to review over the plan period to ensure the target remains relevant. The demonstration of the achievement of this standard should be set out in the Energy Statement.

All development proposals will be encouraged to reflect high quality design and high environmental standards, demonstrating sustainable construction methods including but not limited to:

- Minimising both energy demands and energy loss
- Maximising passive solar lighting and natural ventilation
- Maximising resource efficiency
- Reducing the impact on the external environment and maximising opportunities for cooling and shading (by the provision of open space and water, planting, and green roofs, for example); and

#### 1.5.4 Policy ESD4

##### **Policy ESD 4: Decentralised Energy Systems**

**The use of decentralised energy systems, providing either heating (District Heating (DH)) or heating and power (Combined Heat and Power (CHP)) will be encouraged in all new developments.**

#### 1.5.5 Policy ESD5

##### **Policy ESD 5: Renewable Energy**

**The Council supports renewable and low carbon energy provision wherever any adverse impacts can be addressed satisfactorily. The potential local environmental, economic and community benefits of renewable energy schemes will be a material consideration in determining planning applications.**

**A feasibility assessment of the potential for significant on site renewable energy provision (above any provision required to meet national building standards) will be required for:**

- **All residential developments for 100 dwellings or more**
- **All residential developments in off-gas areas for 50 dwellings or more**
- **All applications for non-domestic developments above 1000<sup>m</sup><sup>2</sup> floorspace.**

**Where feasibility assessments demonstrate that on site renewable energy provision is deliverable and viable, this will be required as part of the development unless an alternative solution would deliver the same or increased benefit. This may include consideration of 'allowable solutions' as Government Policy evolves.**

### 1.6 Building Regulations Part L 2021 (new buildings)

Building Regulations set minimum legal standards for design and construction. Approved Document Part L 2021 (Volume 2: Buildings other than dwellings 2021 edition) specifically relates to regulated operational energy demands/CO<sub>2</sub> emissions. Compliance with Part L requires that for each 'new' building, its calculated 'Actual Building' Emission Rate (BER – kgCO<sub>2</sub>/m<sup>2</sup>.yr) is less than its 'Notional' Building' Target Emission Rate (TER).

The Actual Building represents the proposed design, whereas the Notional Building is one that matches the Actual Building in terms of shape/size/no. of zones though with fabric/HVAC/lighting inputs as detailed within the NCM Modelling Guide (2021). Assigned Notional Building standards often exceed (better) the current Part L minimum requirements as stated within the Part L documentation.

When undertaking Part L analysis, the complete building is simulated with the impacts of external climate, building fabric performance, HVAC systems, internal lighting scheme design and low/zero carbon (LZC) technology provision.

The non-domestic Part L calculations have been completed by an approved Non-Domestic Level 5 Energy Assessor using IES VE 2025.0.0.0 and BRUKL VE Compliance check version v7.0.29.0. This is an approved dynamic thermal software tool for the calculation of the regulated energy performance of buildings.

### 1.6.1 Carbon Factors

The latest 2021 Part L calculation methodology incorporates a step change in applied carbon factors which now align with the increasingly decarbonised UK mains grid. A significantly reduced electricity carbon factor of 0.111 to 0.163kgCO<sub>2</sub>/kWh (varies seasonally) serves to meaningfully discourage on-site combustion driven heating plant whilst favouring highly efficient electrically powered alternatives (i.e. electric heat pumps).

To further persuade the adoption of electric only plant, the Notional Target Building also adopts photovoltaics should the Actual building employ combustion technologies.

**In summary, reduced mains-grid supply carbon factors are fundamental to reducing 'regulated' Part L emissions, additionally, 'real-life' (towards Net Zero Carbon) building operational CO<sub>2</sub> performances are also improved.**

Note that the CO<sub>2</sub> emissions offset (kgCO<sub>2</sub>/year) that is associated with on-site electricity generation is also reduced as a lower PV generated/grid displaced carbon factor of 0.092 to 0.197kgCO<sub>2</sub>/kWh applies (varies monthly).

'Non-regulated' energy consumptions (e.g. miscellaneous plug/process loads, external lighting, vertical transportation, cold water pumping and others) are not included within Part L BER/TER performance values; however, these will likely play a significant role in real world building operation.

### 1.6.2 Net Zero Carbon Analysis

'Real-world' (CIBSE TM54) operational energy performance assessments can be completed during later detailed design stages and once further building operational and plant selection information is known.

## 2. ENERGY STRATEGY

### 2.1 Planning ESD Requirements – Design Approach Commentary

#### 2.1.1 ESD 1 Mitigating and Adapting to Climate Change

- *ESD 1 - Designing developments to reduce carbon emissions and use resources more efficiently*

New construction buildings are demonstrated to be able to comfortably comply with the demanding regulated energy/CO<sub>2</sub> targets as stipulated by the latest Building Regulations Part L 2021, as well as (where applicable) those required to achieve BREEAM New Construction 'Excellent Ratings.' The operational energy/CO<sub>2</sub> performance of existing refurbishment buildings are proposed to be optimised through the application of realistic and practical design methodologies (improved fabric/lighting/HVAC performances and substantial photovoltaics provision)

- *ESD 1- Promoting the use of decentralised and renewable or low carbon energy where appropriate*

Historically, thermally inefficient buildings (poorly insulated and leaky) with high-flow DHW fittings and high-loss LTHW/DHW distribution networks, had very high heating requirements. Modern day energy efficient buildings minimise these demands/losses so that heat is typically of secondary importance compared to other building energy demands (i.e. lighting, fans/pumps, substantial small power/equipment etc.).

Therefore, whilst the proposed buildings designs aim to limit space heating and DHW demands/loads as far as is practically possible, the proposed adoption of a comprehensive and distributed (i.e. local to each building) low carbon heat pump technology strategy will significantly reduce associated energy demands (seasonal COP performance > 300%).

This approach enables the inherent energy savings benefits associated with high-efficiency electric heat pump technologies to be realised whilst meeting important plant redundancy concerns in critical/important buildings infrastructure. As a complementary compliance measure, a significant proportion of remaining energy demands are to be offset by substantial on-site photovoltaic electricity generation.

Note that since the Cherwell Local Plan 2011 – 2031 was adopted (20<sup>th</sup> July 2015), there has been an industry step change which now actively discourages fuel combustion technologies (incl. biomass) due to pollution (particulates/CO<sub>2</sub>/NO<sub>x</sub>), noise implications (CHP), significant fuel processing/transportation/storage requirements and maintenance concerns. The very latest Part L 2021 methodology reflects this updated awareness. There is now a common acceptance that decentralised energy systems (i.e. district heating schemes that typically rely upon combustion technologies and have significant pumping and distribution heat losses) are generally a far inferior solution in comparison to latest generation electric high-efficiency modular heat pumps. Unless heat can be sourced as an unwanted by-product of a reliable and long-term industrial process (for example), it is not a recommended modern and sustainable design approach.

- *ESD 1 - The incorporation of suitable adaption measures in new development to ensure that development is more resilient to climate change impacts incl. passive solar design for heating and cooling*

The proposed buildings are intended to benefit from:

- Highly insulated and airtight fabric performances that, where practical, significantly exceed (better) the latest Building Regulations requirements
- The specification of solar control glass enables the limitation of unwanted summertime solar heat gains and hence minimised space cooling requirements whilst optimising occupant comfort levels. The proposed glazing strategy will also enable passive wintertime solar gains to be realised with an effective balance between limiting summertime solar gains, benefitting from wintertime passive solar heating and enabling effective daylight ingress
- The substantial use of exposed structural thermal mass in key building areas (incl. residential areas) as an important passive design measure that will successfully attenuate internal temperature swings, limit space heating and cooling energy demands, and help to maintain year-round thermally comfortable conditions
- Addressable daylight linked internal lighting dimming to appropriate areas

In line with MoJ standards and (where applicable) BREEAM requirements, the proposed HVAC strategies are demonstrated to successfully maintain comfortable summertime conditions for a range of both current and future climate change scenarios. Space heating demands will remain limited in the long term due to the specification of high performing building fabric in conjunction with high efficiency ventilation heat recovery.

## 2.1.2 ESD 2 Energy Hierarchy and Allowable Solutions

*ESD 2 - In seeking to achieve carbon emissions reductions, we will promote an 'energy hierarchy' as follows:*

- *Reducing energy use, using sustainable design and construction measures*

The proposed energy strategy follows the industry standard LEAN, CLEAN and GREEN approach. By default, compliance with Part L 2021 and the requirements associated with targeted BREEAM Excellent ratings, ensure that sustainable (energy efficient) design and construction approaches are required.

- *Supplying energy efficiently and giving priority to decentralised energy supply*

As previously discussed, (see section 2.1.1), a comprehensive high-efficiency electric heat pump strategy has been followed in line with latest Building Regulations requirements. A decentralised energy strategy has not been implemented as there are no known existing heat networks close to the development and no known nearby industrial process from which to utilise otherwise wasted heat. The intrinsic energy efficiency and redundancy benefits associated with a distributed (local to each building) heat pump strategy is a far more practical, less polluting, sustainable and cost-effective approach.

- *Making use of renewable energy*

Included within the proposed scheme design is a substantial photovoltaics provision. The associated arrays are proposed to be wired into the sites private wire network and will serve to significantly offset building energy demands.

- *Making use of allowable solutions*

It has been demonstrated that the proposed on-site LEAN, CLEAN and GREEN design measures are able to successfully meet all known to be applicable project energy/CO<sub>2</sub> performance targets.

### 2.1.3 ESD 3 Sustainable Construction

*ESD 3 – All new non-residential development will be expected to meet at least BREEAM 'Very Good' with immediate effect, subject to review over the plan period to ensure the target remains relevant.*

The new Main Building, North Building, Gatehouse, Escort Rest and Visitors buildings are targeting BREEAM Excellent ratings (one step better than Very Good).

*ESD 3 – All development proposals will be encouraged to reflect high quality design and high environmental standards, demonstrating sustainable construction methods but not limited to:*

- *Minimising both energy demands and energy loss*
- *Maximising passive solar lighting and natural ventilation*
- *Maximising resource efficiency*

As previously stated, the proposed new buildings designs will be:

- Aligned with the latest stringent energy performance targets associated with Part L 2021 and the targeted BREEAM Excellent ratings
- The proposed façade strategy strives to achieve a balance between limiting unwanted summertime solar gains (detrimental to occupant comfort) whilst benefiting from useful wintertime solar ingress (offset mechanical space heating requirements) and year-round internal daylighting performance
- Energy efficiency considerations are fundamental to the proposed designs. High performing building fabric, the use of high efficiency heat pumps, energy efficient mechanical ventilation with heat recovery and low energy lighting schemes all serve to maximise resource efficiency

#### 2.1.4 ESD 4 Decentralised Energy Systems

*ESD 4 – The use of decentralised energy systems, providing either heating (District Heating (DH) or heating and power (Combined Heat and Power (CHP)) will be encouraged by all new developments. All new non-residential development will be expected to meet at least BREEAM 'Very Good' with immediate effect, subject to review over the plan period to ensure the target remains relevant.*

As previously addressed (see section 2.1.1), combustion based decentralised energy systems are discouraged by the latest Part L 2021 and BREEAM compliance methodologies. The alternative of electric heat pump linked DH schemes are regarded as a poorer performing alternative to a distributed (local to each building) heat pump approach due to the significant energy benefits (avoidance of substantial distribution and pumping losses), reduced costs implications (avoidance of the extensive groundworks needed) and increased redundancy performance (each building can operate independently of others).

#### 2.1.5 ESD 5 Renewable Energy

*ESD 5 – The council supports renewable and low carbon energy provision wherever any adverse effects can be addressed satisfactorily. A feasibility assessment of the potential for significant on-site renewable energy provision (above any provision required to meet national building standards) will be required for all applications for non-domestic developments above 1,000m<sup>2</sup> floor space.*

As previously discussed, the currently proposed scheme design includes for a **large photovoltaics installation**, however, this is not intended to meaningfully exceed that required to demonstrate compliance with Part L 2021 and BREEAM Excellent targets. For this reason, a detailed feasibility study is interpreted as not required.

Photovoltaics are a well-established, common place and proven technology. They generate 100% on-site renewable electricity, have minimal ongoing maintenance requirements, are silent in operation and pose no meaningful adverse effects to wildlife or adjacent properties.

Note that the comprehensive adoption of air source heat pumps (ASHP's) across the site also represents a sensible, practical, and highly energy efficient approach to appropriate low/zero carbon technology inclusion.

In terms of other renewable/low or zero carbon technologies and how they could be applied to the site, see the following summary statements for why these are deemed not appropriate and hence have not been seriously considered for the proposed development:

**Solar Thermal Hot Water** – **discounted** despite having the potential to significantly contribute towards meeting DHW requirements, these have been discounted due to the complexity associated with roof mounting these systems and the need for easy access for cleaning and maintenance – difficult to achieve on a secure site with multiple-storey buildings. In addition, the use of high efficiency heat pumps significantly reduces the energy required to generate a unit of heat energy (>300% seasonally efficient). Where heat pumps receive renewable energy generated by photovoltaics, this represents a more intelligent use of available panel mounting space (which can also be located away from the buildings themselves)

**Building Mounted (mini/micro) Wind Turbines** – **discounted** as these are proven to operate only intermittently in real world usage and have high maintenance considerations. Additionally, there would need to be many of these units installed (10 – 100 depending on kW capacity of each unit) to generate a meaningful extent of on-site electricity. In comparison to on-site photovoltaics, they represent a poor choice

**Large Scale (tall) Wind Turbines** – **discounted** as whilst these are a proven renewable technology that can reliably generate very large amounts of on-site electricity, there are significant planning consent concerns that relate to their size, noise considerations and potential wildlife implications. Additionally, these require a consistent wind regime to be regarded as economically viable, and they have significant ongoing maintenance requirements. In general, they do not compare favourably to the relative simplicity and reliability of on-site photovoltaics

**Small Scale Hydro Power** – **discounted** as there are no known rivers suitable for significant hydro infrastructure installation within the proposed development boundary

**Tidal or Wave Power** – **discounted**

**Biomass Boilers** – **discounted** due to emissions/pollution and practicality implications (see section 2.1.1)

**Combined Heat and Power (CHP)** – **discounted** due to emissions/pollution, noise, Building Regulations/BREEAM discouragement and practicality implications (see section 2.1.1)

**District Heating** – **discounted** (see sections 2.1.1 & 2.1.4) due to poor overall performance (both cost and efficiency) vs. localised high-efficiency heat pump strategy

**Water Source Heat Pumps** – **discounted** as there are no known suitable water sources within the site-boundary. Additionally, seasonal performance improvements are marginal vs. local (to buildings) air source heat pumps

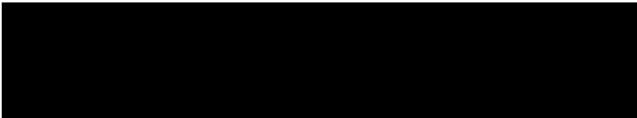
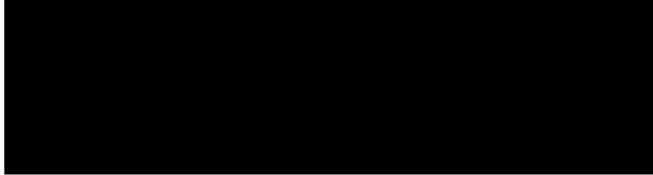


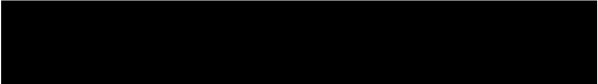
**Ground Source Heat Pumps** – **discounted** due to:


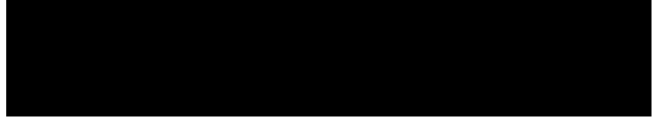
- Limited real-world performance (overall system CoP) benefits in comparison to the relative simplicity and flexibility of modern distributed (i.e. per building served) high-efficiency air source heat pumps (ASHP's)
- The relative simplicity associated with the use of reversible ASHP's (VRF) to provide both heating and cooling as required
- Limited site-wide space heating requirements when assessed as part of the broader total site energy demands (i.e. fans/pumps, lighting, plug loads etc.). In other words, a modest possible reduction in heating energy requirements (if GSHP's were adopted) will have a limited impact upon overall site energy demands/CO<sub>2</sub> emissions
- The need for very substantial ground works (multiple deep boreholes and/or extensive trench piping/areas required) to achieve required heat outputs (kW)
- Significantly increased groundworks/installation/commissioning costs
- Concerns relating to ground conditions suitability and possible heat & coolth saturation impairing long term effectiveness & efficiencies
- Redundancy concerns and high distribution energy requirements (heat losses and pumping) if a centralised 'district heating' approach were adopted

**Hydrogen Fuel Rooms** – **discounted**. Whilst promising these remain an emerging, expensive, and potentially impractical (increased explosion risk and complex gas storage and distribution requirements) technology. These would also require 'green' hydrogen to be sourced otherwise would not be regarded as a renewable or low carbon technology

## 2.2 As-Modelled Building Fabric Performances

### 2.2.1 Proposed Buildings

Fabric Element	U-Value (W/m <sup>2</sup> .K)	Notes
<b>Heat Loss Ground Contact Floors</b>	0.15 – New Build 0.18 – (Temp) Office 0.70 – Dojo & FM	Part L 2021 Limiting value – 0.18W/m <sup>2</sup> .K Applies to all building types 
<b>Heat Loss Roofs</b>	0.15 – New flat roofs 0.16 – New lightweight pitched roofs 0.18 – (Temp) Office 0.35 – Dojo & FM	Part L 2021 Limiting values – 0.18W/m <sup>2</sup> .K (flat) and 0.16W/m <sup>2</sup> .K (pitched) 
<b>Heat Loss External Walls</b>	0.17 0.26 – (Temp) Office 0.21 – Dojo & FM	Part L 2021 Limiting value – 0.26W/m <sup>2</sup> .K Applies to all building types and all wall construction types 
<b>Exterior Vertical Glazing</b>	1.50 (incl. framing) with G-value 0.45 and Lt 70% 1.60 (incl. framing) with G-value 0.45 and Lt 70% - (Temp) Office, Dojo & FM	Part L 2021 Limiting value – 1.60W/m <sup>2</sup> .K Applies to all building types and to all window units and glazed curtain walling areas. 
<b>Rooflights</b>	1.50 (incl. framing) with G-value 0.45 and Lt 70%	Part L 2021 Limiting value – 2.20W/m <sup>2</sup> .K 
<b>Exterior Heat Loss Doors</b>	1.60 (incl. framing)	Part L 2021 Limiting value – 1.60W/m <sup>2</sup> .K
<b>Air Permeability</b>	5m <sup>3</sup> /hr.m <sup>2</sup> @50Pa	Part L 2021 Limiting value – 8m <sup>3</sup> /hr.m <sup>2</sup> @50Pa

Fabric Element	U-Value (W/m <sup>2</sup> .K)	Notes
<b>Internal Ceilings</b>	Circa. 1.40 to 3.24 are typical values for uninsulated construction build-ups with and without ceiling voids and surface finish dependent (i.e. carpeting/Vinyl)	
<b>Internal Partitions</b>	Circa. 1.00	





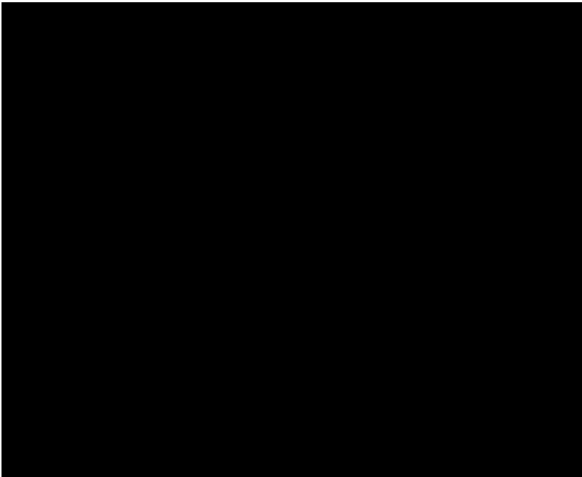
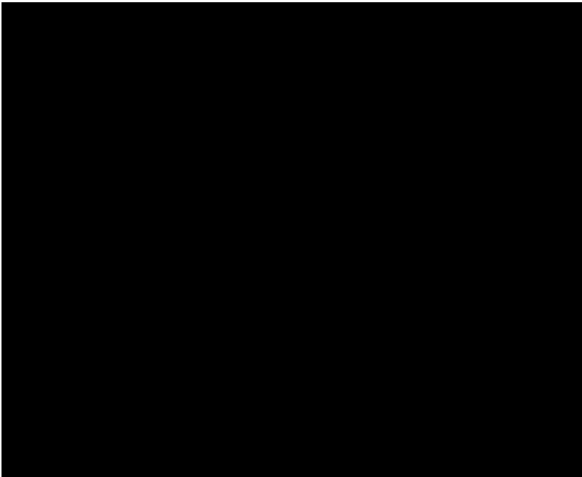
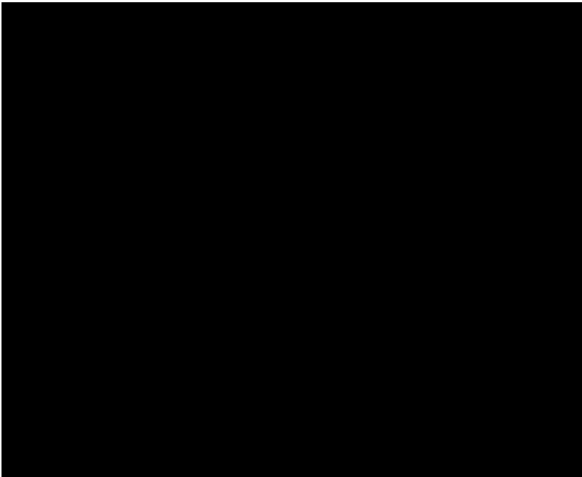
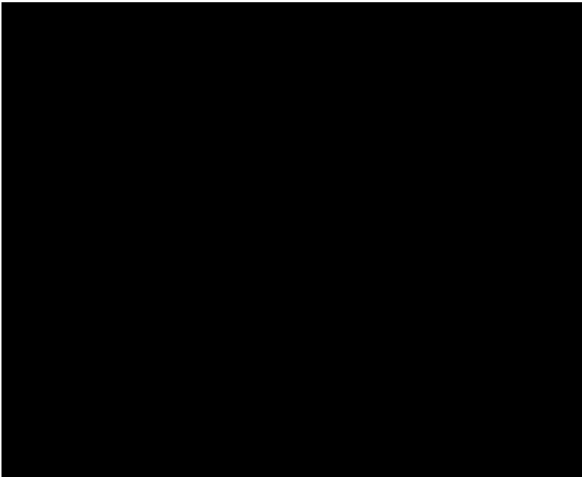
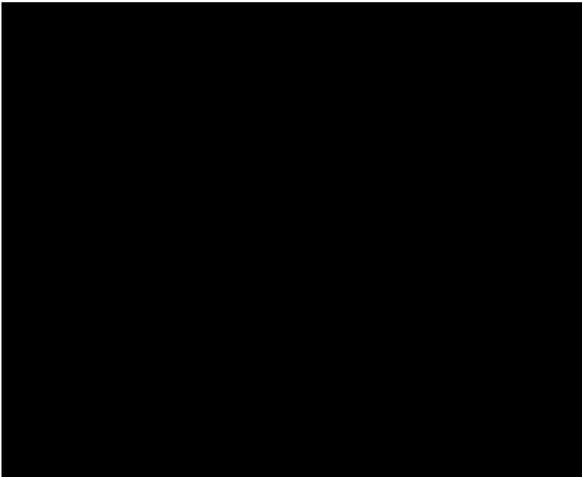
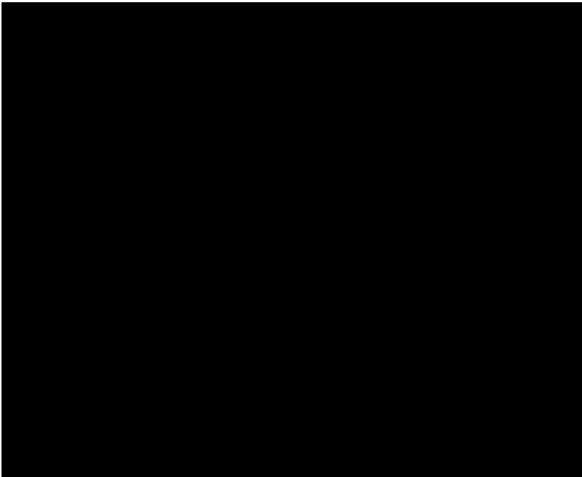
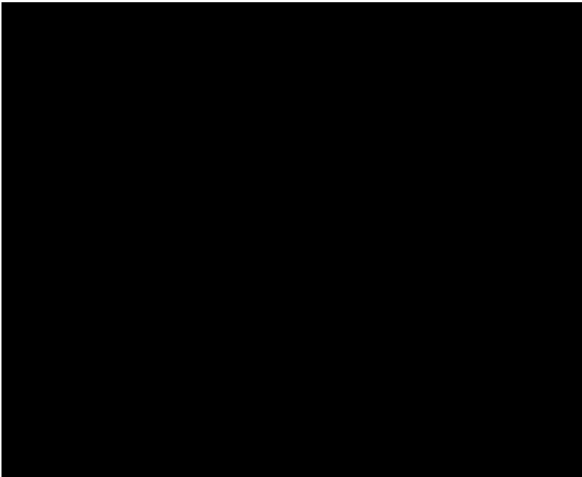
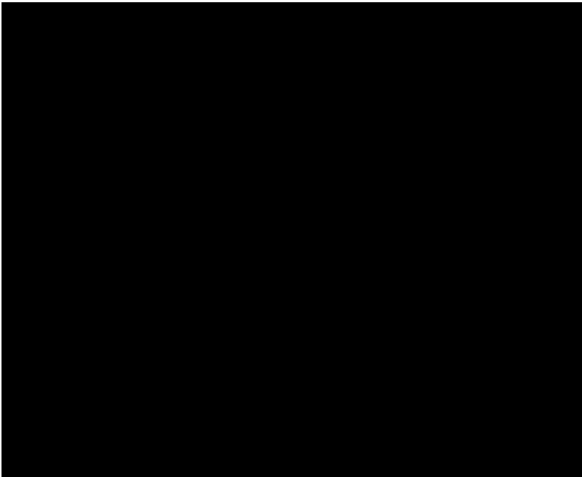
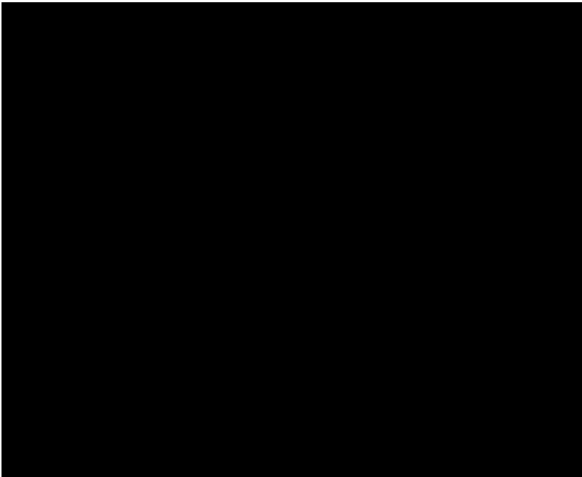
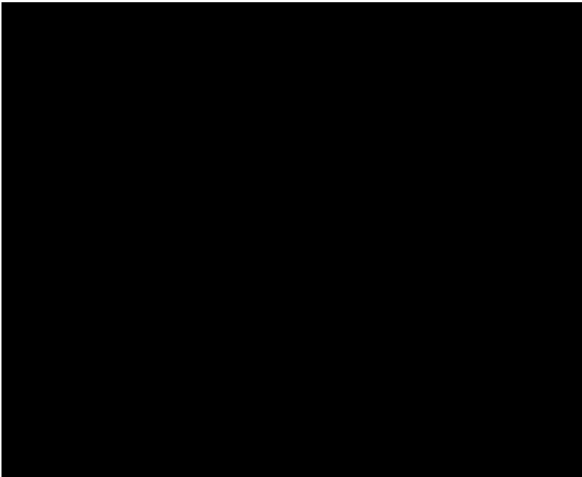
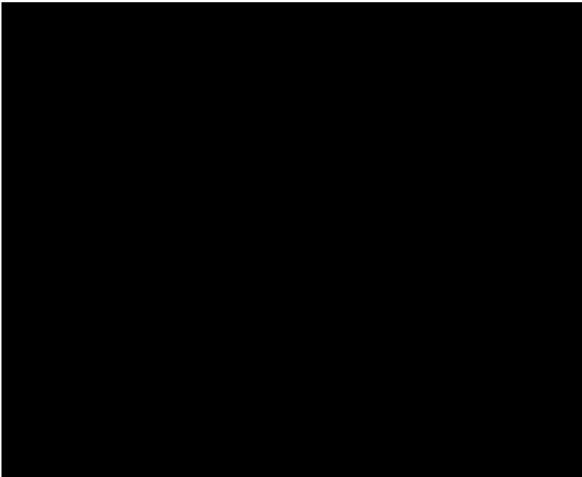
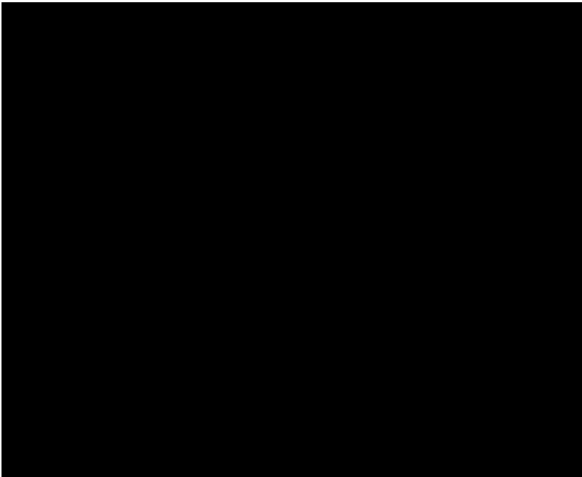
## 2.3 Part L 2021 – Key Systems Inputs Summary

### 2.3.1 Proposed Buildings

#### Assigned HVAC Systems High-level Summary

Refer to separate Stage 2 MEP Documentation for systems details and assignment in full

#### **Main Building:**

- 100% of DHW supplied via a centrally located ASHP system with appropriate storage and continuously circulating distribution system
- Building is predominantly heated via ASHP LTHW fed UFH/radiators with mechanical supply and return ventilation via AHU's incorporating high-efficiency heat recovery
  - Residential bedrooms/bathrooms
  - Circulation areas
  - WC/changing/shower areas
  - Select offices
  - Communal TV room/Mosque and Multi-Faith Spaces
  - Interview  rooms
- 
- For Part L purposes, no areas have been modelled as naturally ventilated (i.e. no façade openings active).   

- Other building areas heated and cooled via high-efficiency VRF systems with mechanical supply and return ventilation (incl. heat recovery):
  - 
  - 
  - 
  - 
  - 
  - 
  - 
  - 
  - 
  - 
  - 
  - 
- The large commercial kitchen (and adjacent ancillary areas) and dining/servery areas area modelled as heated and cooled via a Constant Volume (Fixed Fresh Air) all air system
  - The main kitchen room is also modelled with 40ACH of extract ventilation
  - Cooled process spaces (walk-in cool rooms etc.) have not been modelled as conditioned within the Part L calculations (i.e. NCM stores with no HVAC systems assigned)

- HO and Moj IT spaces are cooled via local high-efficiency DX units

**North (CASU) Building:**

- 100% of DHW supplied via a centrally located ASHP system with appropriate storage and continuously circulating distribution system
- Building is predominantly heated via ASHP LTHW fed UFH with mechanical supply and return ventilation via AHU's incorporating high-efficiency heat recovery
- Association area is heated and cooled via a high-efficiency VRF/DX Split system
- No direct electric radiators are modelled as present (frost protection only)
- [REDACTED]
- Servery has intermittent local extract ventilation provided – 15ACH @ 0.60W/l/s (grease)

**Gatehouse Building:**

- 100% of DHW supplied via electric point-of-use instantaneous units (without storage or distribution losses)
- Building predominantly heated and cooled via high-efficiency VRF systems
- Limited number of transient spaces heated via ASHP LTHW fed radiators
- [REDACTED]
- Full building wide AHU mechanical ventilation incl. high-efficiency heat recovery
- No areas have been modelled as naturally ventilated (i.e. no façade openings active)

**Escort Rest Building:**

- 100% of DHW supplied via electric point-of-use instantaneous units (without storage or distribution losses)
- Regularly occupied (non transient) spaces heated and cooled via high-efficiency VRF systems
- [REDACTED]
- Full building wide HRU mechanical ventilation incl. high-efficiency heat recovery
- No areas have been modelled as naturally ventilated (i.e. no façade openings active)

**Visitors Building:**

- 100% of DHW supplied via electric point-of-use instantaneous units (without storage or distribution losses)
- Office and Waiting areas are heated and cooled via high-efficiency VRF systems
- [REDACTED]
- Full building wide HRU mechanical ventilation incl. high-efficiency heat recovery

- No areas have been modelled as naturally ventilated (i.e. no façade openings active)

**Dojo Property Store Building:**

- 100% of DHW supplied via electric point-of-use instantaneous units (without storage or distribution losses)
- Gymnasium heated and cooled via high-efficiency VRF system with HRU mechanical ventilation incl. high-efficiency heat recovery
  - Adjacent WC's and property store are modelled as indirectly conditioned by the same system
  - [REDACTED]
- No areas have been modelled as naturally ventilated (i.e. no façade openings active)

**FM Office/Workshop Building:**

- 100% of DHW supplied via electric point-of-use instantaneous units (without storage or distribution losses)
- FM Office/Store [REDACTED] heated and cooled via high-efficiency VRF system
  - HRU mechanical ventilation incl. high-efficiency heat recovery
- Workshop modelled as ventilation based heating and cooling
  - Mechanical supply and extract without heat recovery
- No areas have been modelled as naturally ventilated (i.e. no façade openings active)

**Office Building:**

- 100% of DHW supplied via electric point-of-use instantaneous units (without storage or distribution losses)
- Building predominantly heated and cooled via high-efficiency VRF systems
  - Adjacent spaces (circulation, corridors, staff rest, WC's, changing) are modelled as indirectly conditioned by the same VRF system (realistic real world operation)
  - [REDACTED]
- Full building wide HRU mechanical ventilation incl. high-efficiency heat recovery
- No areas have been modelled as naturally ventilated (i.e. no façade openings active)

**Key HVAC Efficiencies**

- ASHP LTHW Heating Seasonal Efficiency – 350%
- VRF Heating Seasonal Efficiency – 350%
- VRF Cooling SEER performance – 450%
- Main Building Kitchen/Dining Constant Volume AHU Cooling SEER – 450%

- ASHP DHW Generation Seasonal Efficiency – 329%
- Main Building DHW distribution circulating pipework [REDACTED]
- North Building DHW distribution circulating pipework [REDACTED]
- Main Building Kitchen Constant Volume System – SFP 1.60W/l/s & 50% HR
- General AHU's – SFP 1.60W/l/s & 85% HR
- Smaller HRU/MVHR Units – SFP 1.50W/l/s & 75% HR
- Variable speed LTHW pumping with pressure sensors

### Lighting and HVAC Management Features

- To date appropriate/realistic lighting efficiency inputs (Luminaire 95lm/W efficacies and appropriate working plane lux levels) have been applied. During detailed design stages it will be necessary that room-by-room lighting inputs be aligned with detailed Dialux calculations
- A comprehensive addressable lighting control strategy has been assumed to be present. This includes presence, absence and manual control controls for appropriate spaces.
- Conservatively daylight linked dimming has not been applied to date (incl. bedrooms)
- Comprehensive Building Energy Management Systems (BEMS) able to meter, monitor and automate the warning of out-of-range energy consumption values
- Full building Power Factor Correction > 0.95

### Renewables

1,468m<sup>2</sup> (272MWh/yr generation) of unshaded high efficiency Module (>21%) photovoltaic panels that are tilted and south-facing

### Further Comments

**The proposed site-wide energy efficiency measures combined with a substantial total photovoltaics provision, has resulted in a very meaningful reduction in predicted regulated energy demands. The proposed Stage 2 building designs represent energy efficient solutions that are sensible, practical, thermally comfortable, economically viable and environmentally responsible.**

## 2.4 Part L 2021 - BRUKL Performance Outputs

### 2.4.1 All Buildings TER vs. BER Summary and Photovoltaics Requirements

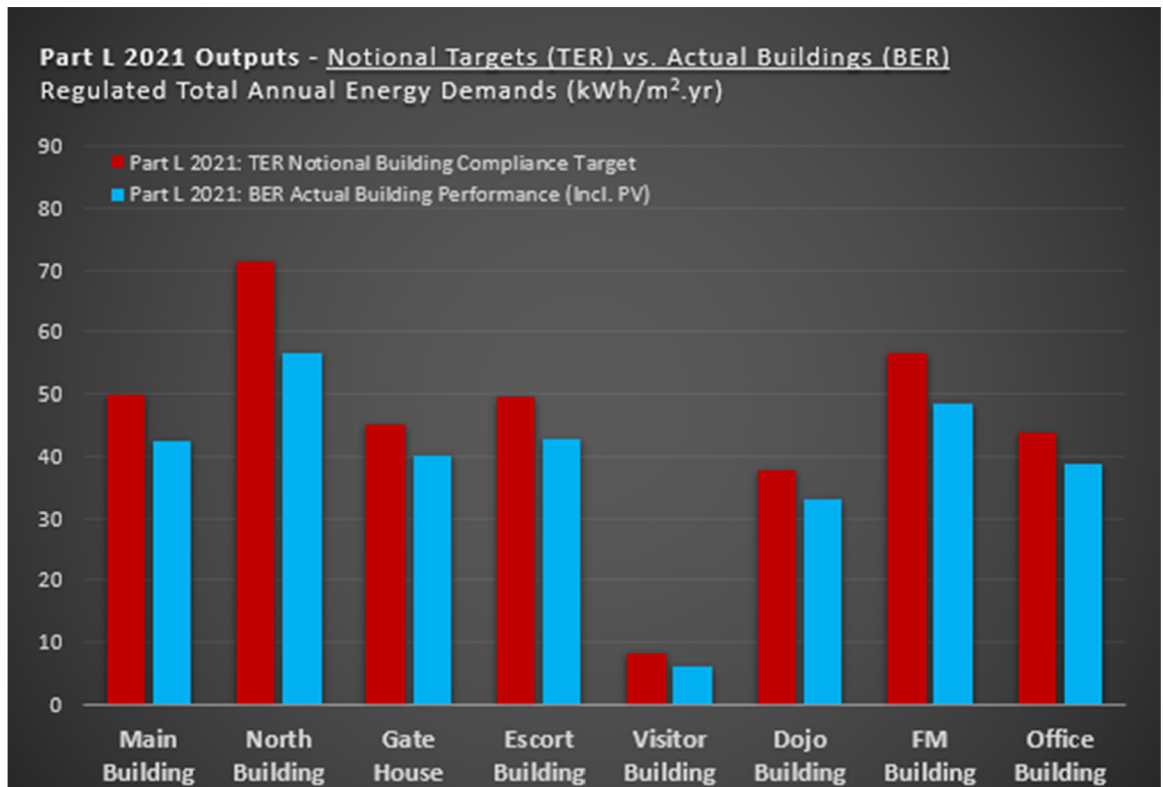
The following table summarises the Regulated (excl. small power/equipment) Notional Target Emission Rates (TER), the Actual Building Emission Rates (BER) and applied photovoltaics areas.

A minimum 10% compliance margin has been calculated to date for all buildings. As the buildings progress through the detailed design phases, it is likely that these values will evolve as refined performance information becomes available:

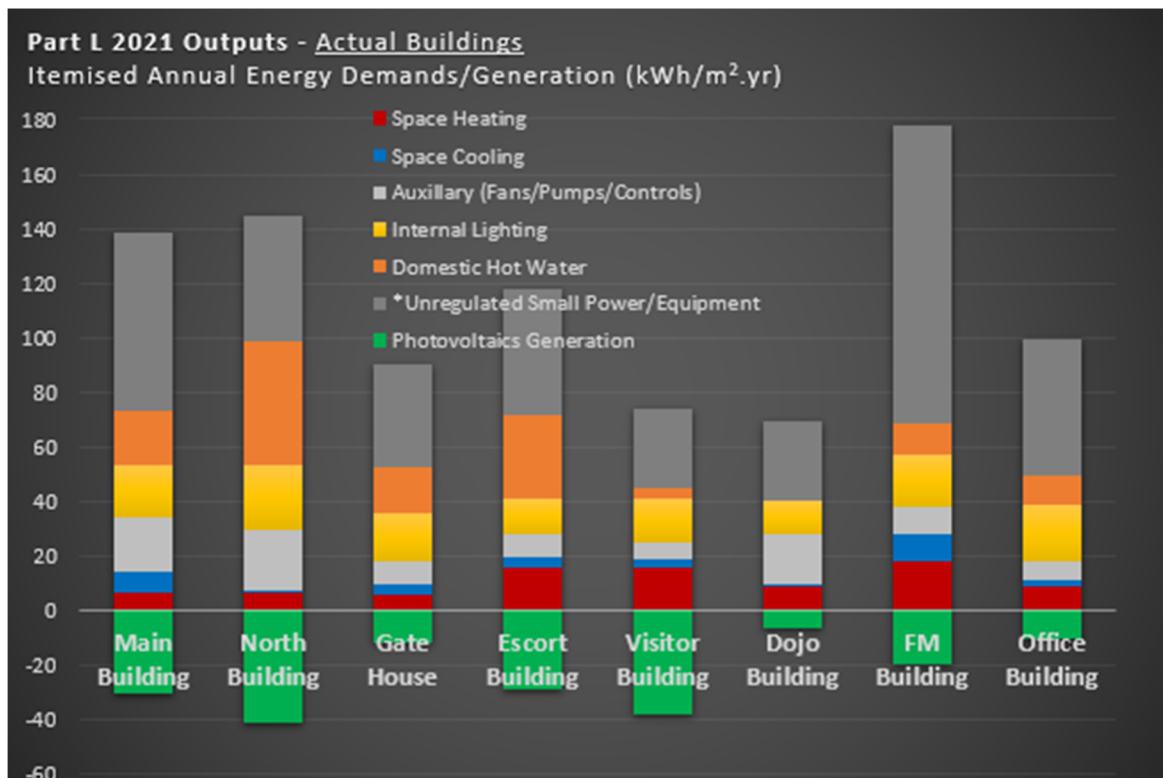
**All proposed buildings are demonstrated as new build Part L 2021 compliant.**

Building(s)	Notional Target Emission Rate kgCO <sub>2</sub> /m <sup>2</sup> .yr	Building Emission Rate kgCO <sub>2</sub> /m <sup>2</sup> .yr	Part L 2021 Margin	Specified Photovoltaics Requirements
Main Building	6.80	5.83	+14.3%	1,300m <sup>2</sup>
North (CASU)	9.81	8.07	+17.7%	47m <sup>2</sup>
Gatehouse	6.17	5.54	+10.2%	40m <sup>2</sup>
Escort Rest	6.94	6.13	+11.7%	28m <sup>2</sup>
Visitors Building	1.45	1.30	+10.3%	21m <sup>2</sup>
Dojo/Property Store	5.22	4.59	+12.1%	5m <sup>2</sup>
FM Office/Workshop	7.76	6.76	+12.9%	10m <sup>2</sup>
Office Building	5.99	5.39	+10.0%	17m <sup>2</sup>

**Table 2:** Tabulated Part L 2021 Compliance Performance Summary (incl. photovoltaics)



**Figure 4:** Per Building Part L 2021 Compliance Performance Summary (incl. photovoltaics)



**Figure 5:** Per Building Itemised Annual Energy Demands - Part L 2021 Performance Summary (incl. photovoltaics)

### Part L Comments:

When comparing Actual to Notional BRUKL energy consumptions (kWh/m<sup>2</sup>.yr) it is to be expected that Actual values will at times exceed those of the Notional building. The reasoning is that the (non-editable) energy efficiency and control strategy inputs automatically applied to the Notional building cannot necessarily be met or bettered during real world building design.

The Stage 2 modelling inputs applied to date are to be regarded as those that are realistically achievable and practical. Photovoltaics are then required to offset any resultant energy demands/CO<sub>2</sub> emissions. During detailed building design stages there may be scope to further optimise building HVAC/lighting performance which in turn could impact the required photovoltaics provision.

Whilst 'Unregulated Small Power/Equipment' energy demands (and associated heat gains) are incorporated within the Part L 2021 energy balance calculations, they are not included in either the Actual BER or Notional Building TER determinations.

## 2.4.2 Main Building – BRUKL Outputs Summary

**The CO<sub>2</sub> emission and primary energy rates of the building must not exceed the targets**

Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> annum	6.8
Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> annum	5.83
Target primary energy rate (TPER), kWh <sub>pe</sub> /m <sup>2</sup> annum	73.75
Building primary energy rate (BPER), kWh <sub>pe</sub> /m <sup>2</sup> annum	62.23
Do the building's emission and primary energy rates exceed the targets?	BER =< TER   BPER =< TPER

### Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m <sup>2</sup> ]	7846.3	7846.3		Retail/Financial and Professional Services
External area [m <sup>2</sup> ]	12546.7	12546.7		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	SWI	SWI		Offices and Workshop Businesses
Infiltration [m <sup>3</sup> /hm <sup>2</sup> @ 50Pa]	5	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	2938.23	3561.24		Storage or Distribution
Average U-value [W/m <sup>2</sup> K]	0.23	0.28		Hotels
Alpha value* [%]	28.5	10		Residential Institutions: Hospitals and Care Homes
				Residential Institutions: Residential Schools
				Residential Institutions: Universities and Colleges
			<b>100</b>	<b>Secure Residential Institutions</b>
				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

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

### Energy Consumption by End Use [kWh/m<sup>2</sup>]

	Actual	Notional
Heating	5.88	5.57
Cooling	7.68	4.82
Auxiliary	20.71	10.41
Lighting	19.19	12.3
Hot water	19.58	16.75
Equipment*	65.33	65.33
<b>TOTAL**</b>	<b>73.04</b>	<b>49.85</b>

\* 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<sup>2</sup>]

	Actual	Notional
Photovoltaic systems	30.64	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>30.64</i>	<i>0</i>

### Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	144.25	136.11
Primary energy [kWh <sub>pe</sub> /m <sup>2</sup> ]	62.23	73.75
Total emissions [kg/m <sup>2</sup> ]	5.83	6.8

### 2.4.3 North Building – BRUKL Outputs Summary

**The CO<sub>2</sub> emission and primary energy rates of the building must not exceed the targets**

Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> :annum	9.81
Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> :annum	8.07
Target primary energy rate (TPER), kWh <sub>PE</sub> /m <sup>2</sup> :annum	105.93
Building primary energy rate (BPER), kWh <sub>PE</sub> /m <sup>2</sup> :annum	84.06
Do the building's emission and primary energy rates exceed the targets?	BER =< TER   BPER =< TPER

### Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m <sup>2</sup> ]	201	201		Retail/Financial and Professional Services
External area [m <sup>2</sup> ]	783	783		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	LON	LON		Offices and Workshop Businesses
Infiltration [m <sup>3</sup> /hm <sup>2</sup> @ 50Pa]	5	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	160.01	198.29		Storage or Distribution
Average U-value [W/m <sup>2</sup> K]	0.2	0.25		Hotels
Alpha value* [%]	29.3	10		Residential Institutions: Hospitals and Care Homes
				Residential Institutions: Residential Schools
				Residential Institutions: Universities and Colleges
			<b>100</b>	<b>Secure Residential Institutions</b>
				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

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

### Energy Consumption by End Use [kWh/m<sup>2</sup>]

	Actual	Notional
Heating	6.62	7.23
Cooling	0.19	0.47
Auxiliary	22.15	11.56
Lighting	24.24	13.58
Hot water	45.11	38.61
Equipment*	45.93	45.93
<b>TOTAL**</b>	<b>98.31</b>	<b>71.46</b>

\* 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<sup>2</sup>]

	Actual	Notional
Photovoltaic systems	41.79	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>41.79</i>	<i>0</i>

### Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	81.26	80.16
Primary energy [kWh <sub>PE</sub> /m <sup>2</sup> ]	84.06	105.93
Total emissions [kg/m <sup>2</sup> ]	8.07	9.81

## 2.4.4 Gatehouse Building – BRUKL Outputs Summary

**The CO<sub>2</sub> emission and primary energy rates of the building must not exceed the targets**

Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> :annum	6.17
Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> :annum	5.54
Target primary energy rate (TPER), kWh <sub>PE</sub> /m <sup>2</sup> :annum	66.85
Building primary energy rate (BPER), kWh <sub>PE</sub> /m <sup>2</sup> :annum	59.32
Do the building's emission and primary energy rates exceed the targets?	BER =< TER   BPER =< TPER

### Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m <sup>2</sup> ]	600	600		Retail/Financial and Professional Services
External area [m <sup>2</sup> ]	1632.6	1632.6		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	SWI	SWI		Offices and Workshop Businesses
Infiltration [m <sup>3</sup> /hm <sup>2</sup> @ 50Pa]	5	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	363.49	467.46		Storage or Distribution
Average U-value [W/m <sup>2</sup> K]	0.22	0.29		Hotels
Alpha value* [%]	28.97	10		Residential Institutions: Hospitals and Care Homes
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging				Residential Institutions: Residential Schools
				Residential Institutions: Universities and Colleges
			<b>97</b>	<b>Secure Residential Institutions</b>
				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
			<b>3</b>	<b>Others: Miscellaneous 24hr Activities</b>
				Others: Car Parks 24 hrs
				Others: Stand Alone Utility Block

### Energy Consumption by End Use [kWh/m<sup>2</sup>]

	Actual	Notional
Heating	5.69	5.58
Cooling	3.66	3.32
Auxiliary	8.13	8.04
Lighting	18.17	12.24
Hot water	16.81	15.97
Equipment*	37.61	37.61
<b>TOTAL**</b>	<b>52.46</b>	<b>45.15</b>

\* 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<sup>2</sup>]

	Actual	Notional
Photovoltaic systems	12.36	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>12.36</i>	<i>0</i>

### Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	110.52	111.18
Primary energy [kWh <sub>PE</sub> /m <sup>2</sup> ]	59.32	66.85
Total emissions [kg/m <sup>2</sup> ]	5.54	6.17

## 2.4.5 Escorts Rest Building – BRUKL Outputs Summary

**The CO<sub>2</sub> emission and primary energy rates of the building must not exceed the targets**

Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> ·annum	6.94	
Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> ·annum	6.13	
Target primary energy rate (TPER), kWh <sub>PE</sub> /m <sup>2</sup> ·annum	73.75	
Building primary energy rate (BPER), kWh <sub>PE</sub> /m <sup>2</sup> ·annum	63.65	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

## Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m <sup>2</sup> ]	179.1	179.1		Retail/Financial and Professional Services
External area [m <sup>2</sup> ]	650.7	650.7		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	SWI	SWI		Offices and Workshop Businesses
Infiltration [m <sup>3</sup> /hm <sup>2</sup> @ 50Pa]	5	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	149.73	180.86		Storage or Distribution
Average U-value [W/m <sup>2</sup> K]	0.23	0.28		Hotels
Alpha value* [%]	26.95	10		Residential Institutions: Hospitals and Care Homes
				Residential Institutions: Residential Schools
				Residential Institutions: Universities and Colleges
			<b>97</b>	<b>Secure Residential Institutions</b>
				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
			<b>3</b>	<b>Others: Miscellaneous 24hr Activities</b>
				Others: Car Parks 24 hrs
				Others: Stand Alone Utility Block

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

## Energy Consumption by End Use [kWh/m<sup>2</sup>]

	Actual	Notional
Heating	15.72	11.96
Cooling	3.71	2.39
Auxiliary	8.31	7.44
Lighting	13.21	11.95
Hot water	30.7	29.17
Equipment*	46.45	46.45
<b>TOTAL**</b>	<b>71.65</b>	<b>62.91</b>

\* 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<sup>2</sup>]

	Actual	Notional
Photovoltaic systems	28.98	13.3
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>28.98</i>	<i>13.3</i>

## Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	159.15	139.83
Primary energy [kWh <sub>PE</sub> /m <sup>2</sup> ]	63.65	73.75
Total emissions [kg/m <sup>2</sup> ]	6.13	6.94

## 2.4.6 Visitors Building – BRUKL Outputs Summary

**The CO<sub>2</sub> emission and primary energy rates of the building must not exceed the targets**

Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> annum	1.45
Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> annum	1.3
Target primary energy rate (TPER), kWh <sub>PE</sub> /m <sup>2</sup> annum	12.88
Building primary energy rate (BPER), kWh <sub>PE</sub> /m <sup>2</sup> annum	9.86
Do the building's emission and primary energy rates exceed the targets?	BER =< TER   BPER =< TPER

## Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m <sup>2</sup> ]	95.3	95.3		Retail/Financial and Professional Services
External area [m <sup>2</sup> ]	387.5	387.5		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	LON	LON		Offices and Workshop Businesses
Infiltration [m <sup>3</sup> /hm <sup>2</sup> @ 50Pa]	5	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	93.65	108.05		Storage or Distribution
Average U-value [W/m <sup>2</sup> K]	0.24	0.28		Hotels
Alpha value* [%]	27.42	10		Residential Institutions: Hospitals and Care Homes
				Residential Institutions: Residential Schools
				Residential Institutions: Universities and Colleges
			<b>100</b>	<b>Secure Residential Institutions</b>
				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

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

## Energy Consumption by End Use [kWh/m<sup>2</sup>]

	Actual	Notional
Heating	15.44	10.72
Cooling	3.18	2.29
Auxiliary	6.41	7.22
Lighting	15.55	12.58
Hot water	3.78	3.41
Equipment*	29.36	29.36
<b>TOTAL**</b>	<b>44.36</b>	<b>36.22</b>

\* 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<sup>2</sup>]

	Actual	Notional
Photovoltaic systems	38.33	27.89
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>38.33</i>	<i>27.89</i>

## Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	117.68	113.31
Primary energy [kWh <sub>PE</sub> /m <sup>2</sup> ]	9.86	12.88
Total emissions [kg/m <sup>2</sup> ]	1.3	1.45

## 2.4.7 Dojo Property Store Building – BRUKL Outputs Summary

**The CO<sub>2</sub> emission and primary energy rates of the building must not exceed the targets**

Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> .annum	5.22
Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> .annum	4.59
Target primary energy rate (TPER), kWh <sub>eq</sub> /m <sup>2</sup> .annum	56.22
Building primary energy rate (BPER), kWh <sub>eq</sub> /m <sup>2</sup> .annum	48.94
Do the building's emission and primary energy rates exceed the targets?	BER =< TER   BPER =< TPER

### Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m <sup>2</sup> ]	134.2	134.2		Retail/Financial and Professional Services
External area [m <sup>2</sup> ]	495.4	495.4		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	SWI	SWI		Offices and Workshop Businesses
Infiltration [m <sup>3</sup> /hm <sup>2</sup> @ 50Pa]	5	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	244.04	140.46		Storage or Distribution
Average U-value [W/m <sup>2</sup> K]	0.49	0.28		Hotels
Alpha value* [%]	29.79	10		Residential Institutions: Hospitals and Care Homes
				Residential Institutions: Residential Schools
				Residential Institutions: Universities and Colleges
			<b>100</b>	<b>Secure Residential Institutions</b>
				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

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

### Energy Consumption by End Use [kWh/m<sup>2</sup>]

	Actual	Notional
Heating	8.74	4.89
Cooling	0.22	0.42
Auxiliary	18.95	26.11
Lighting	11.93	6.47
Hot water	0	0
Equipment*	29.29	29.29
<b>TOTAL**</b>	<b>39.83</b>	<b>37.88</b>

\* 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<sup>2</sup>]

	Actual	Notional
Photovoltaic systems	6.91	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>6.91</i>	<i>0</i>

### Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	109.8	55.89
Primary energy [kWh <sub>eq</sub> /m <sup>2</sup> ]	48.94	56.22
Total emissions [kg/m <sup>2</sup> ]	4.59	5.22

## 2.4.8 FM Office Workshop Building – BRUKL Outputs Summary

**The CO<sub>2</sub> emission and primary energy rates of the building must not exceed the targets**

Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> annum	7.76
Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> annum	6.76
Target primary energy rate (TPER), kWh <sub>ec</sub> /m <sup>2</sup> annum	83.82
Building primary energy rate (BPER), kWh <sub>ec</sub> /m <sup>2</sup> annum	71.82
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER   BPER ≤ TPER

## Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m <sup>2</sup> ]	92.6	92.6		Retail/Financial and Professional Services
External area [m <sup>2</sup> ]	412.8	412.8		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	SWI	SWI		Offices and Workshop Businesses
Infiltration [m <sup>3</sup> /hm <sup>2</sup> @ 50Pa]	5	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	174.96	138.88		Storage or Distribution
Average U-value [W/m <sup>2</sup> K]	0.42	0.34		Hotels
Alpha value* [%]	29.02	10		Residential Institutions: Hospitals and Care Homes
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging			<b>81</b>	<b>Secure Residential Institutions</b>
				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
			<b>19</b>	<b>Others: Miscellaneous 24hr Activities</b>
				Others: Car Parks 24 hrs
				Others: Stand Alone Utility Block

## Energy Consumption by End Use [kWh/m<sup>2</sup>]

	Actual	Notional
Heating	17.55	10.2
Cooling	10.39	12.05
Auxiliary	10.21	15.77
Lighting	18.98	7.72
Hot water	11.37	10.8
Equipment*	109.3	109.3
<b>TOTAL**</b>	<b>68.5</b>	<b>56.53</b>

\* 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<sup>2</sup>]

	Actual	Notional
Photovoltaic systems	20.02	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>20.02</i>	<i>0</i>

## Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	324.75	302.9
Primary energy [kWh <sub>ec</sub> /m <sup>2</sup> ]	71.82	83.82
Total emissions [kg/m <sup>2</sup> ]	6.76	7.76

## 2.4.9 Office Building – BRUKL Outputs Summary

**The CO<sub>2</sub> emission and primary energy rates of the building must not exceed the targets**

Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> annum	5.99
Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> annum	5.39
Target primary energy rate (TPER), kWh <sub>pe</sub> /m <sup>2</sup> annum	64.89
Building primary energy rate (BPER), kWh <sub>pe</sub> /m <sup>2</sup> annum	57.62
Do the building's emission and primary energy rates exceed the targets?	BER =< TER   BPER =< TPER

## Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m <sup>2</sup> ]	303.6	303.6		Retail/Financial and Professional Services
External area [m <sup>2</sup> ]	933	933		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	SWI	SWI		Offices and Workshop Businesses
Infiltration [m <sup>3</sup> /hm <sup>2</sup> @ 50Pa]	5	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	221.61	250.66		Storage or Distribution
Average U-value [W/m <sup>2</sup> K]	0.24	0.27		Hotels
Alpha value* [%]	27.93	10		Residential Institutions: Hospitals and Care Homes
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging				Residential Institutions: Residential Schools
			98	Residential Institutions: Universities and Colleges
				<b>Secure Residential Institutions</b>
				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
			2	<b>Others: Miscellaneous 24hr Activities</b>
				Others: Car Parks 24 hrs
				Others: Stand Alone Utility Block

## Energy Consumption by End Use [kWh/m<sup>2</sup>]

	Actual	Notional
Heating	8.65	6.35
Cooling	2.17	3.09
Auxiliary	7.29	10.67
Lighting	20.56	13.64
Hot water	10.62	10.09
Equipment*	49.67	49.67
<b>TOTAL**</b>	<b>49.27</b>	<b>43.83</b>

\* 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<sup>2</sup>]

	Actual	Notional
Photovoltaic systems	10.38	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>10.38</i>	<i>0</i>

## Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	129.84	114.99
Primary energy [kWh <sub>pe</sub> /m <sup>2</sup> ]	57.62	64.89
Total emissions [kg/m <sup>2</sup> ]	5.39	5.99

### 3. THERMAL COMFORT (SUMMERTIME OVERHEATING)

#### 3.1 Introduction

The iterative Stage 2 summertime overheating analysis has directly informed the proposed HVAC strategies that enable comprehensive compliance with both MoJ standards and BREEAM HEA04 requirements using both current and future climate files.

In general, a combined approach of intermittently cooled mechanical fresh air (only) ventilation with beneficially exposed structural thermal mass has been shown to successfully maintain acceptable summertime thermal comfort levels.

The buildings in general are regarded as predominantly mechanically ventilated with internal room/zone temperatures that fluctuate within an acceptable/comfortable range, not air-conditioned with close temperature control.

However, in certain particularly high heat gain spaces (e.g. IT rooms, high occupancy density spaces, offices etc.) it has been necessary to implement highly efficient local heat pump cooling solutions. This is to be expected and represents a sensible and pragmatic design approach.

**In general, it should be noted that TM52 adaptive comfort analysis represents a challenging set of compliance criteria with resultant performance being very sensitive to the applied modelling inputs. The analysis inputs applied to date are intended to be representative and realistic of how building rooms/spaces could be used in real-world operation.**

**Whilst the proposed design demonstrates the ability to maintain acceptable and thermally comfortable conditions, this does not necessarily mean that occupied spaces/zones will not feel 'warm' during periods of the day/year. TM52 adaptive comfort analysis considers the principal that occupants likely adapt to and accept warmer internal conditions during periods of higher external air temperatures.**

## 3.2 MoJ Standards and BREEAM HEA04 Credit Requirements

### 3.2.1 CIBSE TM52/TM59 Compliance Criteria

The CIBSE TM52 adaptive thermal comfort methodology is most appropriate to assess summertime overheating risks within rooms/zones that are mechanically (or naturally) ventilated – this excludes those spaces that are locally air conditioned to consistent/fixed cooling setpoints. This approach meets the requirements of both the MoJ technical standards and BREEAM New Construction Credit HEA04 – Thermal Comfort.

The analysis performed assesses internal operative temperatures within regularly 'occupied' rooms/zones only (i.e. Bedrooms, Offices, Interview/Consultation Spaces, Staff Rooms, Dining Areas, Visitor Areas, Worship spaces etc.). All non-transitory but regularly occupied rooms are required to demonstrate compliance. Rooms/zones that would not typically be expected to comply due to the process nature of their activities include Laundry Rooms, Kitchens/Servery Areas, Tea Points etc.

The complete buildings have been simulated with the impacts of external climate (current and future scenarios), fabric performances, occupancy gains, solar heat gains, equipment/lighting sensible heat gains and mechanical/natural ventilation rates assessed.

The following three TM52 derived criteria are assessed:

- **Criterion 1** - Hours of Exceedance (He):
- **Criterion 2** - Daily Weighted Exceedance (We):
- **Criterion 3** - Upper Limit Temperature (Tupp)

In addition, compliance with the CIBSE TM59 (residential) overnight bedroom temperature Criteria 1b has been reported for all bedroom spaces.

- **TM59 Criterion 1b** requires that overnight (22:00 – 07:00) internal operative temperature within individual bedrooms/rooms do not exceed 26°C for more than 33 hours annually

The completed bespoke TM59 analysis has kept the identical operational, occupancy, internal gains and ventilation regimes for all bedroom and non-bedroom areas as applied to the building specific TM52 approach detailed within this report. This is to be regarded as appropriate, as whilst the building is residential, the rooms would not be considered to operate as typical residential apartments (for which the very specific TM59 inputs methodology was developed).

### 3.2.2 Applied Climate Files

Part L 2021 and the schemes Oxfordshire postcode dictates that the current (2021) CIBSE Swindon climate file is applicable. The CIBSE Swindon data sets also represent the most appropriate CIBSE climate location for TM52/TM59 analysis.

#### CL2.1 SBEM Weather Locations Lookup

England & Wales Postcode Areas Lookup

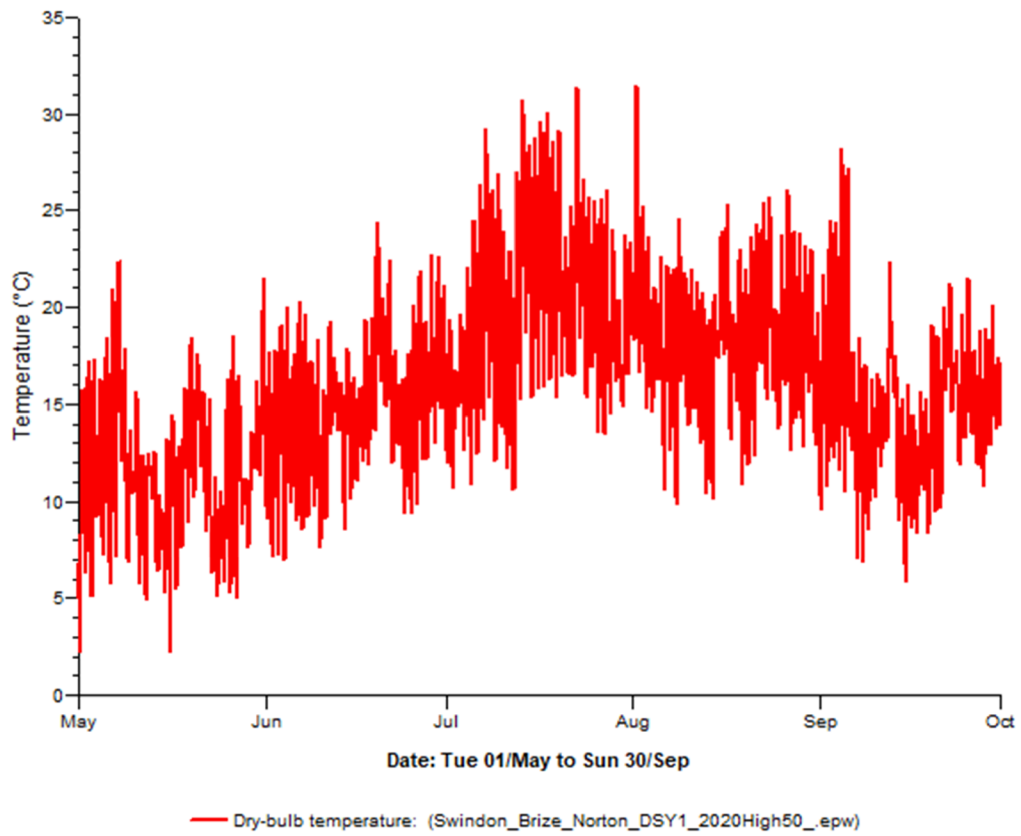
		SBEM Weather Location
Search:	OX	Swindon

Moj/BREEAM CIBSE TM52/TM59 summertime thermal comfort (overheating) analysis, requires the following climate files variations to be assessed:

- **CIBSE SWINDON DSY1 2020 High Emissions** – most appropriate current summer climate. Mandatory Moj and BREEAM HEA04 (current climate) compliance
- **CIBSE SWINDON DSY1 2080 Low Emissions** – less extreme future summer climate. Mandatory Moj (future climate) compliance
- **CIBSE SWINDON DSY2 2020 High Emissions** – BREEAM HEA04 Projected Climate Change Environment Compliance for mechanically ventilated or mixed-mode spaces. Optional BREEAM HEA04 (future climate) compliance
- **CIBSE SWINDON DSY3 2020 High Emissions** – BREEAM HEA04 Projected Climate Change Environment Compliance for mechanically ventilated or mixed-mode spaces. Optional BREEAM HEA04 (future climate) compliance
- **CIBSE SWINDON DSY1 2080 High Emissions** – extreme future summer climate. Optional Moj (future climate) compliance

Note that the applied climate files are not intended to be all encompassing predictions of either current or future climate scenarios. The DSY1 2020 high and DSY1 2080 low are aligned with our understanding of the currently applicable requirement identified within Moj Technical Specification 047 issue 006, clause 106.

- **DSY1 – represents a moderately warm summer**
- **DSY2 – represents a short, intense warm summer**
- **DSY3 – represents a long, less intense warm summer**



**Figure 6:** Applied Swindon DSY1 2020 High Emissions Climate File – Summertime External Dry Bulb Temperature

### **3.3 Compliance Summary**

Compliance performance summaries are provided overleaf on a per building basis.

In general, the Main Building occupied spaces that are mechanically ventilated receive constant fresh air rates, that are limited to 17°C, from AHU's that incorporate high-efficiency heat recovery units (with intelligent bypass functionality) and high-efficiency DX/VRF cooling coils. Intermittent fresh air (only) cooling is intended to be provided during peak summertime periods if required.

It is important to acknowledge that cooled mechanical ventilation rates are not increased to maintain fixed internal temperature setpoints as would be the case with locally comfort cooled (air-conditioned) spaces, rather the modestly cooled constant fresh air only rates are intended to usefully clip peak internal air temperatures and hence benefit TM52/TM59 compliance whilst benefitting overall building energy efficiency.

As previously mentioned, for spaces with particularly high internal heat gains (incl. high occupant densities) and where mechanical ventilation alone has been shown to be insufficient to demonstrate TM52 compliance, high-efficiency heat pump cooling units have been sensibly adopted. During detailed design stages it will be necessary that these units are appropriately sized (CIBSE loads methodology with subsequent dynamic thermal analysis) to ensure that compliant summer conditions can be maintained as per MoJ/BREEAM requirements.

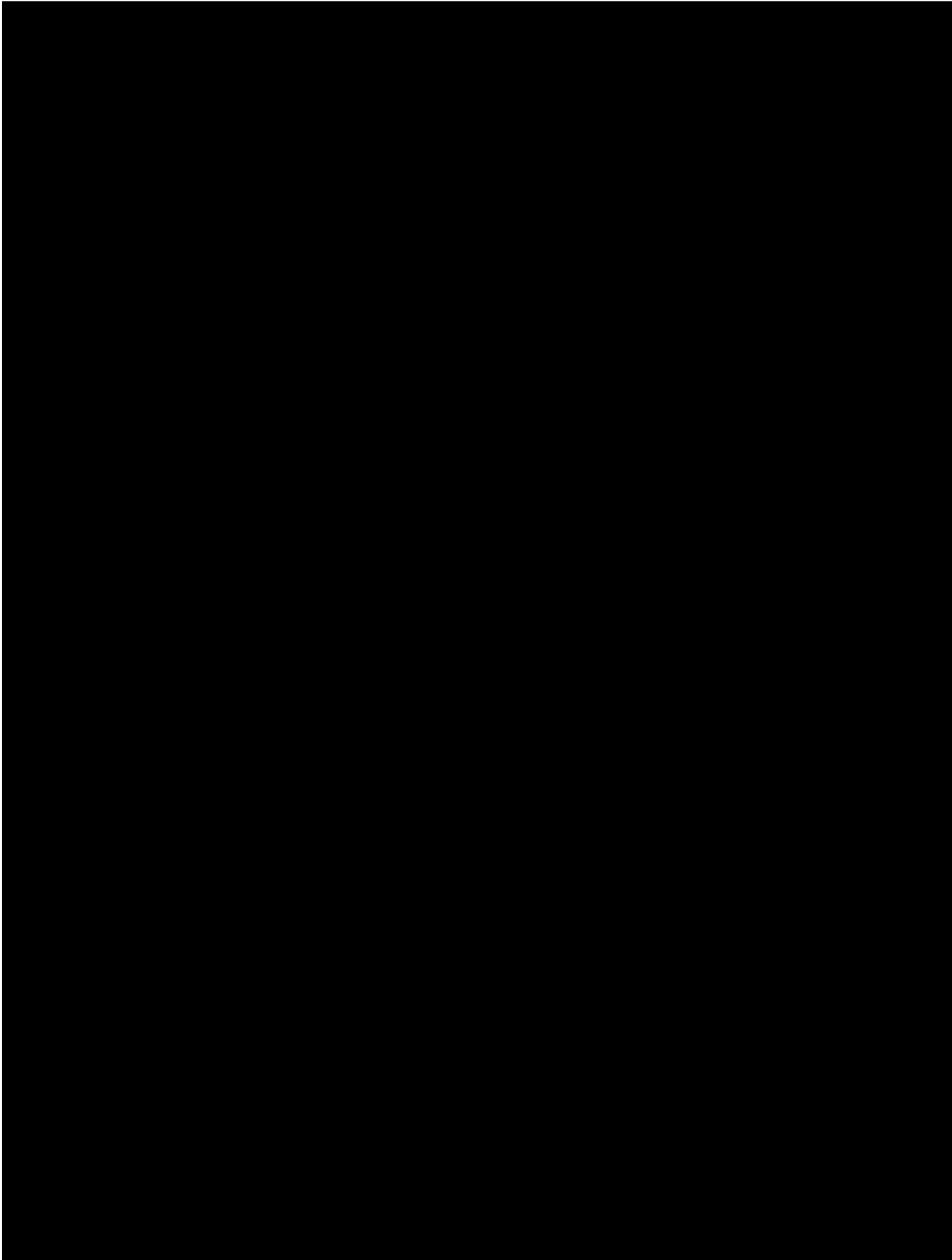
### 3.3.1 Main Building Performance Summary

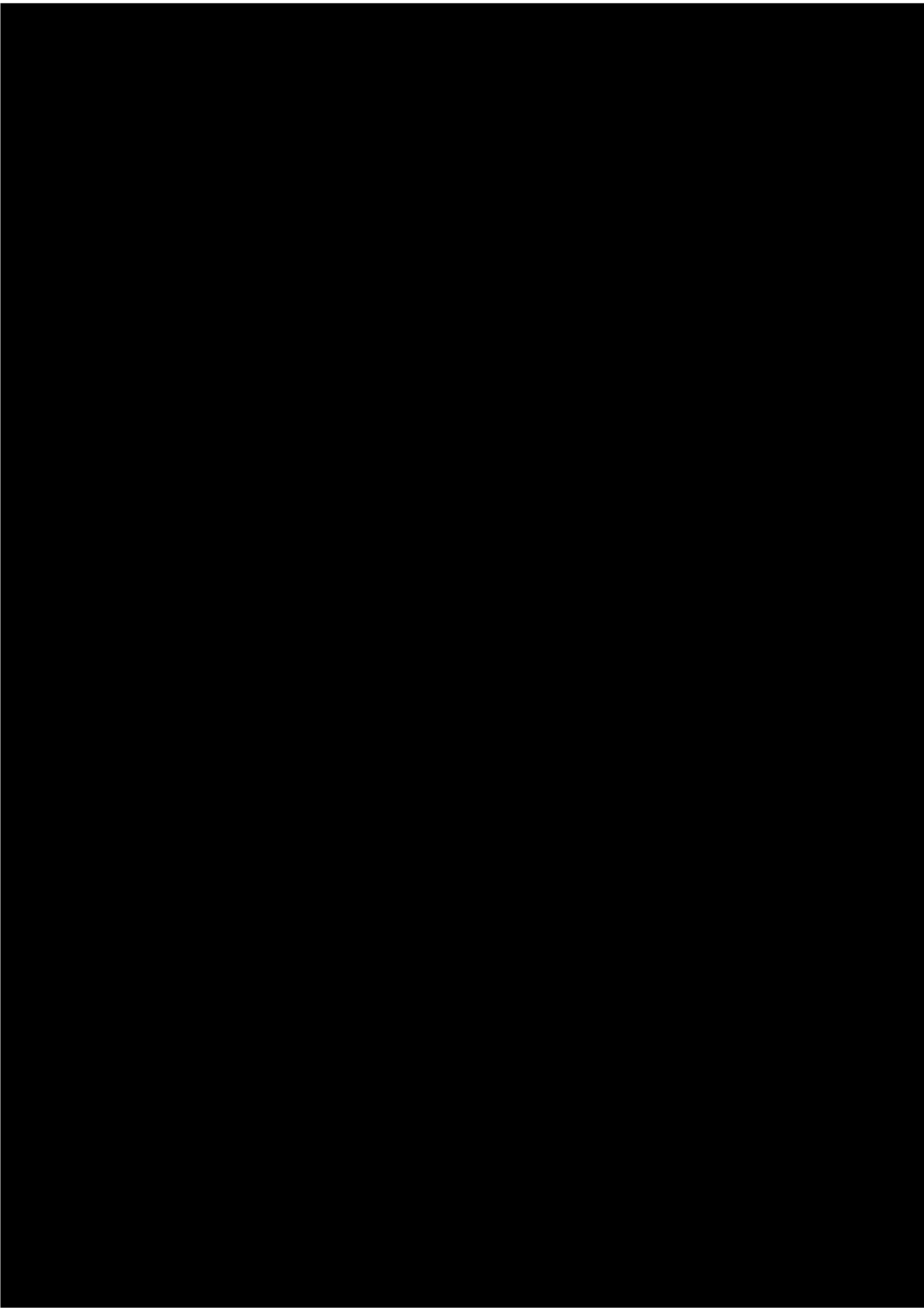
For analysis completed using the 2020 High DSY1/DSY2/DSY3 and 2080 Low/High DSY1 climate files:

- All regularly occupied rooms/zones are shown as TM52 compliant (min. 2 of 3 criteria achieved)

Assessed Spaces	Mechanical Ventilation
ALL Single & Accessible Bedroom/Rooms	18 l/s @17C (Supply Air 24/7)
ALL Double Bedrooms/Rooms	28 l/s @17C (Supply Air 24/7)
GF.0102 Dining	1,608 l/s @17C (Supply Air 24/7)
GF.0063/1.0064/2.0063 Wing Offices	42 l/s @17C (Supply Air 24/7)
1.0096 Fitness Store & Office	55 l/s @17C (Supply Air 24/7)
1.0102 Communal TV Room	1,680 l/s @17C (Supply Air 24/7)
2.0095 Mosque	1,400 l/s @17C (Supply Air 24/7)
2.0097/98 World Faith Zones	560 l/s @17C (Supply Air 24/7)
1.0087 & 2.0088 Interview Rooms	42 l/s @17C (Supply Air 24/7)

- Communal corridors (illustrated in green overleaf) also benefit from the provision of tempered (Constant 17C supply) mechanical fresh air (2ACH - 24/7). This enables observed internal temperatures to be maintained below 26°C
- Note that due to the process nature of the use of the commercial kitchen areas (incl. servery), these would not be expected to be subject to TM52 compliance
- All spaces served by VRF Heat Pump Cooling (see purple areas overleaf - incl. GF/L01 medical wing areas and kitchen offices) are not subject to TM52 compliance criteria. However, during detailed design stages, CIBSE Load calculations are to be performed to ensure appropriate design capacities able to maintain acceptable summertime comfort PMV/PPD values for both current and appropriate future climate scenarios
- During detailed design stages consideration may need to be given to the provision of internal blinds (where appropriate) to limit direct solar exposure of inhabitants and hence benefit comfort levels and minimise possible glare concerns







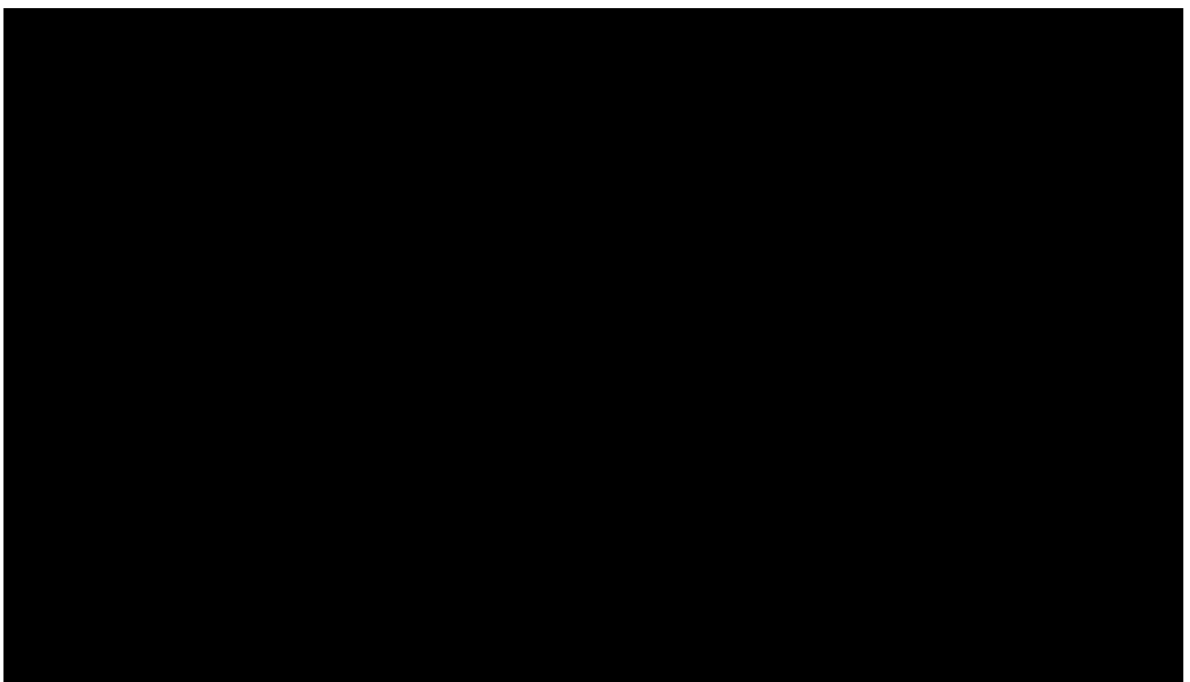
### 3.3.2 North Building Performance Summary

For analysis completed using the 2020 High DSY1/DSY2/DSY3 and 2080 Low/High DSY1 climate files:

- All regularly occupied rooms/zones are shown as TM52 compliant (min. 2 of 3 criteria achieved)

Assessed Spaces	Mechanical Ventilation
ALL Bedrooms/Rooms (2 occupants)	28 l/s @17C (Supply Air 24/7)
Rule 40 / Rule 42 accommodation	28 l/s @17C (Supply Air 24/7)
G.16 Wing Office	28 l/s @17C (Supply Air 24/7)

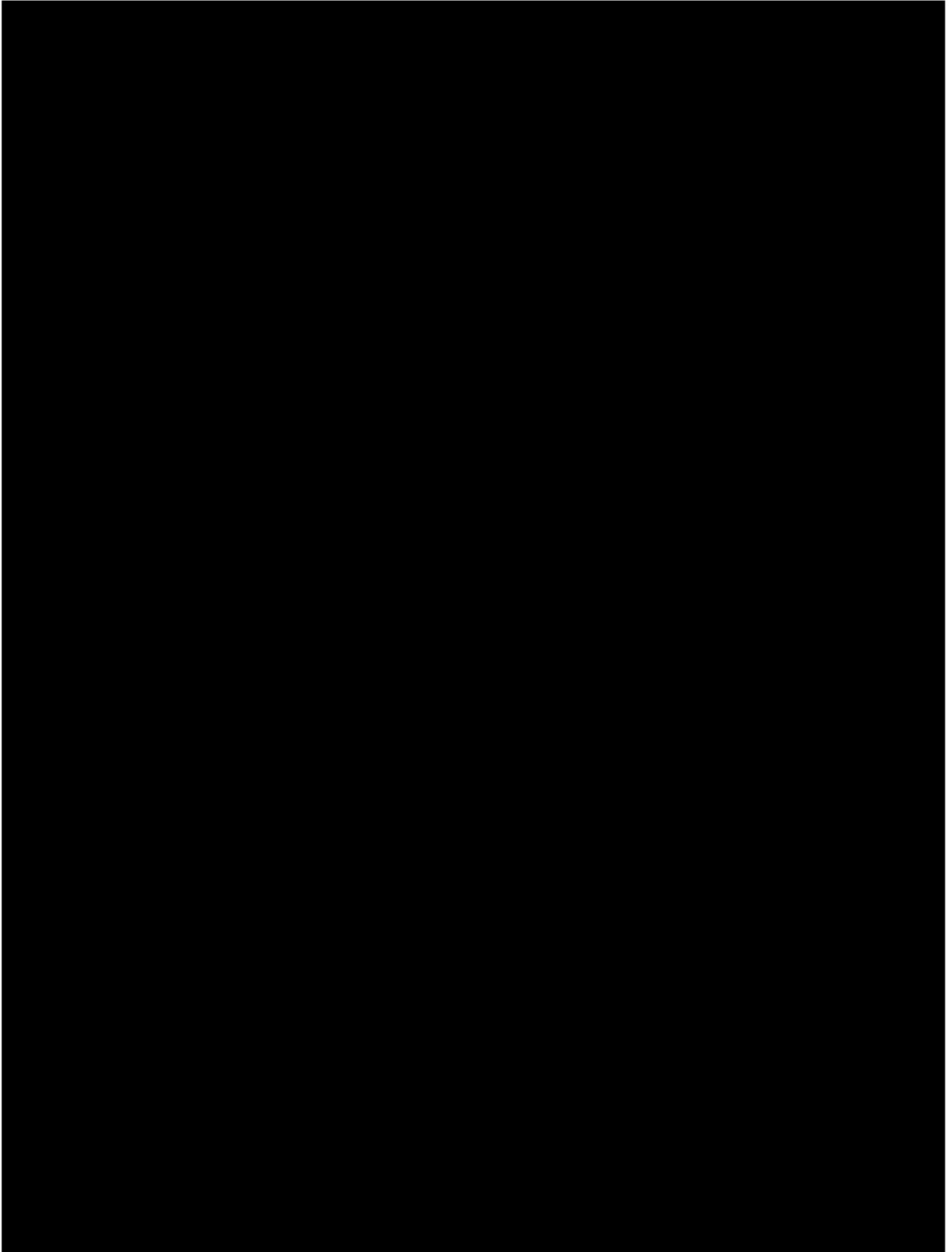
- Corridors/lobbies (illustrated in green overleaf) also benefit from the provision of tempered (Constant 17C supply) mechanical fresh air (2ACH - 24/7). This enables observed internal temperatures to be maintained below 26°C
- Note that due to the intermittent usage and process nature of the server space, this would not be expected to be subject to TM52 compliance, however, is demonstrated as being compliant (On demand 15ACH local extract with entrainment from neighbouring main corridor)
- As the G.11 Association Area is served by VRF Heat Pump Cooling (see purple area overleaf) this would not be subject to TM52 compliance criteria. However, during detailed design stages, CIBSE Load calculations are to be performed to ensure appropriate design capacities able to maintain acceptable summertime comfort PMV/PPD values for both current and appropriate future climate scenarios
- During detailed design stages consideration may need to be given to the provision of internal blinds (where appropriate) to limit direct solar exposure of inhabitants and hence benefit comfort levels and minimise possible glare concerns



### 3.3.3 Main Building and North Building Bedrooms/Rooms

For analysis completed using the 2020 High DSY1/DSY2/DSY3 and 2080 Low DSY1 climate files:

- 100% of bedrooms/Rule 40/Rule 42 accommodation rooms are demonstrated as TM59 compliant with overnight (22:00 to 07:00) operative temperatures remaining below 26°C



### 3.3.4 Additional Standalone Buildings

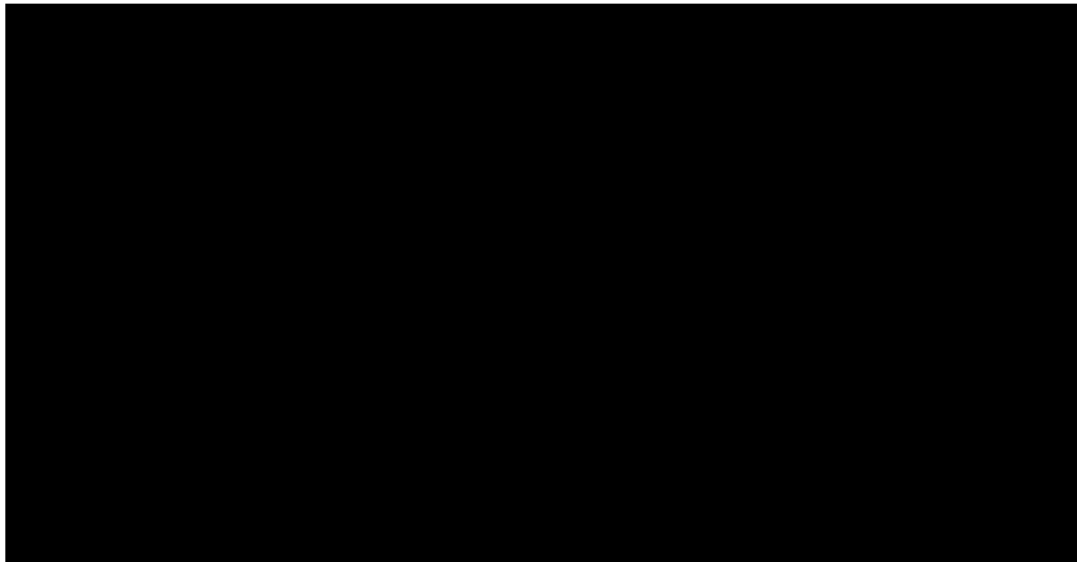
Due to the nature of the space usage types and the inherent energy efficiency benefits associated (both real world and Part L compliance), all regularly occupied rooms are proposed to be **heated and cooled via high-efficiency VRF** (elec. heat pump) systems with fresh air provision met by high-efficiency AHU/HRU's incorporating effective heat recovery strategies. This is an effective strategy to demonstrate Part L compliance, maximise year-round comfort levels and minimise energy demands.

**Analysis completed to date has shown that appropriate room setpoints/operative temperatures and hence year-round thermally comfortable conditions are able to be maintained in all applicable regularly occupied rooms.**

**During the detailed design stage, it will be necessary to ensure that appropriate CIBSE Steady State and Dynamic calculations are completed to ensure adequate room-by-room unit heating and cooling capacities. This analysis is recommended to take into consideration both current and anticipated near/medium term DSY (Design Summer Year) climate files to ensure that year-round thermal comfort can be demonstrated.**

Note that during detailed design stages consideration may need to be given to the provision of internal blinds (where appropriate) to limit direct solar exposure of inhabitants and hence benefit comfort levels and minimise possible glare concerns

#### **Gatehouse:**



**Visitors Building:**



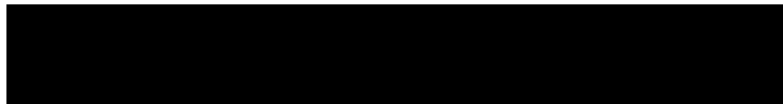
**Escort Rest Building:**



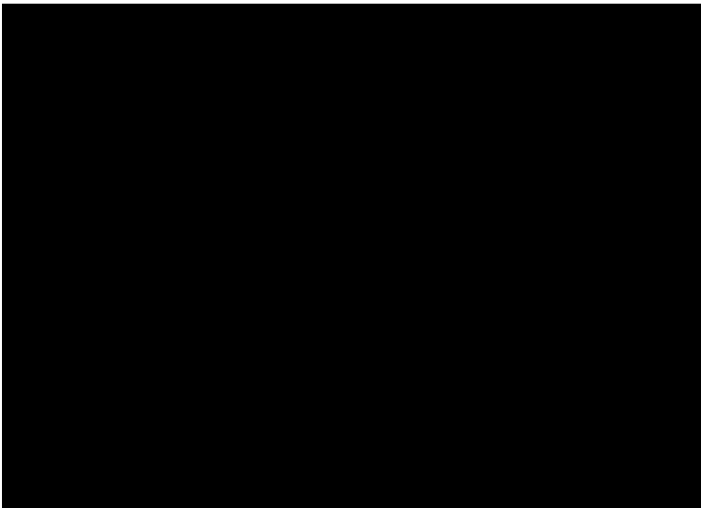
**Dojo and Property Store Building:**

- 00.200A\_Gymnasium - [VRF Heating and Cooling](#)

**Facilities Management Building:**



**Office Building:**



## 4. INTERNAL DAYLIGHTING

Whilst there are no known project daylighting compliance requirements, Stage 2 analysis has been completed for the Main Building, North (CASU) Building and Visitors Building to inform the detailed design stages. Analysis for the Gatehouse and Escort Rest buildings has been presented previously.

### 4.1 Key Modelling Inputs Summary

Input	Values/Comments
<b>Sky Condition</b>	CIE overcast sky (as required for DF calculations)
<b>Analysis Area</b>	Area of Interest (Aoi) excludes 500mm perimeter zone (from external walls and internal partitions)
<b>Glazing Light Transmittance</b>	70% (both vertical and rooflight glazing)
<b>Internal Surface Reflectances</b>	Walls (incl. internal partitions) – 70% (Grey/White) Ceilings (incl. underside roofs) – 70% (Grey/White) Floors – 20% (Darker Grey)
<b>Working Plane Height</b>	Typically 700mm from FFL (desk height)
<b>Internal Furniture/Fittings</b>	None modelled
<b>External Security Fittings/Shading</b>	None modelled

## 4.2 Analysis Outputs Summary

The following summary tables detail room-by-room daylight ingress performances.

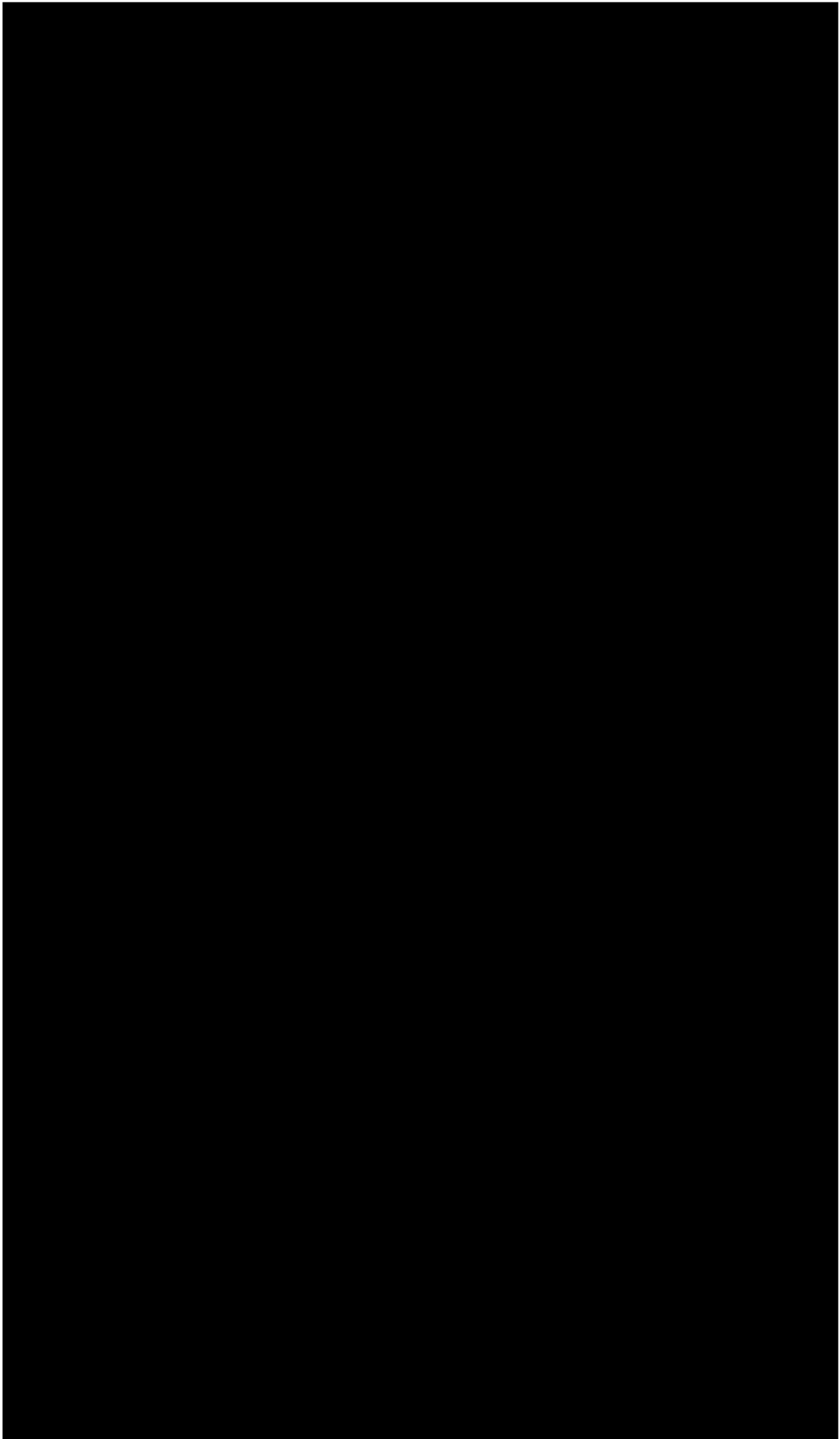
The Daylight Factor (using a standard CIE overcast sky) calculations completed to date are for a representative selection of rooms/zones across all buildings. For further calculation details and output visualisations refer to Appendices.

As the scheme moves into the detailed design stages there may be deemed merit in completing more complex dynamic climate-based daylight analysis to further refine the results (with BREEAM credit compliance in mind).

As previously commented, façade design is often a compromise between:

- Achieving useful year-round daylight ingress - which benefits occupant wellbeing and reduces electrical lighting demands
- The need to limit excessive fabric heat losses (glazed areas have higher heat losses)
- The need to limit unwanted summertime solar heat gains which can be problematic in terms of occupant comfort (overheating concerns)
- Achieving useful wintertime solar gains (to reduce mechanical space heating)
- Architectural design and aesthetics
- Often non-negotiable security considerations

The preliminary calculations completed and detailed within this report confirm that there are a significant number of rooms/spaces that benefit from useful daylight ingress.

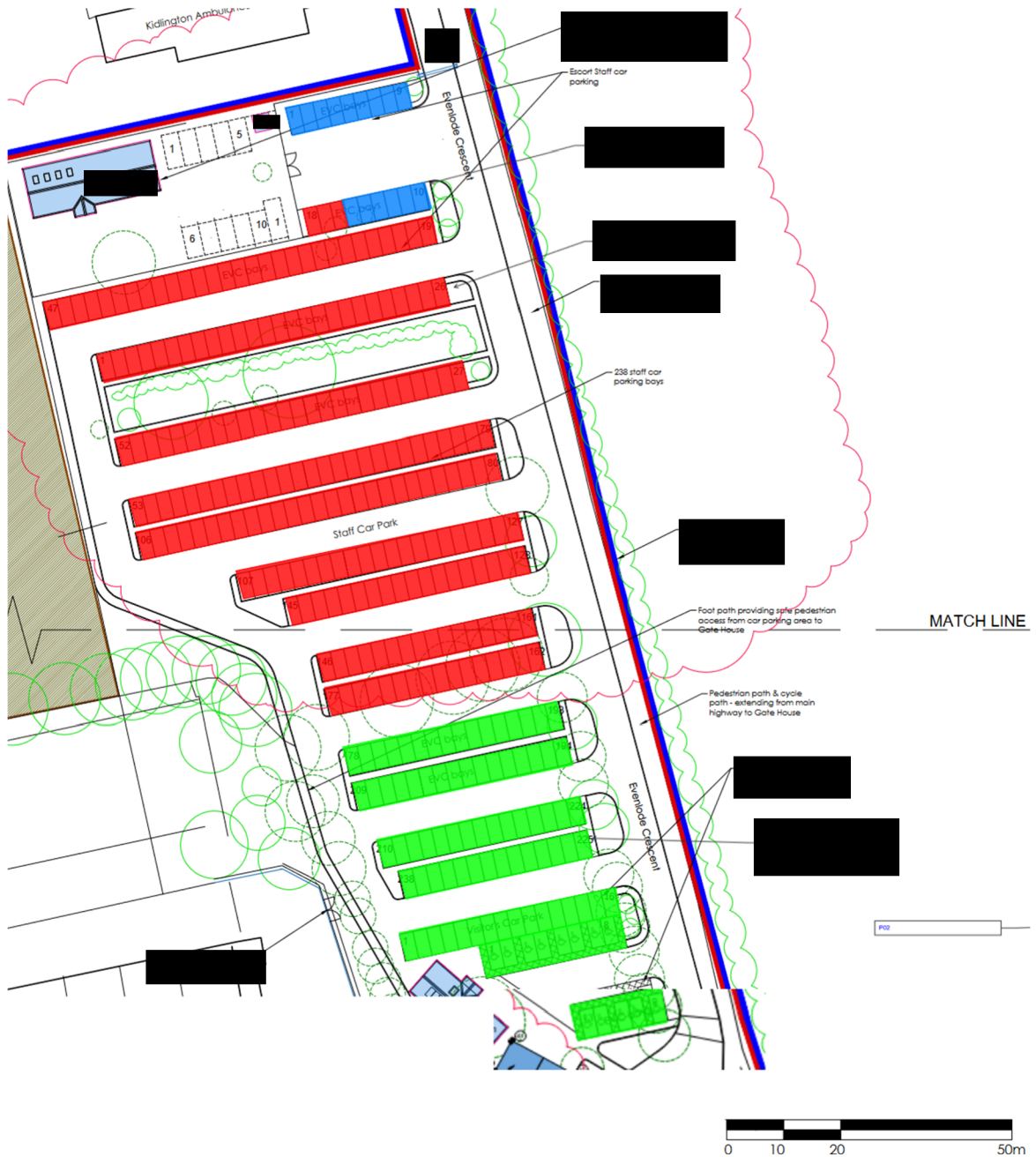




## 5. APPENDICES

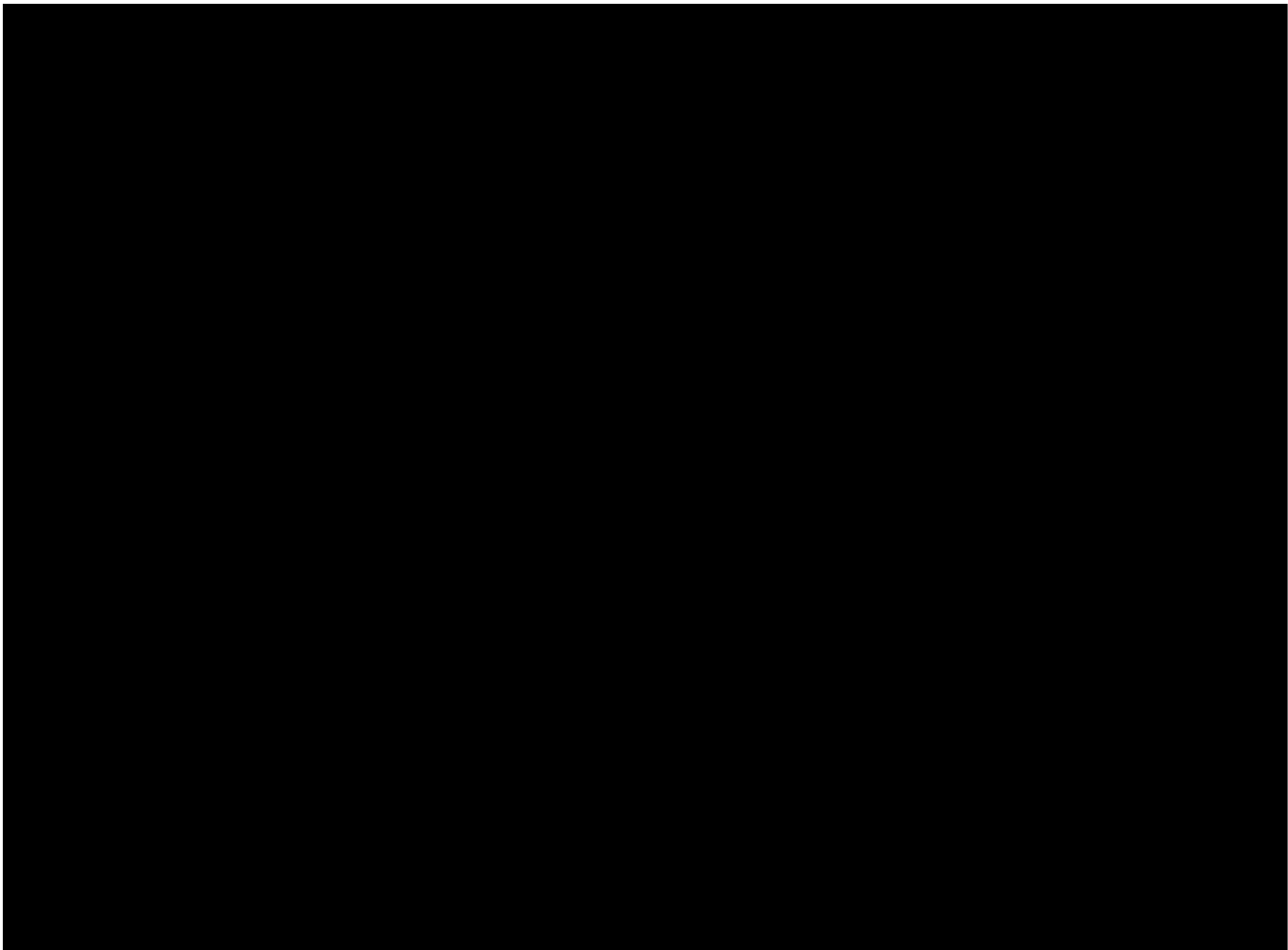
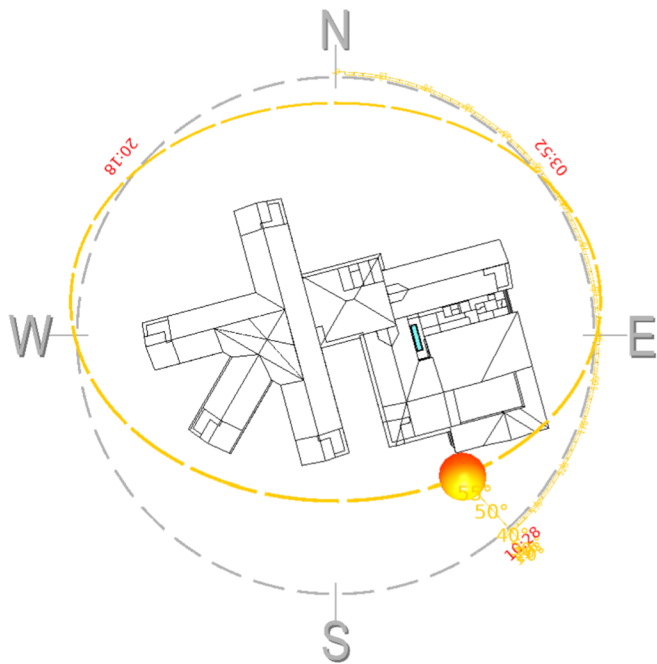
### 5.1 Proposed Photovoltaics Provision

- Red areas totalling 1,468m<sup>2</sup> (panels)
- Optional additional green areas totalling approx. 600m<sup>2</sup> (panels)

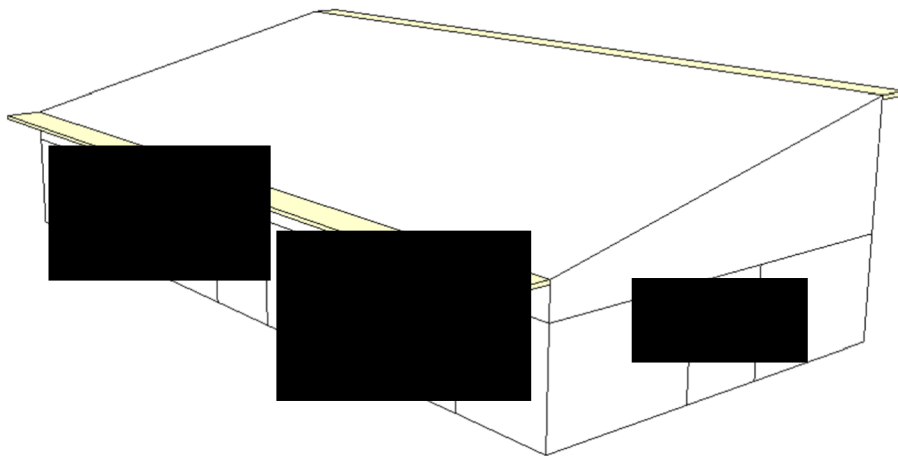
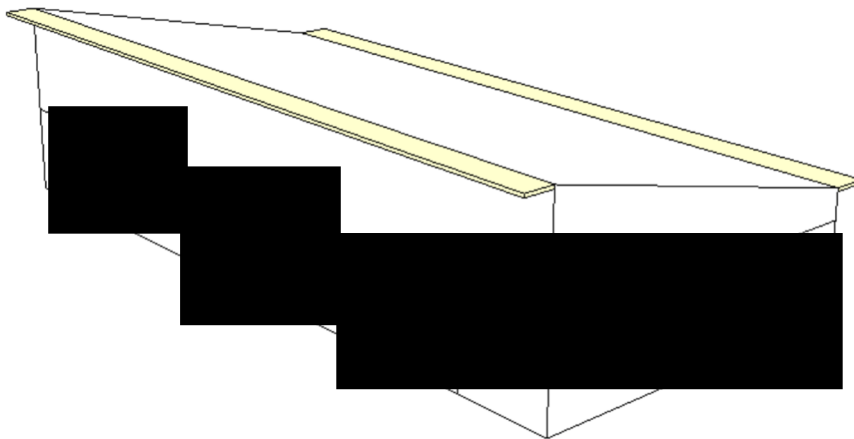
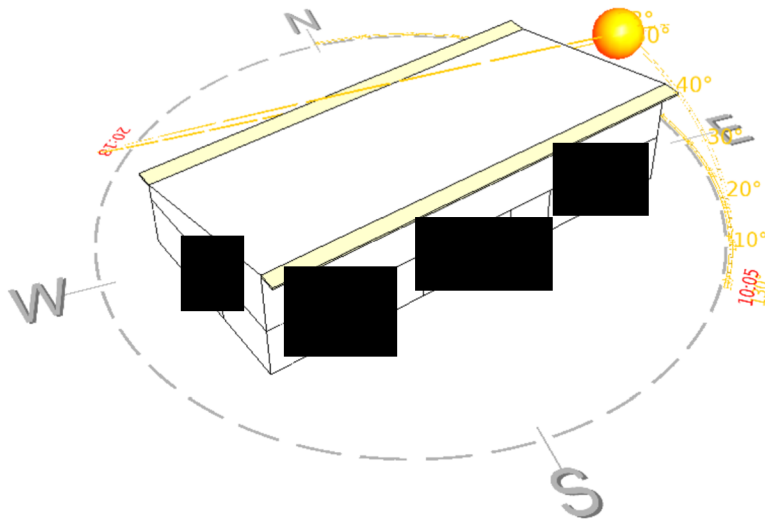


## 5.2 IES Compliance Model Images

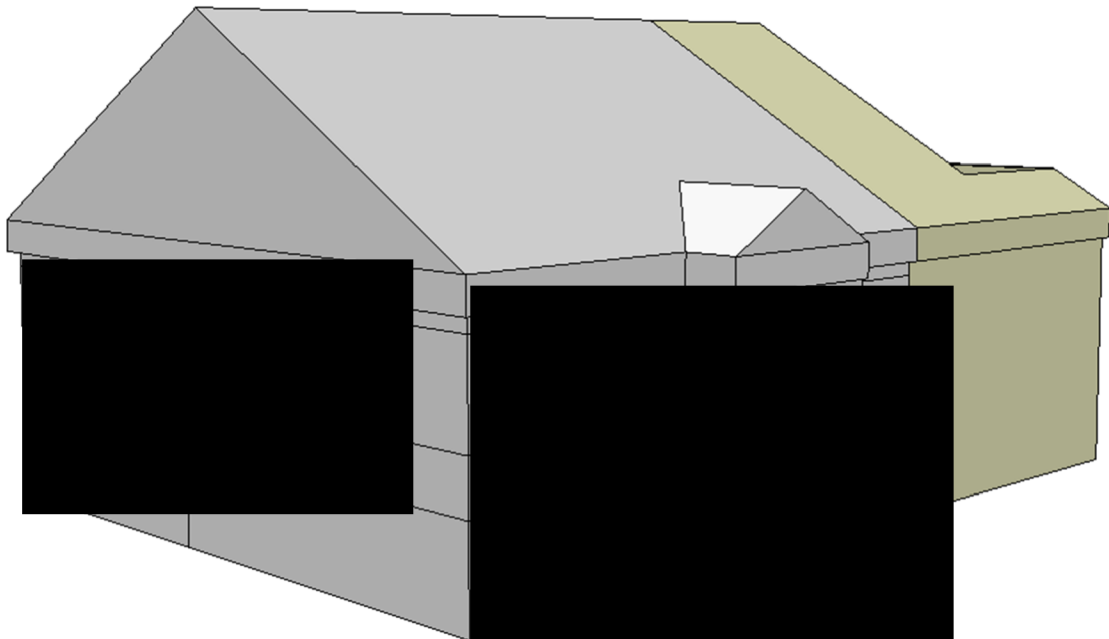
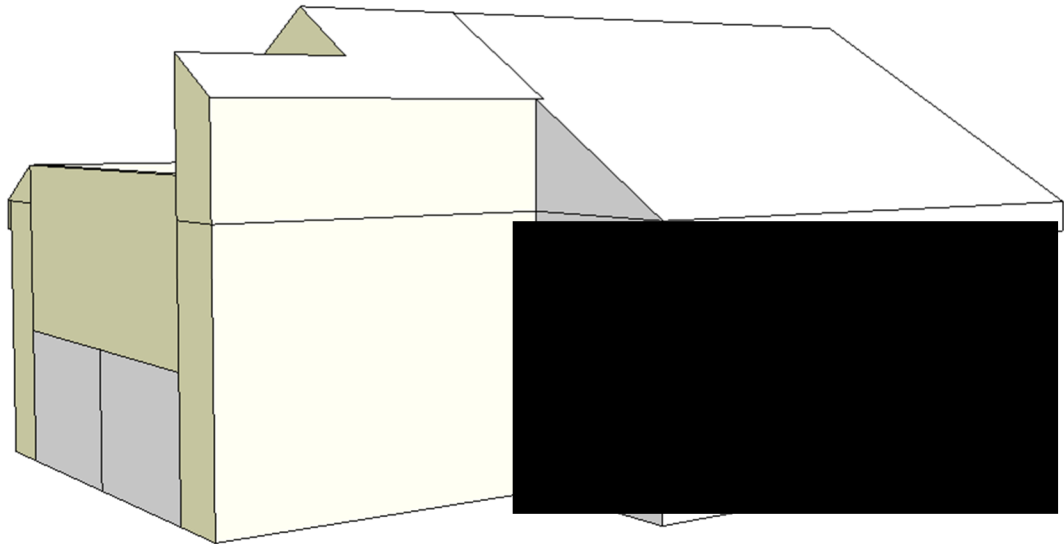
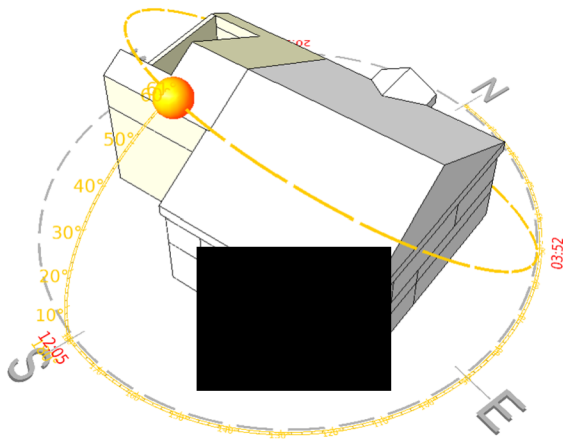
### 5.3 Main Building



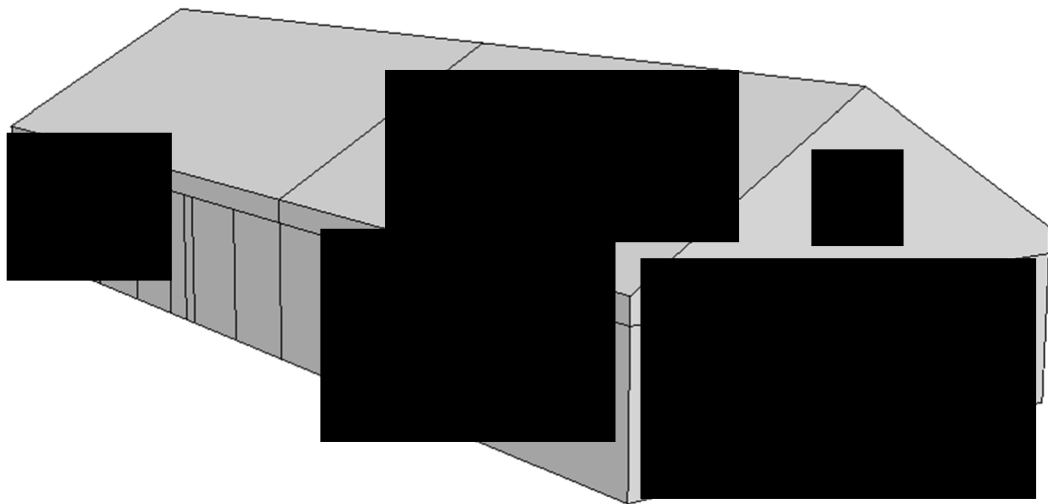
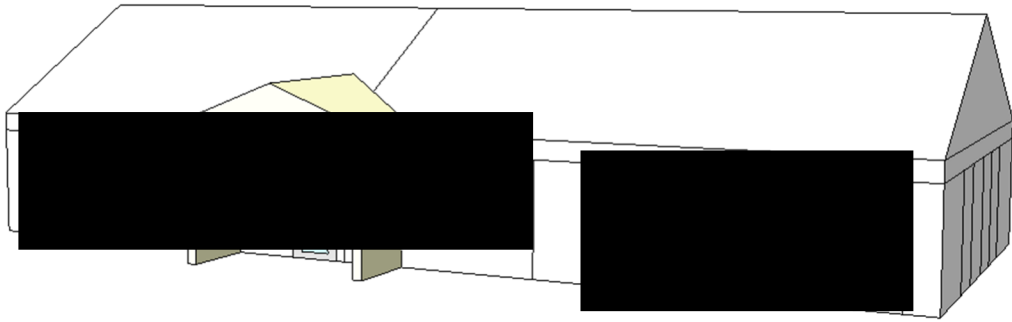
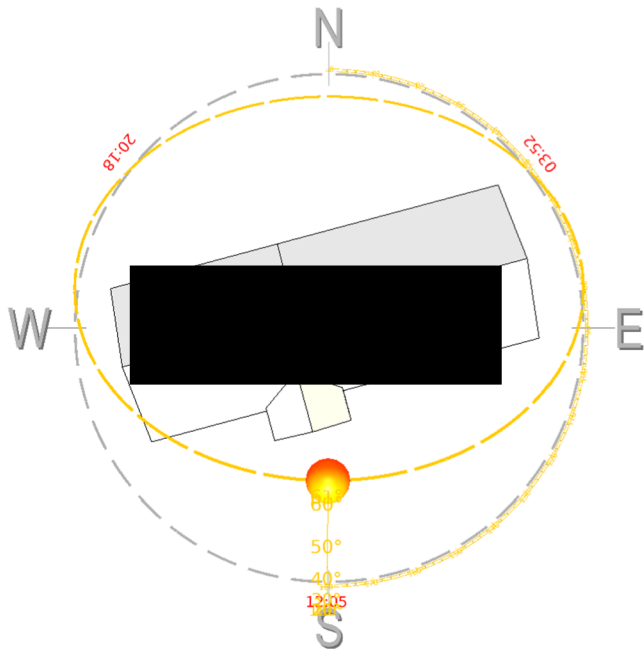
### 5.3.1 North Building



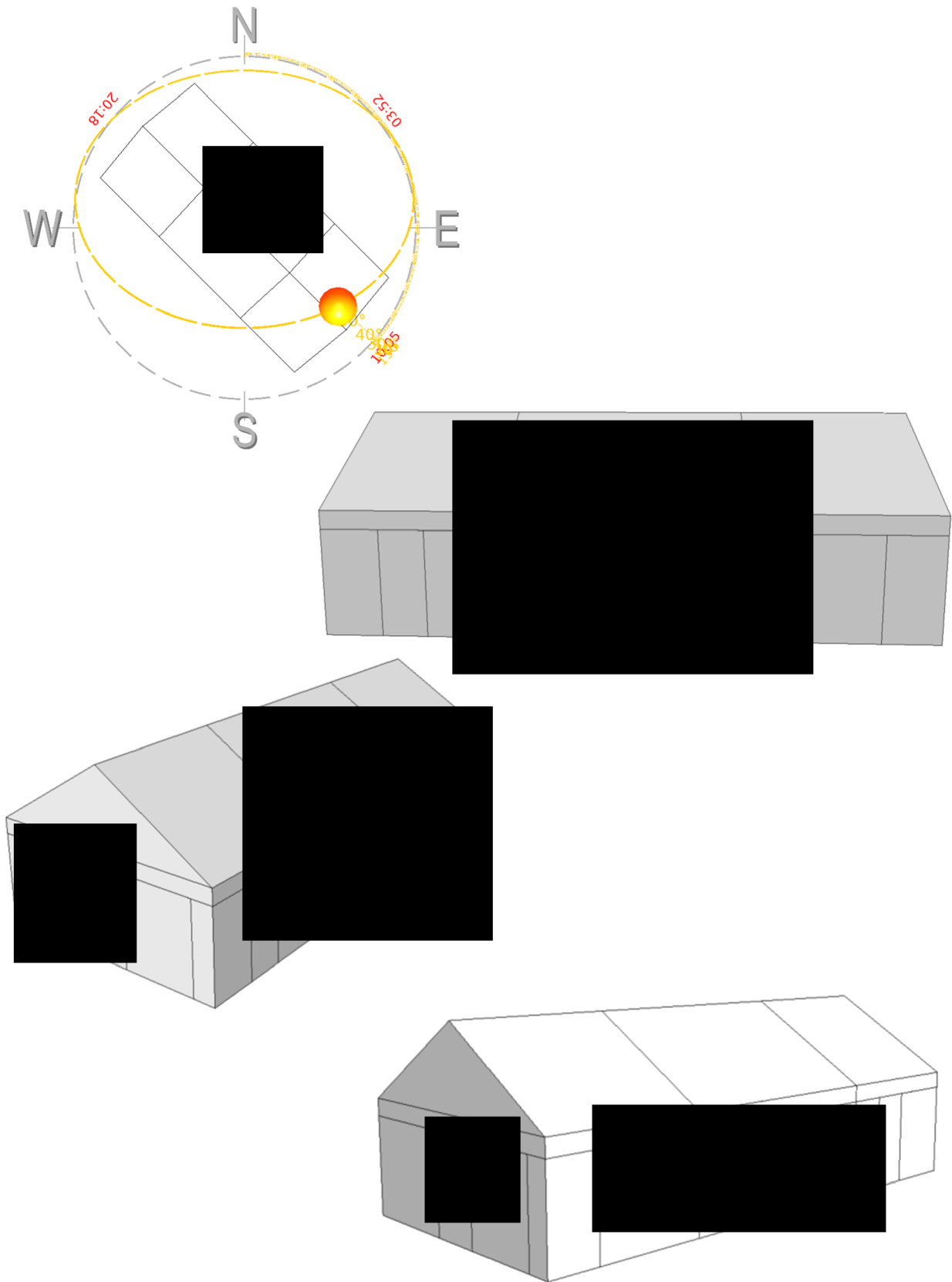
### 5.3.2 Gatehouse Building



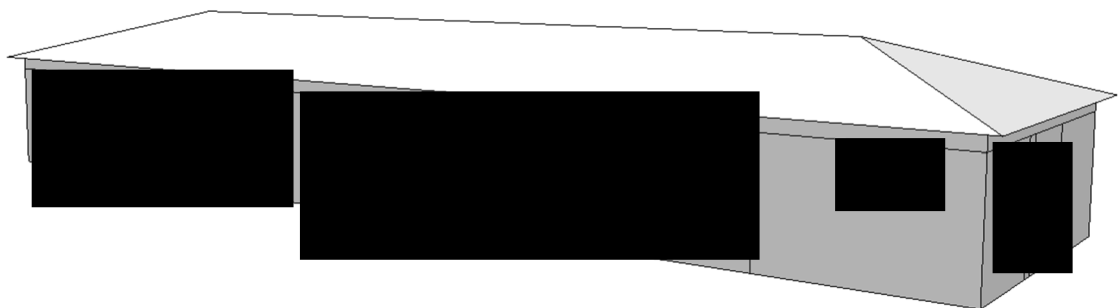
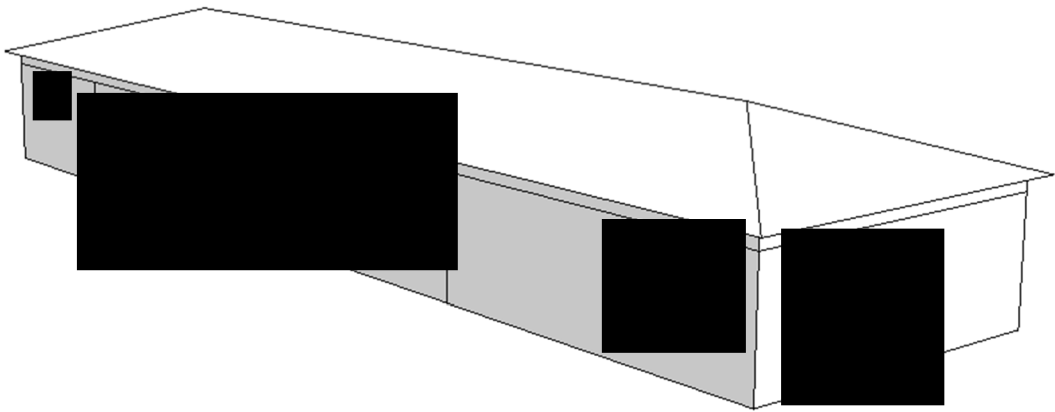
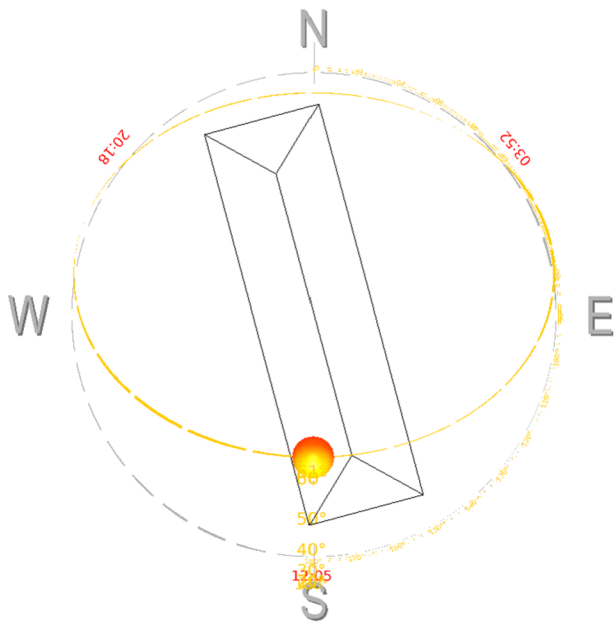
### 5.3.3 Escort Rest Building



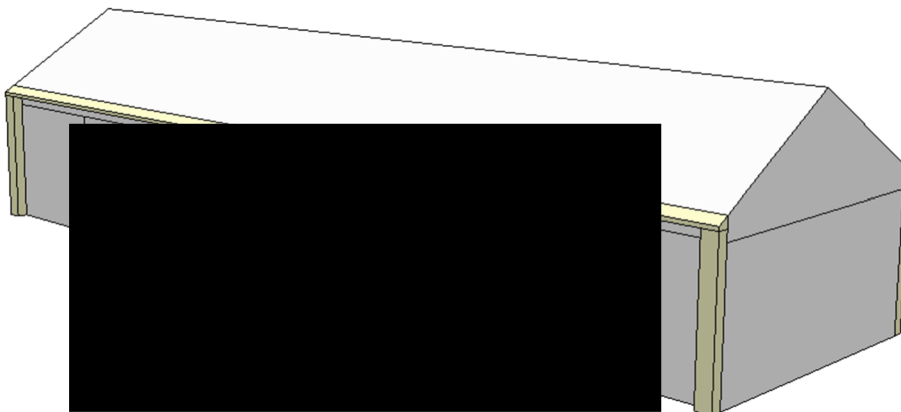
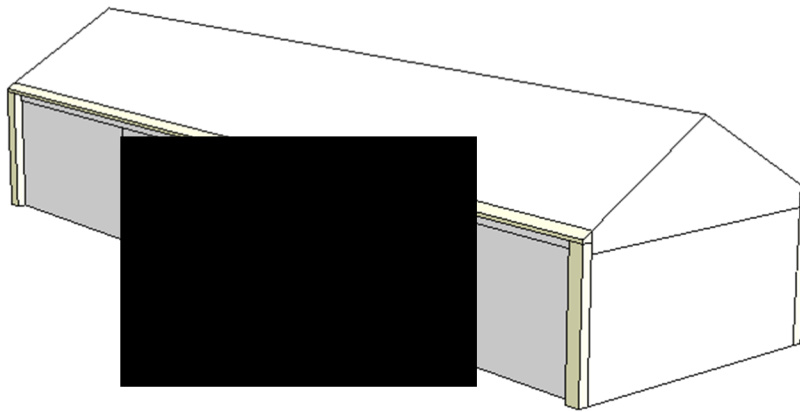
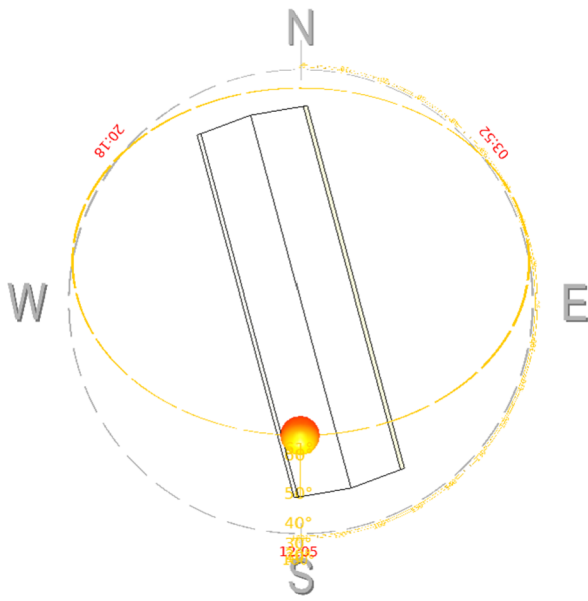
### 5.3.4 Visitors Building



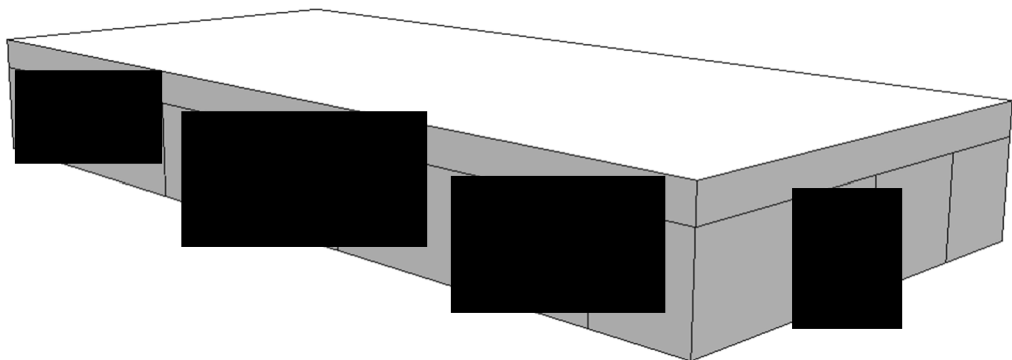
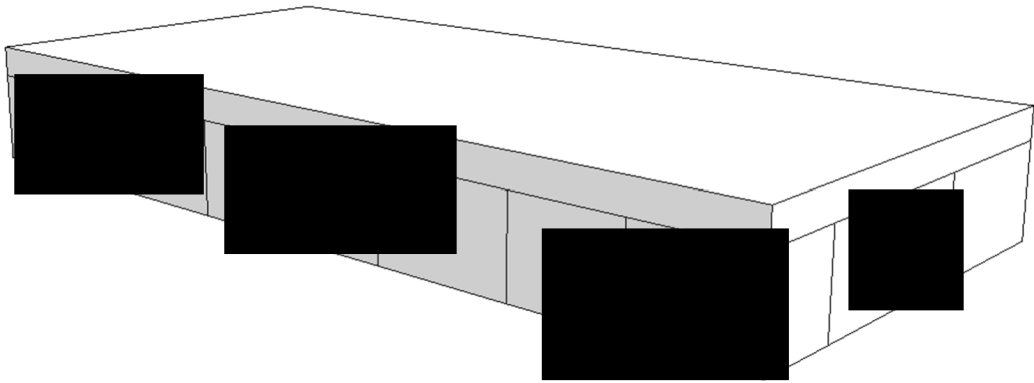
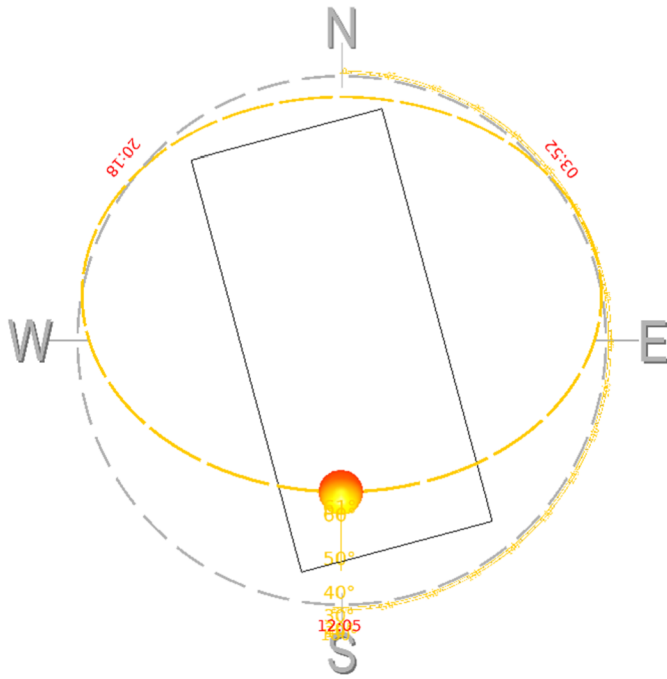
### 5.3.5 Dojo/Property Store Building



### 5.3.6 FM/Workshop Building

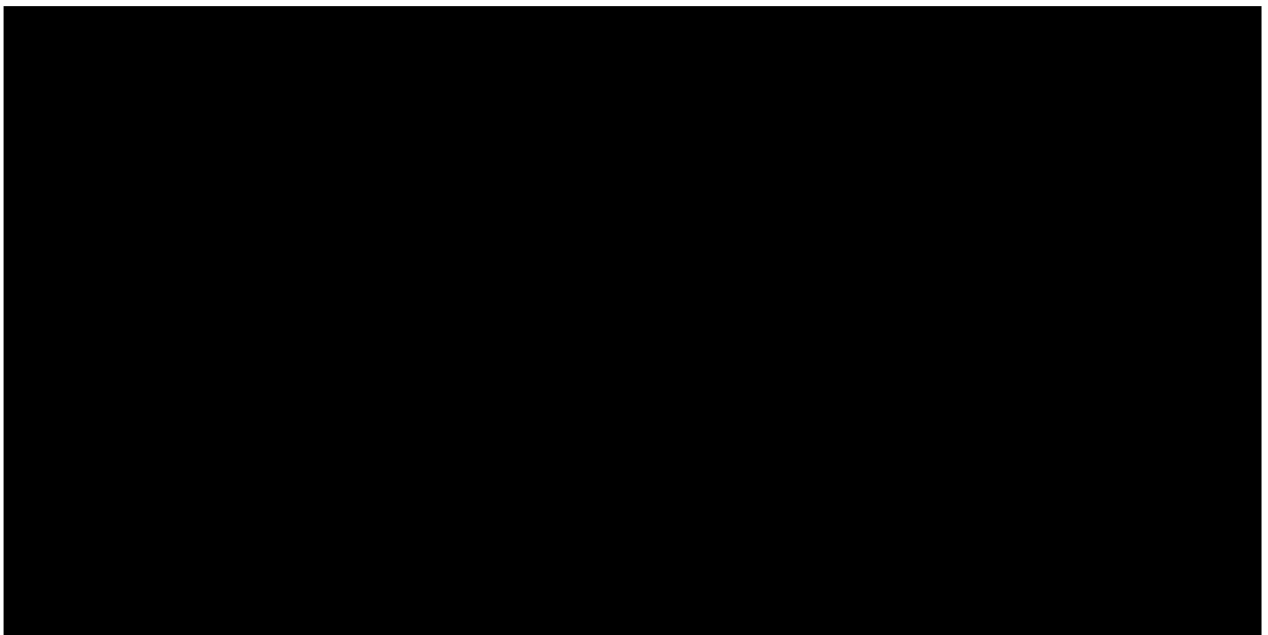
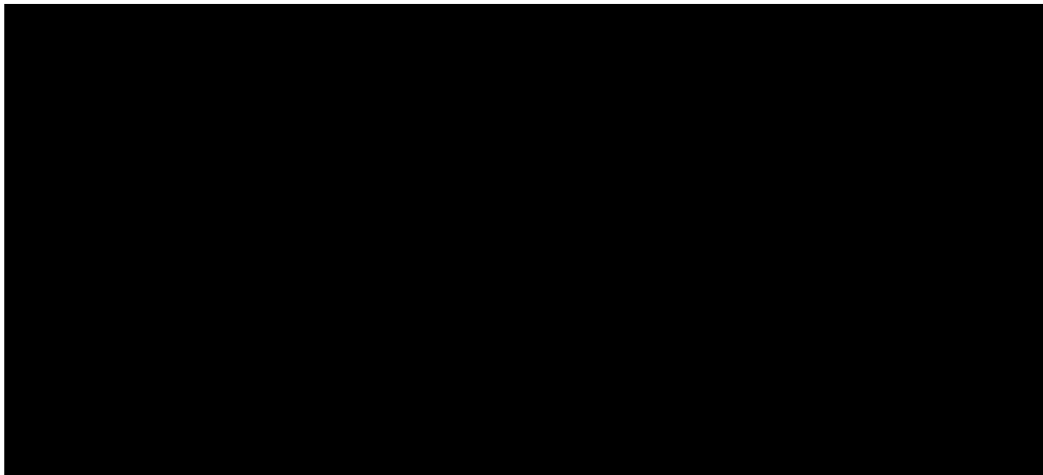
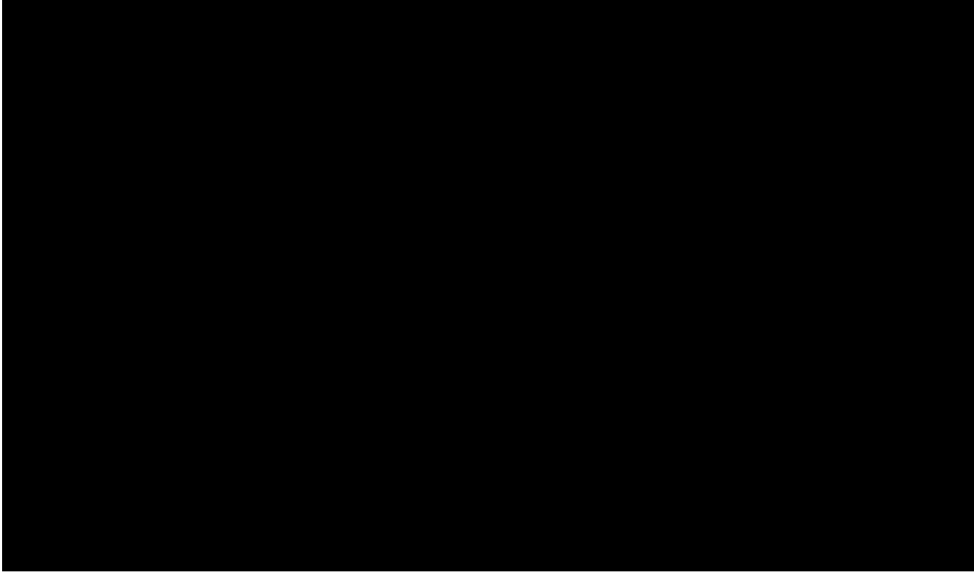


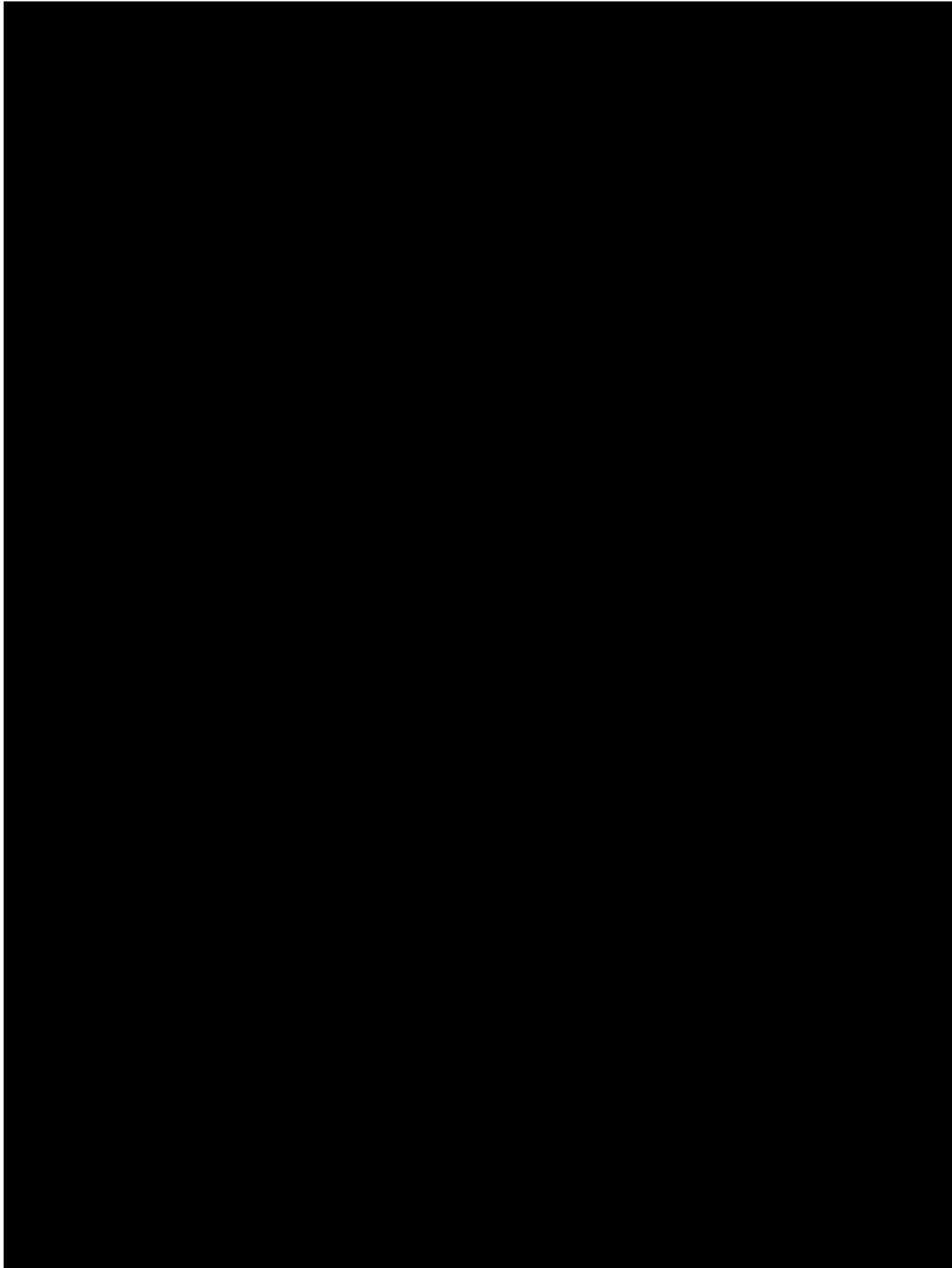
5.3.7 Office Building

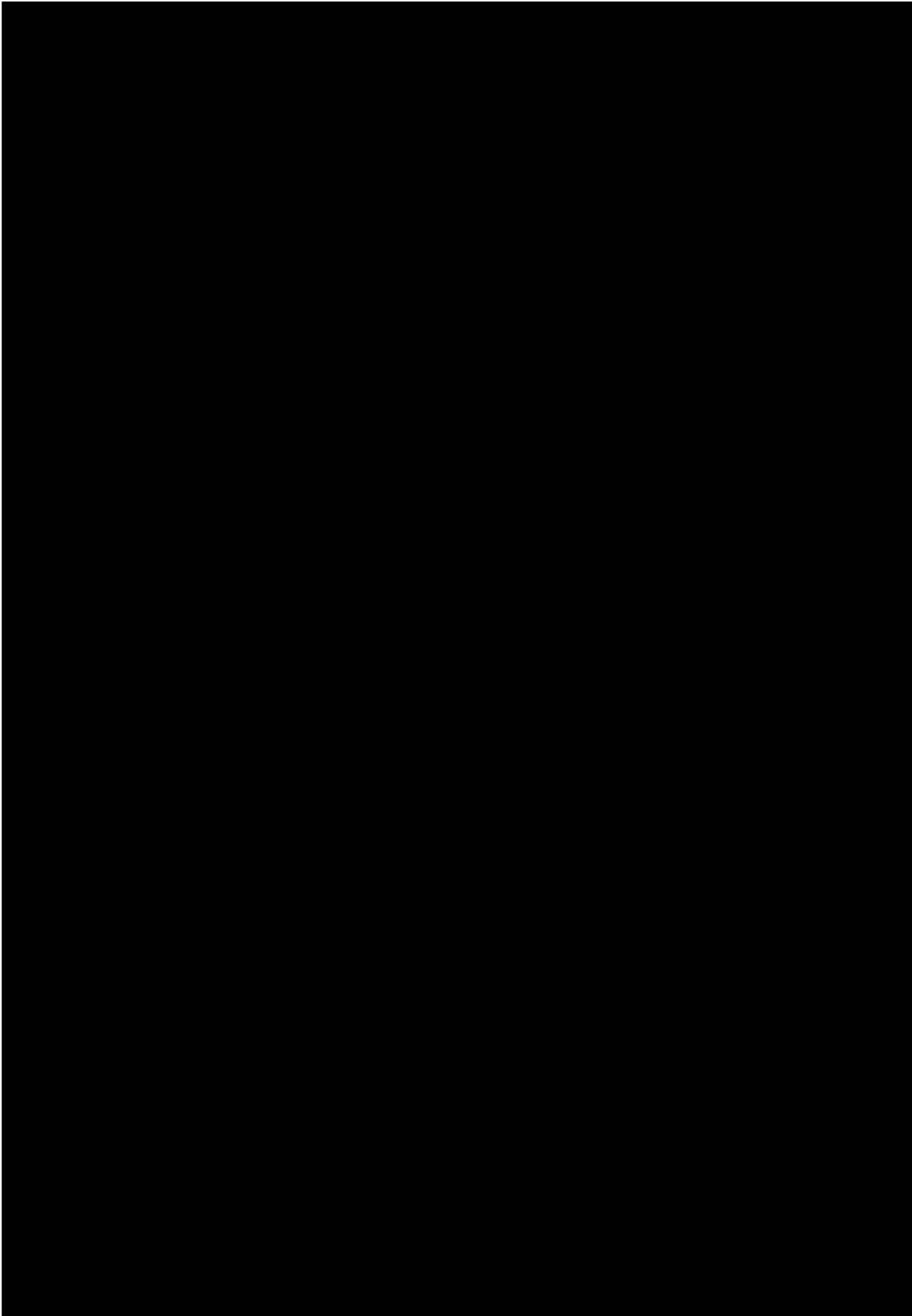


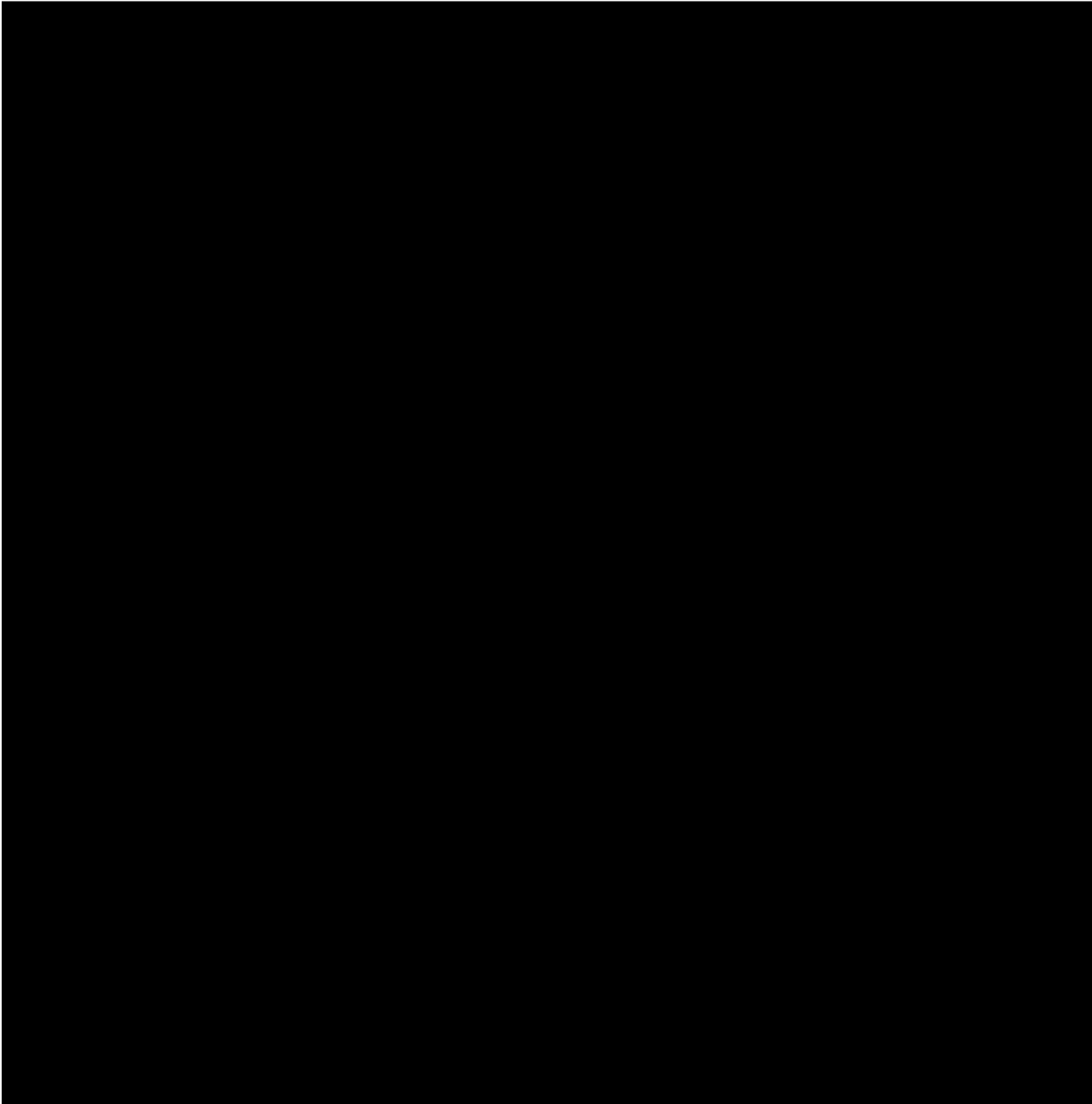
## 5.4 Assigned Fabric U-value Visualisations

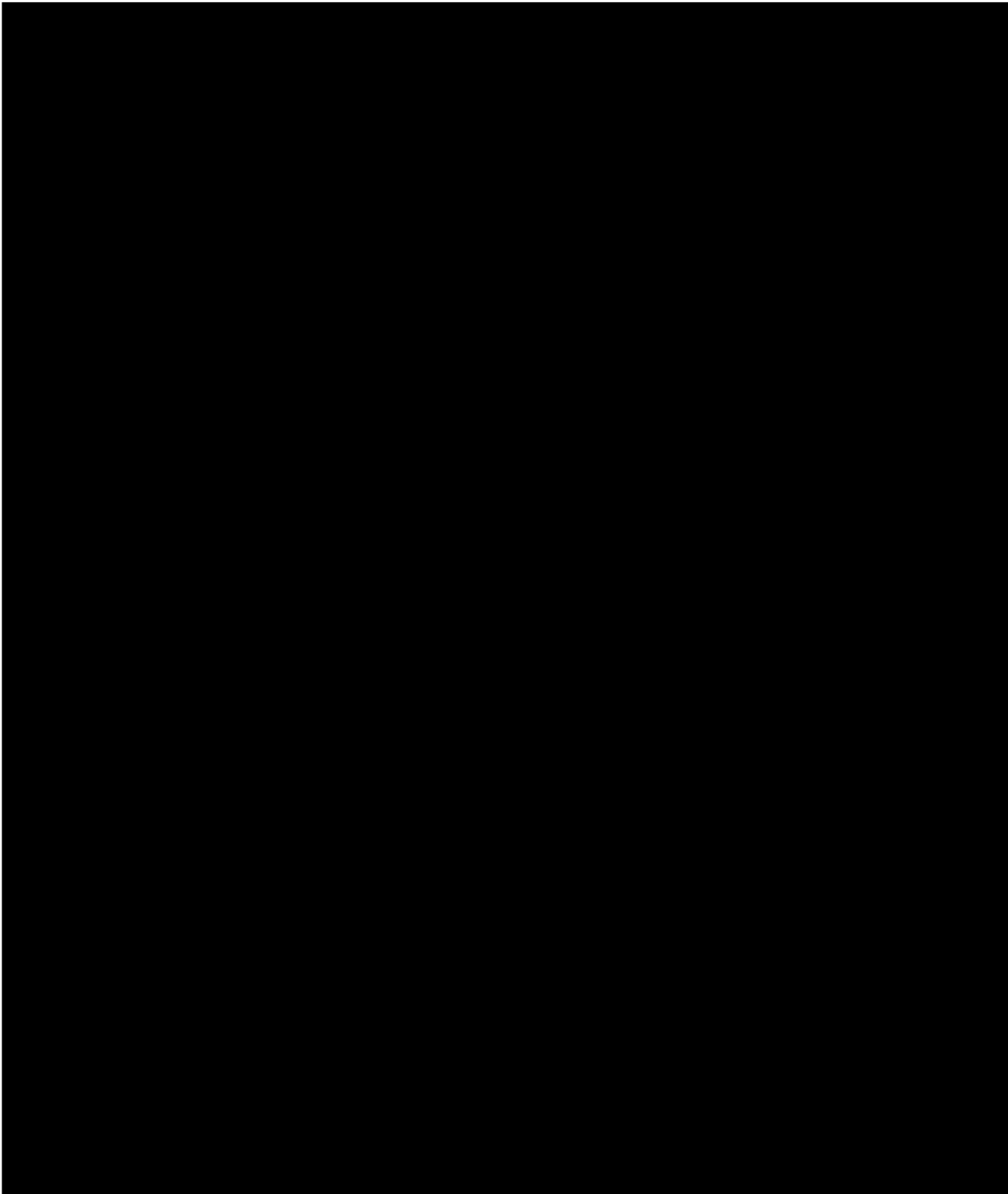
### 5.4.1 Main Building

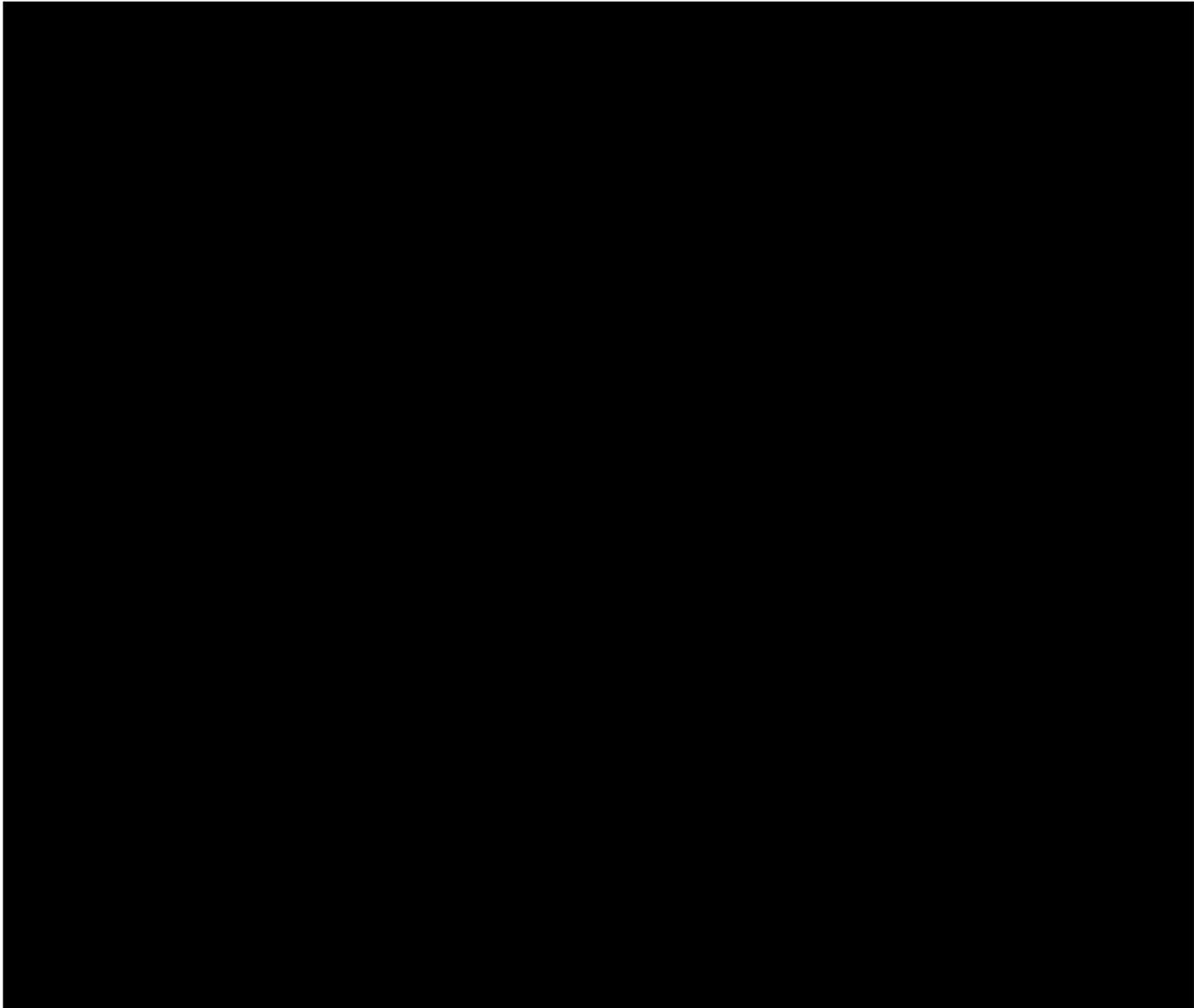


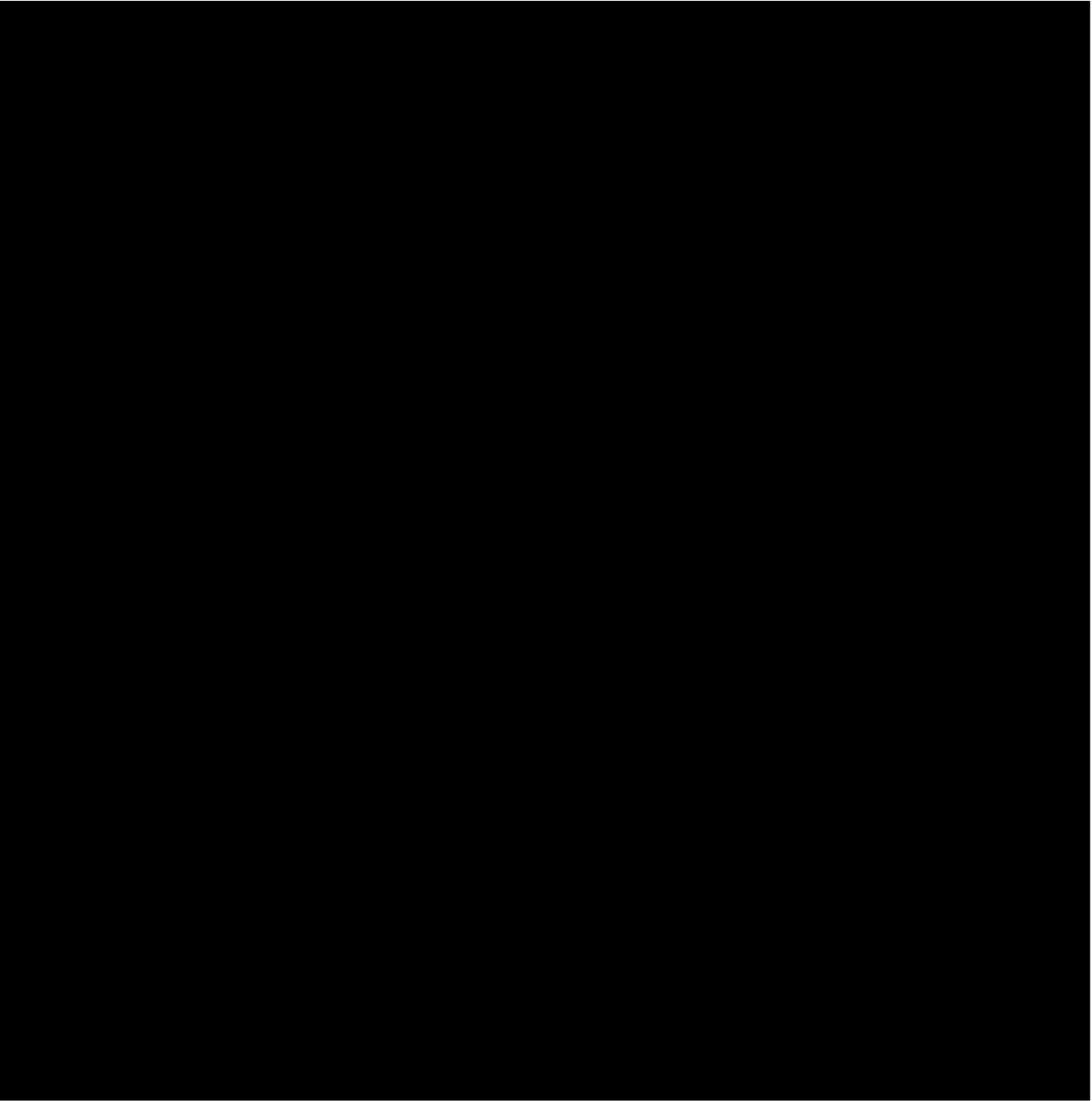


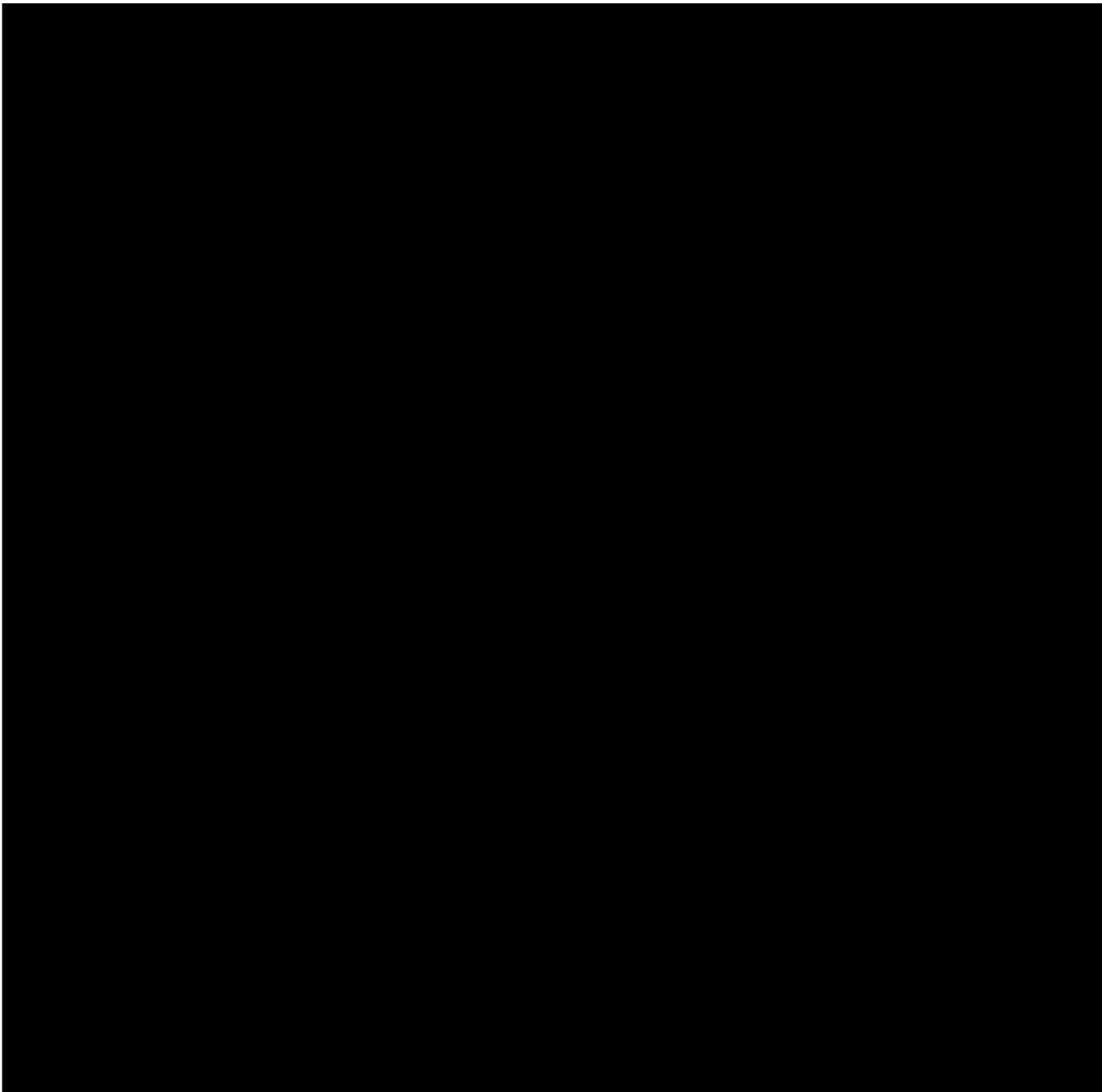








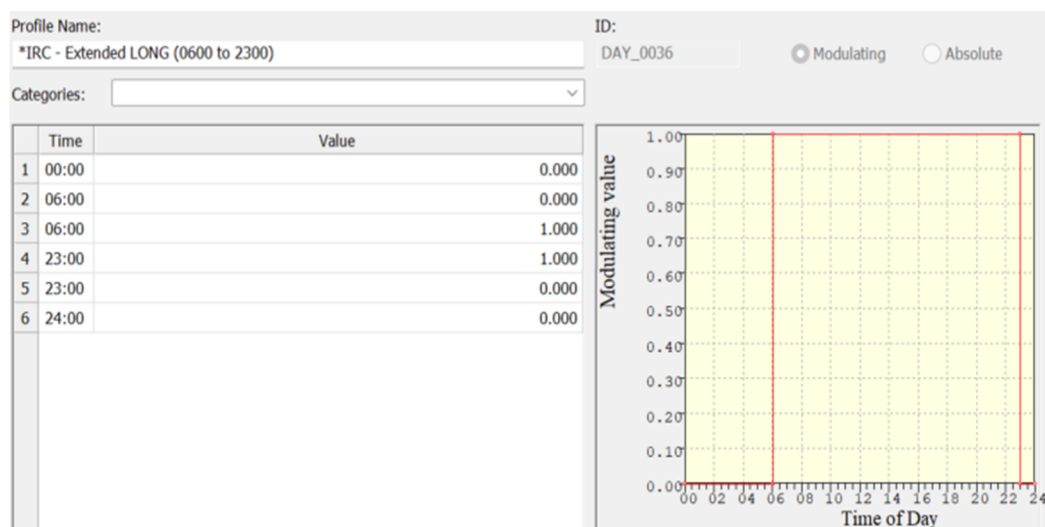
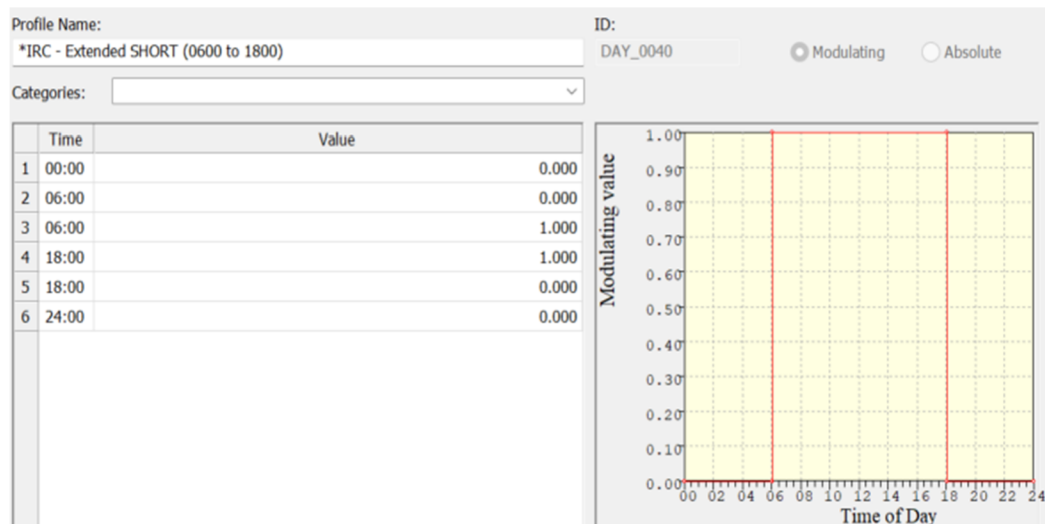


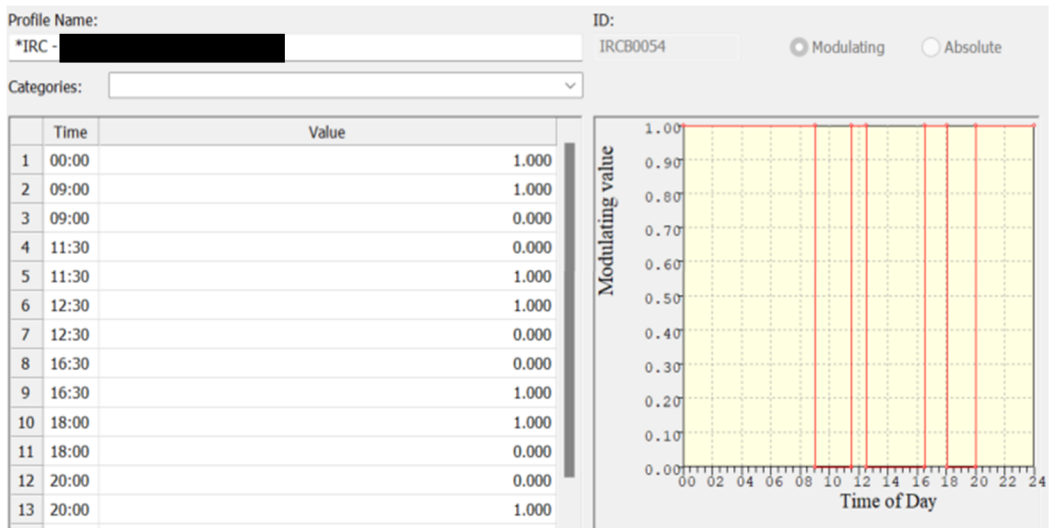
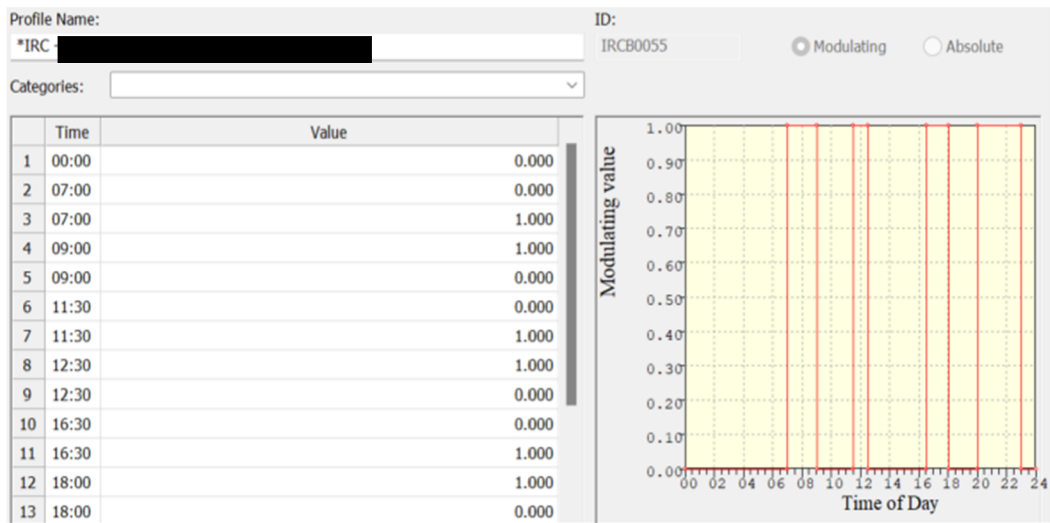
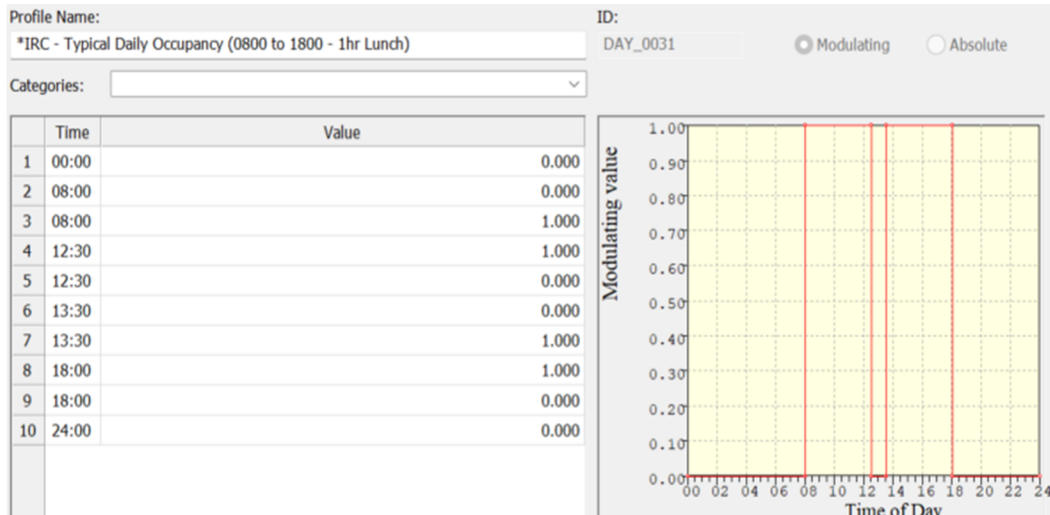


## 5.5 Overheating Analysis – Key Modelling Inputs

### 5.5.1 Internal Gains Profiles

The following graphical images represent the operational profiles applied to occupancy, internal lighting, and small power heat gains. **The form of these profiles is very influential in terms of determining internal operative temperatures and hence the conditioning strategies employed to enable TM52/59 compliance to be demonstrated.** For this reason, it is very important that during detailed design stages the broader design/client team agree to their appropriateness for anticipated real-world building usage.





Profile Name: \*IRC - 24hr Lighting (50% and 80% Modulation) ID: IRCC0001  Modulating  Absolute

Categories:

	Time	Value
1	00:00	0.200
2	07:00	0.200
3	07:00	0.500
4	22:00	0.500
5	22:00	0.200
6	24:00	0.200

Profile Name: \*IRC - Dining Areas Daily Occupancy (0730 to 1900 - Modulating) ID: DAY\_0033  Modulating  Absolute

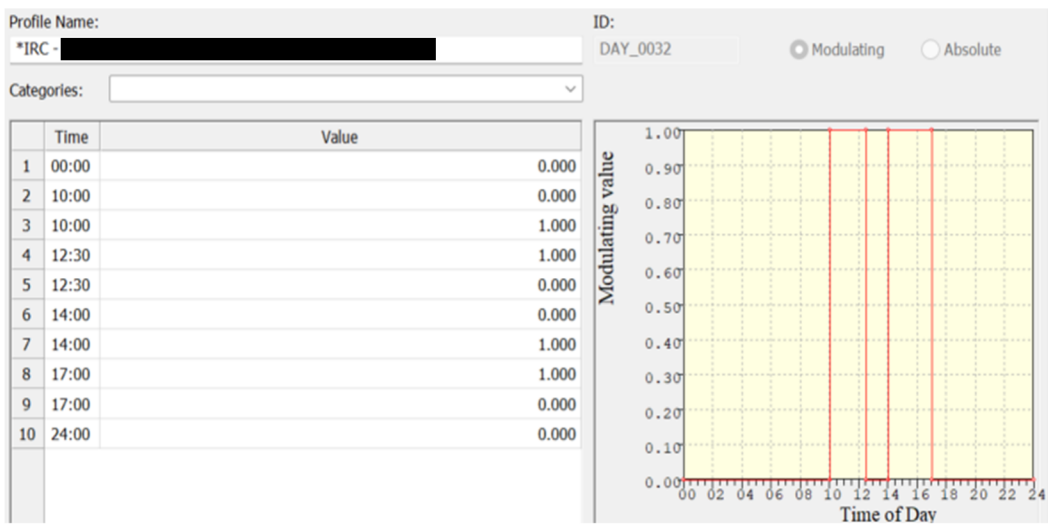
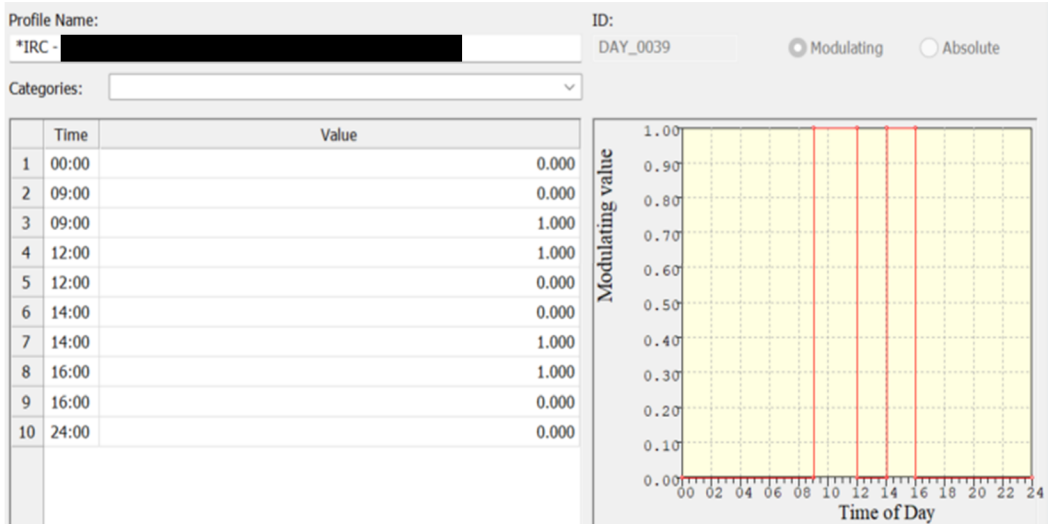
Categories:

	Time	Value
1	00:00	0.000
2	07:30	0.000
3	07:30	1.000
4	09:00	1.000
5	09:00	0.000
6	12:00	0.000
7	12:00	1.000
8	13:30	1.000
9	13:30	0.000
10	17:30	0.000
11	17:30	1.000
12	19:00	1.000
13	19:00	0.000

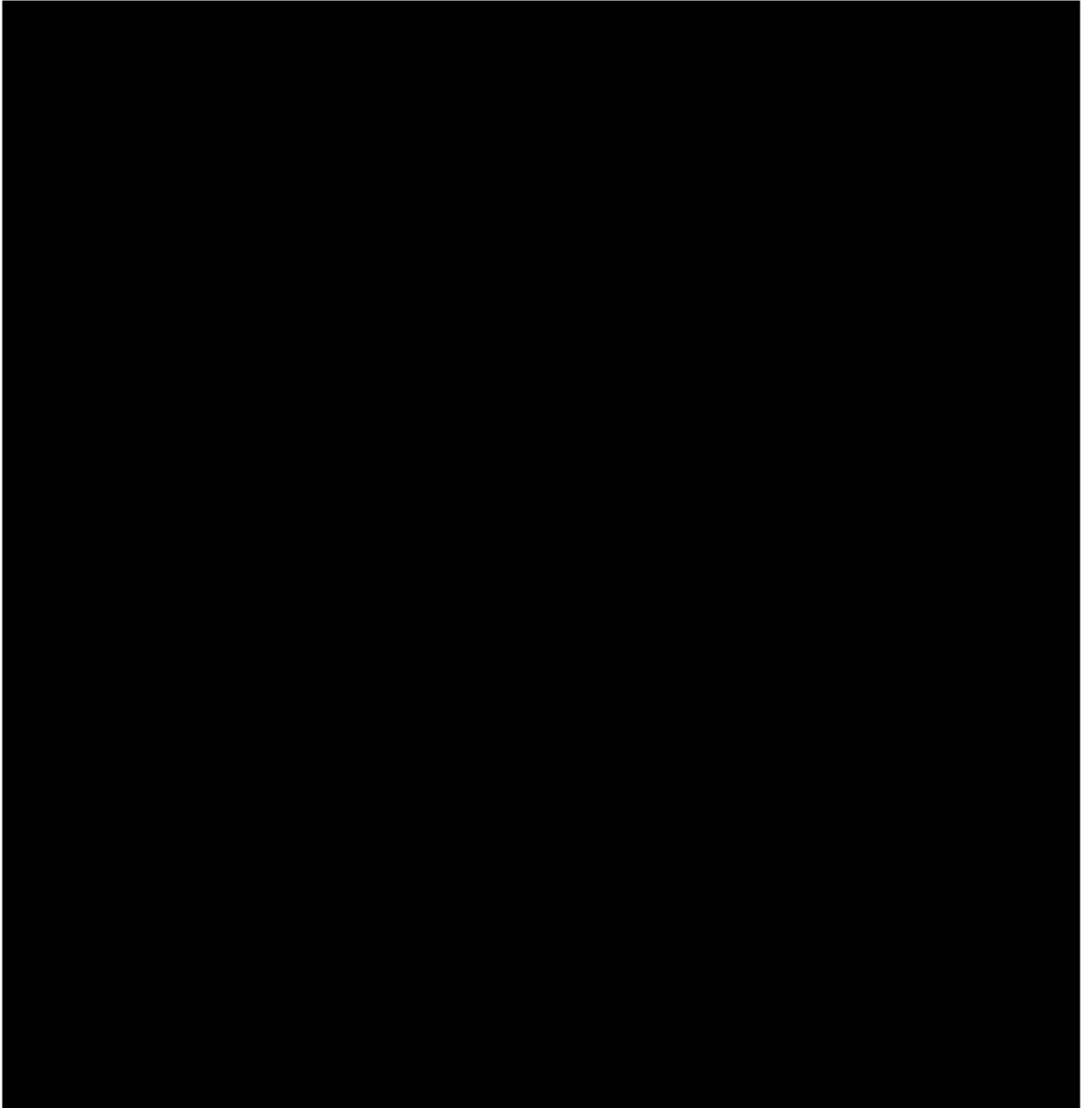
Profile Name: \*IRC [REDACTED] ID: DAY\_0034  Modulating  Absolute

Categories:

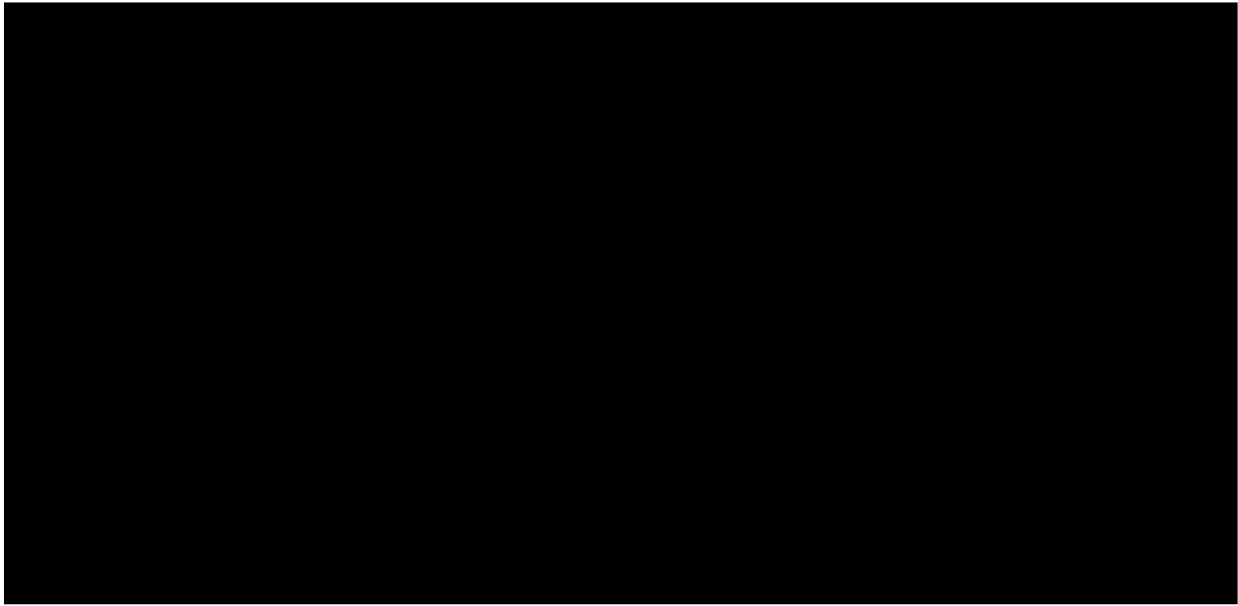
	Time	Value
1	00:00	0.000
2	07:30	0.000
3	07:30	1.000
4	08:00	1.000
5	08:00	0.000
6	10:00	0.000
7	10:00	1.000
8	10:30	1.000
9	10:30	0.000
10	13:00	0.000
11	13:00	1.000
12	13:30	1.000
13	13:30	0.000



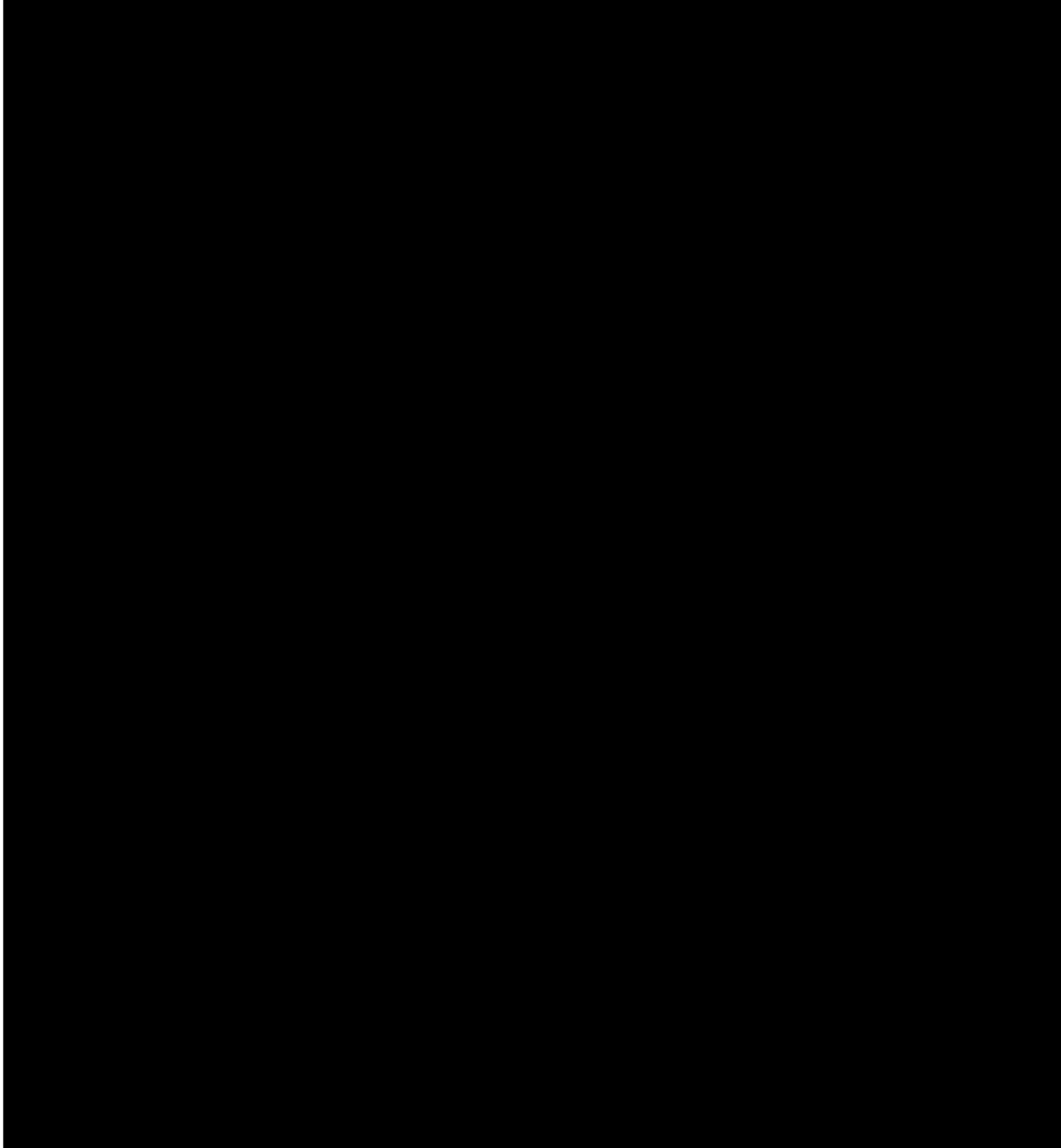
## 5.5.2 Main Building - TM52 - Assessed Rooms Internal Gains Modelling Inputs



### 5.5.3 North Building - TM52 - Assessed Rooms Internal Gains Modelling Inputs



#### 5.5.4 North and Main Buildings – TM59 - Assessed Rooms Internal Gains Modelling Inputs



## 5.6 Internal Daylighting Calculation Visualisations

