

Overheating and Thermal Comfort Report

STOREX South Tottenham

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Executive Summary

This report has been prepared by Atelier Ten to present the overheating assessment carried out for the STOREX South Tottenham development. This assessment outlines the requirements for the mechanically cooled space (Reception) as well as the natural ventilation strategy for the Fab Labs.

This report has been prepared to support the detailed planning application for the proposed STOREX South Tottenham development. The proposed redevelopment of the site provides a new self-storage facility (Use Class B8) that is largely unconditioned, and new light Industrial workspace / incubator units known as Fab Labs (Use Class E(g)(iii)) that are naturally ventilated, as well as associated loading area, car, van and cycle parking, landscaping, and other works ancillary to the development.

A full dynamic thermal comfort analysis has been completed in accordance with the requirements of BREEAM Hea04 and Policy SI 4 of the London Plan. The cooling hierarchy has been followed, which enables both mechanical ventilation and active cooling to eliminated from the Fab Lab spaces. The thermal comfort analysis has been carried out using design summer conditions for a typical year (LHR DSY1_2020 High50) and has informed the temperature zoning and control strategy for the building. Further analysis involves using design summer conditions under climate change scenarios (LHR DSY2_2020 High50, LHR DSY3_2020 High50, LHR DSY1_2050 High50, LHR DSY2_2050 Med50, and LHR DSY3_2050 Med50). This ensures compliance with the modelling requirements for both BREEAM and the Greater London Authority (GLA).

The results for the mechanically cooled spaces have been assessed against the CIBSE Guide A 2015 recommended winter and summer operative temperature ranges and the comfort requirements described in ISO7730:2005 for air-conditioned buildings, using IESVE software, in accordance with CIBSE AM11. For the spaces that are naturally ventilated (Fab Labs), the spaces have been assessed against CIBSE TM52.

The dynamic thermal modelling presented in this report demonstrates that both naturally ventilated and mechanically cooled spaces in the scheme achieve 100% summer comfort compliance under the mandatory DSY1 2020 weather file and BREEAM design for future comfort weather files. The fab lab spaces are likely to be too cold in the winter without supplementary heating. This thermal modelling has informed the thermal zoning and control strategy.

Overshading from adjacent buildings and retained trees are accounted for in the simulations.

Table 0.1 Summary of the design response to each step in the cooling hierarchy

Cooling Hierarchy Step		Design Response	
Fab Labs		Shop/Breakroom	
1.	Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure.	Low g-value glazing specified (0.21), high standards of insulation, glazing areas reduced to reasonable minimums including through the use of opaque louvre panels	Low g-value glazing specified (0.21), high standards of insulation, glazing areas reduced to reasonable minimums including through the use of opaque louvre panels
2.	Minimise internal heat generation through energy efficient design.	Use of electric panel heaters for space heating (frost protection only) and electric POU water minimises heat losses from hot water pipework. Good daylighting and the specification of efficient electrical lighting minimises heat gain from lighting provision.	Efficient VRF heating and cooling and electric POU water minimises heat losses from hot water pipework. Good daylighting and the specification of efficient electrical lighting minimises heat gain from lighting provision.
3.	Manage the heat within a building through exposed thermal mass and high ceilings	200mm exposed concrete floors to ground floor and 100mm exposed concrete blockwork partitions to support a night cooling strategy. 30mm plasterboard to internal walls and ceilings.	200mm exposed concrete floors to ground floor and 25mm plasterboard to internal walls and ceilings.
4.	Provide passive ventilation	Efficient night cooling through actuated and manual louvre panels for daytime thermal comfort. Adequate thermal comfort achieved after this step, eliminating the requirement for mechanical ventilation or active cooling.	Potential for natural ventilation found to be insufficient to eliminate cooling requirement in shop. Automated louvre included in comms room to provide free cooling to server equipment.
5.	Provide mechanical ventilation	-	Provision of mechanical ventilation found to be insufficient to eliminate cooling requirement.
6.	Provide active cooling systems	-	Mechanical cooling provided to shop space via VRF

Table 0.2 Summary of thermal comfort in worst performing mechanically cooled space, assessed using the PPD and PMV metrics

Weather file	Percentage of Occupied Hours Uncomfortable	PPD for 97th Centile Occupied Hours	PMV for 97th Centile PPD
DSY1 2020 High 50 (BREEAM current)	0.1%	9.7%	-0.47/0.47
DSY2 2020 High 50 (BREEAM future)	1.1%	9.8%	-0.48/0.48
DSY1 2020 High 50 (BREEAM future)	1.4%	9.9%	-0.48/0.48

Table 0.3 Summary of thermal comfort in the naturally ventilated Fab Lab spaces, assessed against TM52

Weather File	TM52 Compliance Rate (%)
As designed	
DSY1 2020 High50 (Mandatory)	100%
DSY2 2050 Med50 (BREEAM future)	100%
DSY3 2050 Med50 (BREEAM future)	100%
DSY2 2020 High50 (GLA extreme)	100%
DSY3 2020 High50 (GLA extreme)	100%
DSY1 2050 High50 (GLA future)	100%

1 Introduction

This report has been prepared by Atelier Ten to present the thermal assessment carried out for the proposed shop and Fab Labs in the STOREX South Tottenham development. This assessment aims to evaluate thermal comfort conditions within all occupied spaces against the BREEAM New Construction (NC) Hea 04 Thermal Comfort criteria.

1.1 Policy SI4 of the London Plan

Although not GLA referable due to size, the London Borough of Haringey would like the GLA guidance to be followed. Consequently, compliance with Policy SI4 of the London Plan is desirable to demonstrate that the proposed building has been well designed to manage heat risk.

Policy SI4 states that major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems. To achieve this, Policy SI4 defines a cooling hierarchy that should be followed when developing the space conditioning strategy, which is summarised in Table 1.1. By following this process, energy use for cooling can be designed out wherever possible, and minimised when no alternative to active cooling is possible.

Table 1.1 Cooling hierarchy that should be followed when developing the space conditioning strategy

Cooling Hierarchy Step	
1.	Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure.
2.	Minimise internal heat generation through energy efficient design.
3.	Manage the heat within a building through exposed thermal mass and high ceilings
4.	Provide passive ventilation
5.	Provide mechanical ventilation
6.	Provide active cooling systems

In addition to this, Policy SI4 of the London Plan states that development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure. In addition to this,

1.2 Thermal Comfort

'Thermal comfort' describes a person's state of mind in terms of whether they feel too hot or too cold. Therefore, it is a subjective quality affected both by quantifiable and unquantifiable factors that often complicate its assessment in design. Environmental factors (such as humidity and sources of heat in the workplace) combine with personal factors (i.e., clothing) and metabolic activity-related factors (i.e., how physically demanding the activity is) to influence a person's 'thermal comfort' (see Figure 1.1). It is also affected by less-controllable factors, such as age, sex, and physical and mental wellbeing. As a result, it is difficult to define precisely and globally as a range of environmental, work-related and personal factors need to be considered when deciding what makes a comfortable workplace.

The quality of the thermal environment also has an impact on the health and well-being of occupants and has an impact on disease transmission risk. As stated in the WELL standard, "cold and dry spaces are known to facilitate the spread of the influenza virus because low humidity levels allow the virus to persist longer in the air, while low air temperature extends the virus shedding period. On the other hand, overly warm indoor spaces are linked to increases in sick building syndrome symptoms, irregular heart rate, respiratory issues, fatigue and negative mood. Warm and humid indoor spaces are also associated with mould and fungal growth."

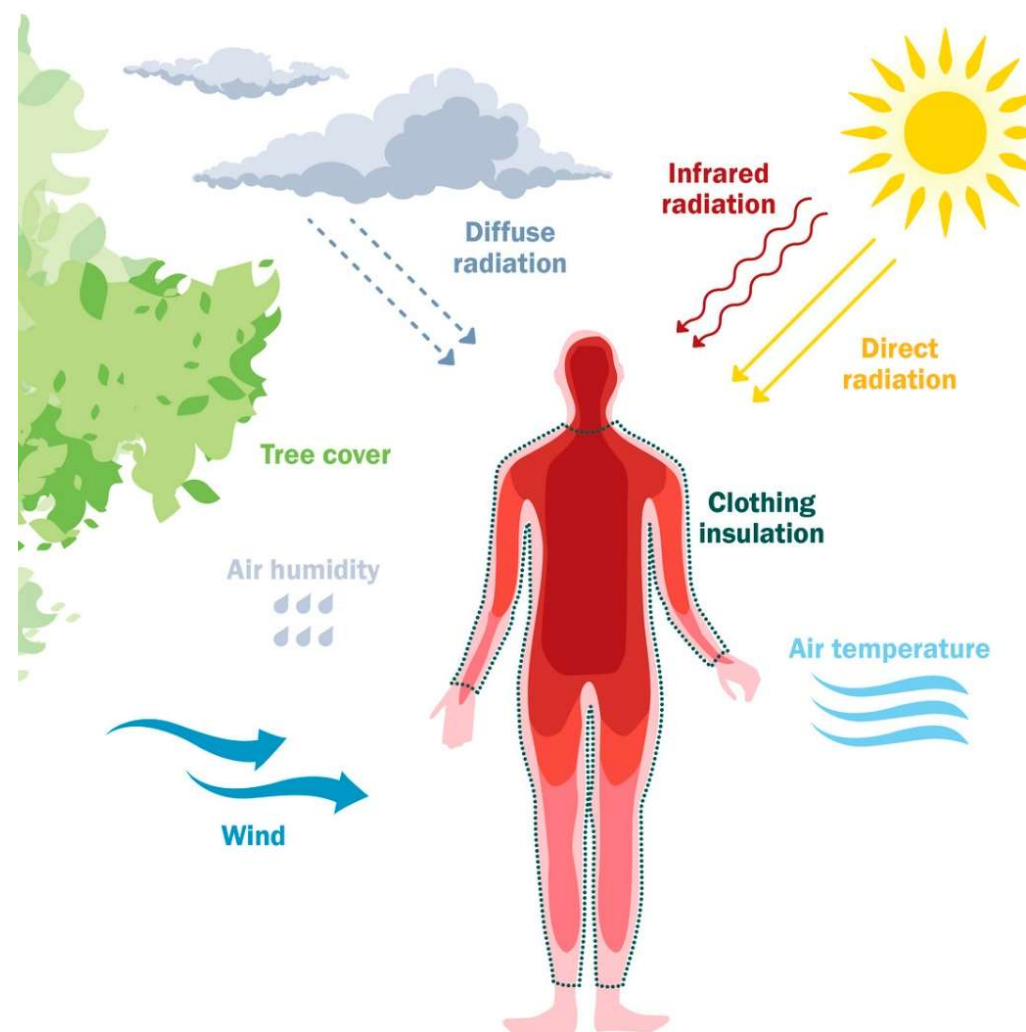


Figure 1.1 Personal thermal comfort factors

1.3 BREEAM Hea 04 Thermal Comfort Criteria

Building thermal conditioning systems aim to create a thermal environment that satisfies the largest possible proportion of people in a space. As such, thermal comfort is not measured by room temperature, but by the number of people expressing satisfaction with their thermal state. BREEAM Hea 04 specifies two methodologies for assessing thermal comfort in spaces: ISO7730:2005 Predicted Mean Vote (PMV) and Percentage of People Dissatisfied (PPD) indices, intended for use in air-conditioned spaces; and a CIBSE TM52/TM59 adaptive thermal comfort model, intended for use in naturally ventilated spaces. As the STOREX South Tottenham development contains both air-conditioned zones (the shop and break room), and naturally ventilated areas (the Fab Labs), the use of both methods are required to assess thermal comfort in the scheme.

1.3.1 Thermal Comfort in Air-Conditioned Buildings

BREEAM Hea 04 requires that thermal comfort in air-conditioned buildings assessed using Predicted Mean Vote (PMV) and Percentage of People Dissatisfied (PPD) indices. Both indices have been obtained from the thermal model calculations carried out as part of the assessment presented in this report.

The PMV combines the influence of air temperature, mean radiant temperature, air movement, and humidity with that of clothing and activity level into one value (Table 1.2). The PMV is an index that predicts the mean votes of a large group of persons on the seven-point thermal sensation scale based on the heat balance of the human body; see Table 1.2 and Table 1.3.

Table 1.2 Seven-point thermal sensation scale used for PMV

Number on the Seven-Point Temperature Scale	Thermal Sensation of Occupants
+3	Hot
+2	Warm
+1	Slightly warm
0	Neutral
-1	Slightly cool
-2	Cool
-3	Cold

The PPD index provides a quantitative prediction of the percentage of thermally dissatisfied users likely to feel too warm or too cool in an environment. Thermally dissatisfied people are those who will vote hot, warm, cool, or cold on the 7-point thermal sensation scale. The PPD index has a minimum of 5% of people dissatisfied, and a maximum of 100%. Equations for evaluating PMV and PPD are regulated by the ISO standard ISO7730:2005.

Table 1.3 ISO7730:2005 Thermal comfort indices and operative temperature ranges

Category	Thermal Comfort Indices		Operative Temperatures (°C)		Max Air Velocity (m/s)	
	PPD (%)	PMV	Summer	Winter	Summer	Winter
A	≤6	0 ± 0.2	24.5 ± 1.0	22.0 ± 1.0	0.12	0.10
B	≤10	0 ± 0.5	24.5 ± 1.5	22.0 ± 2.0	0.19	0.16
C	≤15	0 ± 0.7	24.5 ± 2.5	22.0 ± 3.0	0.24	0.21

1.3.2 Thermal Comfort in Naturally Ventilated Buildings

BREEAM Hea 04 requires that overheating risk is assessed using the adaptive comfort methodology described by either CIBSE TM52 (non-domestic buildings), or TM59 (domestic buildings), as appropriate to the scheme. As the proposed development is non-domestic, the adaptive comfort methodology described by CIBSE TM52 is applied.

Adaptive comfort models recognise that people's perception of thermal comfort is not a constant and varies with the external climate - people are more likely to be tolerant of warm indoor air temperatures in hot seasons when the outdoor air is also hot. To this end, CIBSE TM52 defines an adaptive thermal comfort temperature which varies with the running mean of outdoor temperature. As different use types may have different expectations of comfort, CIBSE TM52 also defines three usage categories: Category I (suitable for children or vulnerable adults), Category II (suitable for new builds), and Category 3 (suitable for existing buildings or uses with a low expectation of thermal comfort). These set a comfort threshold temperature of 1, 2, and 3°C respectively above the adaptive thermal comfort temperature, beyond which occupants are likely to feel discomfort.

To assess overheating risk, CIBSE TM52 establishes three overheating risk criteria based on frequency of overheating, severity of overheating, and maximum permitted temperatures respectively. These criteria are based on the temperature increase ΔT above the comfort threshold temperature and are summarised in Table 1.4. To achieve compliance with TM52, any two of these three criteria must be achieved.

The adaptive thermal comfort model presented in CIBSE TM52 predicts that people in naturally ventilated spaces have a higher tolerance to thermal discomfort than that predicted by PMV and PPD models. This recognises that when people are uncomfortable, they act to restore their comfort (such as by opening a window or removing warm layers). Consequently, application of the adaptive thermal comfort model for naturally ventilated buildings requires that occupants are given the opportunity to have autonomy over their environment, such as through opening windows or a flexible dress code.

Table 1.4 CIBSE TM52 - The Limits of Thermal Comfort: Avoiding Overheating in European Buildings comfort criteria.

Criteria to Meet		TM52 Compliance
Criterion 1: Hours of exceedance (He)	The number of hours (He) during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive, shall not be more than 3 % of occupied hours. (the number of hours for which an adaptive thermal comfort threshold temperature is exceeded)	A room or building that fails any two of the three criteria is classed as overheating
Criterion 2: Daily weighted exceedance (We)	This criterion deals with the severity of overheating within any one day. This sets a daily limit for acceptability (the degree to which the operative temperature exceeds the adaptive thermal comfort threshold temperature).	
Criterion 3: Upper limit temperature (Tupp)	3rd Criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable. To set an absolute maximum value for the indoor operative temperature the value of ΔT shall not exceed 4 K. The threshold or upper limit temperature sets a limit beyond which normal adaptive actions will be insufficient to restore personal comfort and most occupants will complain of being 'too hot'. This criterion covers the extremes of hot weather conditions and future climate scenarios (the maximum temperature experienced at any occupied time).	

1.4 Hea 04 Target Thermal Comfort Criteria

The air-conditioned areas of the building will be designed to achieve at least Category B, where the PMV index is within the 0.5 and -0.5 range. This corresponds to a PPD below 10%. Furthermore, the values of PMV should not exceed the tabulated values for more than 3% of occupied hours. Table 1.5 summarises the acceptable range of thermal comfort recommended in CIBSE Guide A.

Table 1.5 CIBSE Guide A recommended thermal comfort state

	PMV	PPD
Summer / Winter	-0.5 to 0.5 (97% of occupied hrs)	≤10%

In this assessment, both indices (PMV and PPD) have been obtained from the thermal model calculations for the shop in the STOREX South Tottenham development. The seasonal activity levels, clothing levels and customary operative temperatures given in CIBSE Guide A for small shops are summarised in Table 1.6 below.

Clothing levels fluctuate between light and medium wear between 0.6 and 1.0 Clo for the respective summer and winter times. An average air speed of 0.1 m/s has been assumed in all spaces.

Table 1.6 CIBSE Guide A (Table 1.5) recommended comfort criteria

Room Type	CIBSE Guide A Space Type	Winter Operative Temperature (°C)	Winter Activity	Winter Clothing (Clo)	Summer Operative Temperature (°C)	Summer Activity	Summer Clothing (Clo)
Shop/Breakroom	Retailing - small shops	19-21	1.4 Met	1.0	21-25	1.3 Met	0.6

For naturally ventilated spaces, BREEAM Hea 04 also requires that indoor air temperatures in winter meet the operative temperatures set out in CIBSE Guide A. The Fab Lab spaces are intended to be industrial spaces. The closest space types in CIBSE Guide A are Education - Workshop, or Factory - Light Work. Both of these stipulate a winter operative temperature range of 16-19°C, to be achieved for 97% of the year.

1.5 Heating and Cooling Setpoints

The adopted design criteria establish anticipated thermal conditions during the occupied hours. To save energy, we recommend that the facility management team implements setback temperatures that relax the temperature control during periods of no occupancy. However, we expect this to be implemented with sufficient warm-up and cool-down periods during which the space temperature is reset gradually, and the design conditions are fully achieved by the time of occupancy. In this assessment, the occupied period is assumed to be between 8am and 6pm, with the heating, cooling, and ventilation systems turning on three hours prior to occupancy to precondition the space.

The heating and cooling setpoints are based on the customary operative temperatures given in CIBSE Guide A and are shown below in Table 1.7.

Table 1.7 Modelled heating and cooling setpoints

	Heating Setpoint Temperature (Winter)	Cooling Setpoint Temperature (Summer)
Reception/Shop	20°C	23°C
Fab Labs	-	-

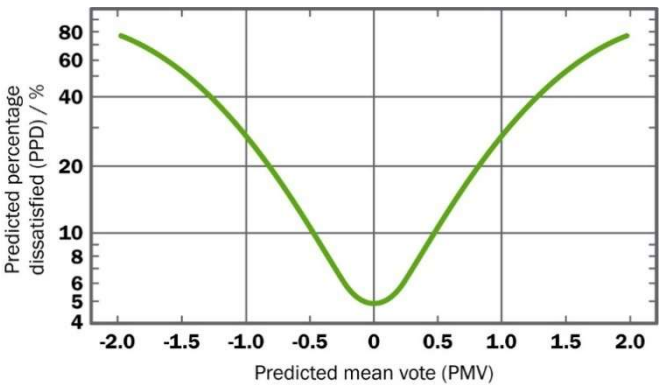


Figure 1.2 PMV and PPD visual relationship

2 Thermal Modelling

This section presents the proposed building's internal and external thermal and operational characteristics applied in the thermal assessment.

2.1 Methodology

The thermal model has been developed and simulated within the IES Virtual Environment (IESVE 2025). IESVE is an accredited software used in accordance with Manual AM11:2015 Building Energy and Environmental Modelling.

2.2 Weather Data

Thermal modelling simulations were carried to determine the operative temperatures within the building using the recommended 2020 (current) and projected 2050 CIBSE design summer year (DSY) weather year data set for London Heathrow. The CIBSE weather data set for London Heathrow was selected in accordance with CIBSE TM49: Design Summer Years for London. The weather scenarios investigated in this analysis are summarised in Table 2.1.

Table 2.1 Weather scenarios.

Scenario	Weather File	Comment
Current Weather Baseline	LHR1989_2020High50pct.epw (DSY1)	Primary dataset used to assess thermal comfort for a moderately warm summer
Future Weather Climate Change (Mechanically ventilated/mixed mode spaces [BREEAM], naturally ventilated spaces [GLA])	LHR2003_2020High50pct.epw (DSY2)	A year with a very intense single warm spell
	LHR1978_2020High50pct.epw (DSY3)	A year with a prolonged period of sustained warmth
Future Weather 2050 Climate Change (Naturally ventilated spaces [BREEAM])	LHR2003_2050Med50pct.epw (DSY2)	A year with a very intense single warm spell, adjusted for the impact of climate change in 2050 in a medium emissions scenario
	LHR1978_2050Med50pct.epw (DSY3)	A year with a prolonged period of sustained warmth, adjusted for the impact of climate change in 2050 in a medium emissions scenario
Additional future weather 2050 (Naturally ventilated spaces [GLA])	LHR1989_2050High50pct.epw (DSY1)	A warm, but not extreme summer, adjusted for the impact of climate change in 2050 in a high emissions scenario

2.3 Geometry

A three-dimensional (3D) model of the proposed building was developed using the IESVE ModelIT module (see Figure 2.1). The building was divided into zones, each with their own thermal template, representing the anticipated usage and other parameters that contribute to the internal conditions. These parameters include operative temperature set points and profiles for heating, heat gains from people, lighting and equipment and ventilation. The occupied space types analysed as part of the proposed development include:

- Fab Labs
- Shop
- Break room

Circulation spaces, WCs, storage, and plant rooms are all treated as unoccupied spaces for the purposes of this analysis.

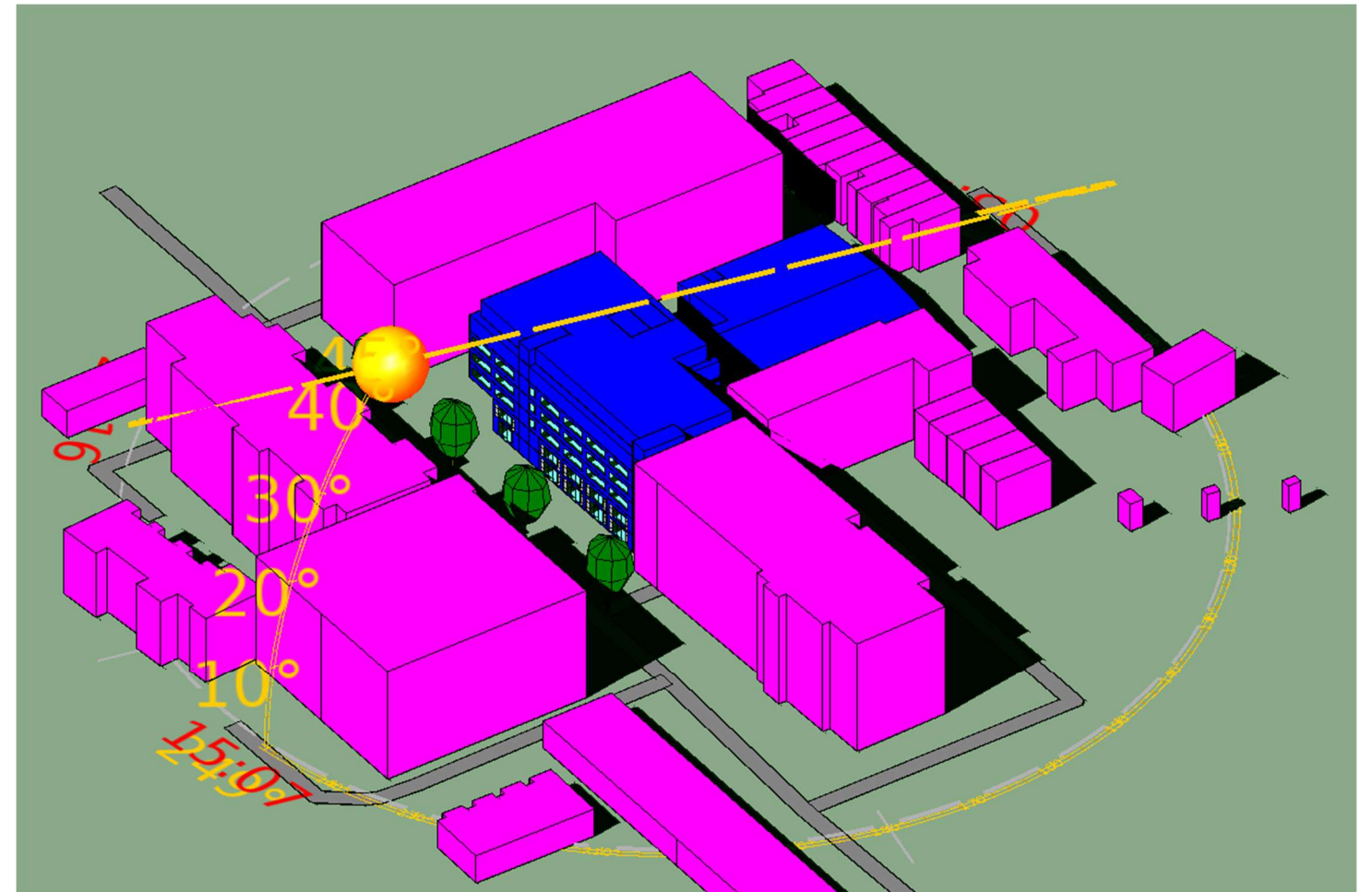


Figure 2.1 STOREX South Tottenham geometry modelled in IESVE

2.4 Thermal Performance of Building Fabric

Table 2.2 presents the modelled thermal performance of the building fabric. The building fabric is comprised of lightweight steel frame construction. The ground floor spaces incorporate 200mm thick exposed concrete floors. The internal partitions to the first floor fab labs comprise 100mm thick exposed concrete blockwork. Elsewhere, 30mm thick plasterboard ceilings and walls are modelled.

Table 2.2 Modelled fabric thermal performance.

Element or System	Modelled Parameter/Performance (Existing)	
Fabric Thermal Performance		
External Wall U-Value	0.53 W/m²K	self-storage and unconditioned
	0.15 W/m²K	fab lab and conditioned (breakroom, reception, IT)
Ground Floor U-Value	0.12 W/m²K (exposed concrete, under slab insulation, insulation from earth excluded)	fab lab and conditioned
	0.18 W/m²K (exposed concrete, uninsulated, insulation from earth included)	self-storage
Exposed floor U-value	0.18 W/m²K	self-storage overhang
Internal Ceiling U-Value	0.12 W/m²K	Conditioned spaces
	0.7 W/m²K	Fab lab areas and ancillary spaces
Internal Partition U-Value	0.26 W/m²K	Between conditioned and unconditioned spaces
	0.7 W/m²K	Between fab lab corridor and self-storage
Roof U-Value	0.16 W/m2K	
Glazing U-value (inc. frame)	1.2 W/m2K	
Opaque Louvre Panels U-value	0.9 W/m²K	
Pedestrian Door U-value	1.6 W/m2K	
Vehicle Door U-value	1.4 W/m²K	
Building Air Permeability	3 m²/h./m³ @ 50Pa	
Glazing Performance		
Glazing g-value	g-value = 0.21	
Glazing Light Transmittance	LT = 50%	

2.5 Internal Gains

The internal gain profiles and occupancy profiles generally follow the NCM templates for warehouse areas. Three templates are used in this analysis: "Sales area", "Eat/Drink", and "Workshop - small scale".

Table 2.3 Internal gains

Space	Lighting Gain	Occupancy Gain	Equipment Gain
Shop	5.33W/m² (8am-6pm)	8.6m²/person (70W sensible gain, 79W latent gain) (8am-6pm)	4.73W/m² (8am-6pm)
Break room	3.00W/m² (8am-6pm)	5.3m²/person (67.1W sensible gain, 42.9W latent gain) (11am-3pm)	11.92W/m² (11am-3pm)
Fab Labs	2.00W/m² (8am-6pm)	10m²/person (48.6W sensible gain, 131.4W latent gain) (8am-6pm)	5W/m² (8am-6pm)

2.6 Ventilation, Heating & Cooling

The shop and break room are conditioned via VRF. This enables different levels of heating and cooling to be supplied and ensures that comfortable thermal conditions can be maintained. The shop and breakroom are supplied with fresh air through mechanical ventilation with heat recovery. Ventilation is provided as per the NCM rates of 10l/s/person.

The "Fab Labs" are heated via electric panel heaters for frost protection only and naturally ventilated. Natural ventilation to the fab labs is provided in the form of two manually openable louvred purge panels to provide occupant thermal comfort, and actuated louvres at the top and bottom of the façade that provide secure night cooling and ventilation for indoor air quality; see Figure 2.2.



Figure 2.2 Natural ventilation openings provided to the Fab Labs (red = manual louvre, green = automated louvre)

Window opening behaviour for the manually operated purge panels follows the Part O window profiles for windows that open in the day only. These start to open when the internal temperature reaches 22 °C, and are fully open when the internal temperature reaches 26 °C.

As the openings for night ventilation and indoor air quality are actuated, more ideal profiles can be applied; see Figure 2.3. The high-level actuated openings begin opening when the indoor air temperature exceeds 19 °C, are fully open when the indoor air temperature reaches 23 °C and are closed when the outdoor air temperature exceeds the indoor air temperature. This prevents excess heat entering the space when the weather outside is hot, and the building is kept cool by the thermal mass. The top opening also opens for indoor air quality in response to CO₂ measurements, when the indoor CO₂ concentration exceeds 1000ppm. The high-level openings help improve thermal comfort in cold weather by ensuring cold outdoor air mixes with the room air before reaching the occupants, reducing draught risk.

The low-level openings start to open when the indoor air temperature exceeds 23 °C, and are fully open when the indoor air temperature exceeds 25 °C. This helps provide a thermal stack effect to drive ventilation in warm weather, while reducing the risk of introducing uncomfortably cold low-level air in colder weather. The location of this low-level inlet near the exposed floor slab helps ensure good thermal contact between the incoming air and the thermal mass, improving the efficiency of the night-cooling strategy.

Time		Value	Time		Value
1	00:00	(gt(ta,21,4)&(ta>to)) gt(co2,1000,100)	1	00:00	gt(ta,24,1)&(ta>to)
2	24:00	(gt(ta,21,4)&(ta>to)) gt(co2,1000,100)	2	24:00	gt(ta,24,1)&(ta>to)

Figure 2.3 Window opening profiles for the high level actuated openings (left) and for the low level actuated openings (right)

Individual heating and cooling plant sizes are assigned to each assessed space, equalling 4kW of heating and 3kW of cooling to the shop, and 3kW of heating and 2kW of cooling to the break room.

2.7 Cooling Hierarchy

In the development of the final strategy, the cooling hierarchy has been followed to eliminate or minimise requirements for mechanical ventilation and cooling. The design response to each step in the Cooling Hierarchy is summarised in Table 2.4.

Table 2.4 Summary of the design response to each step in the cooling hierarchy

Cooling Hierarchy Step		Design Response	
		Fab Labs	Shop
1.	Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure.	Low g-value glazing specified (0.21), high standards of insulation, glazing areas reduced to reasonable minimums including through the use of opaque louvre panels	Low g-value glazing specified (0.21), high standards of insulation, glazing areas reduced to reasonable minimums including through the use of opaque louvre panels
2.	Minimise internal heat generation through energy efficient design.	Use of electric panel heaters for space heating (frost protection only) and electric POU water minimises heat losses from hot water pipework. Good daylighting and the specification of efficient electrical lighting minimises heat gain from lighting provision.	Efficient VRF heating and cooling and electric POU water minimises heat losses from hot water pipework. Good daylighting and the specification of efficient electrical lighting minimises heat gain from lighting provision.
3.	Manage the heat within a building through exposed thermal mass and high ceilings	200mm exposed concrete floors to ground floor and 100mm exposed concrete blockwork partitions to support a night cooling strategy. 30mm plasterboard to internal walls and ceilings.	200mm exposed concrete floors to ground floor and 25mm plasterboard to internal walls and ceilings.
4.	Provide passive ventilation	Efficient night cooling through actuated and manual louvre panels for daytime thermal comfort. Adequate thermal comfort achieved after this step, eliminating the requirement for mechanical ventilation or active cooling.	Potential for natural ventilation found to be insufficient to eliminate cooling requirement in shop. Automated louvre included in comms room to provide free cooling to server equipment.
5.	Provide mechanical ventilation	-	Provision of mechanical ventilation found to be insufficient to eliminate cooling requirement.
6.	Provide active cooling systems	-	Mechanical cooling provided to shop space via VRF

3 BREEAM Hea 04 Analysis

This section of the report summarises the results for the BREEAM Hea 04 thermal comfort analysis conducted by Atelier Ten for the proposed STOREX South Tottenham development. This analysis evaluates thermal comfort conditions within the mechanically cooled shop area and the naturally ventilated Fab Lab areas against the required BREEAM New Construction (NC) Hea 04 Thermal Comfort criteria.

3.1 Air-Conditioned Spaces

3.1.1 Shop

Table 3.1 presents a summary of the thermal comfort in the air-conditioned shop for both the BREEAM current and future climate change files. Sufficient levels of thermal comfort are achieved under all weather files tested in this analysis. This is sufficient to achieve both the thermal modelling and design for future thermal comfort credits in the mechanically cooled space.

Table 3.1 Thermal comfort in the Shop area, assessed under the current and future weather files required for BREEAM Hea04 compliance.

Weather file	Percentage of occupied hours uncomfortable	PPD for 97th centile occupied hours	PMV for 97th centile PPD
DSY1 2020 High 50 (BREEAM current)	0.2%	9.6%	-0.47/0.47
DSY2 2020 High 50 (BREEAM future)	0.7%	9.7%	-0.47/0.47
DSY3 2020 High 50 (BREEAM future)	1.1%	9.8%	-0.48/0.48

3.1.2 Break room

Table 3.2 presents a summary of the thermal comfort in the break room space for both the BREEAM current and future climate change files. Sufficient levels of thermal comfort are achieved under all weather files tested in this analysis. This is sufficient to achieve both the thermal modelling and design for future thermal comfort credits in the mechanically cooled space.

Table 3.2 Thermal comfort in the worst performing fab lab area, assessed under the current and future weather files required for BREEAM Hea04 compliance.

Weather file	Percentage of occupied hours uncomfortable	PPD for 97th centile occupied hours	PMV for 97th centile PPD
DSY1 2020 High 50 (BREEAM current)	0.1%	9.7%	-0.47/0.47
DSY2 2020 High 50 (BREEAM future)	1.1%	9.8%	-0.48/0.48
DSY3 2020 High 50 (BREEAM future)	1.4%	9.9%	-0.48/0.48

3.2 Naturally Ventilated Fab Labs

The Fab Labs spaces are naturally ventilated, and thermal comfort in these spaces is assessed differently during the winter and summer seasons. In the winter, the primary source of thermal discomfort is cold weather. Section 3.2.1 summarises the results of the thermal comfort analysis of the Fab Lab spaces in the winter months. In the summer, the primary source of thermal discomfort is overheating. The risk of summertime overheating in the Fab Lab spaces is summarised in Section 3.2.2.

3.2.1 Winter Thermal Comfort

Without any heating applied, the 3rd centile operative temperature in the worst performing Fab Lab space is 14.3 °C when assessed under the DSY1 2020 High 50 weather file (taken to represent 'current' weather). This is below the 16-19 °C operative temperature range required for thermal comfort in workshop spaces. Consequently, supplementary heating or a seasonal occupancy pattern may be required to meet the BREEAM winter thermal comfort requirements.

3.2.2 Summer Thermal Comfort

Table 3.3 presents the compliance rate with the TM52 overheating analysis under a range of current and future weather conditions. This shows that all Fab Lab spaces achieve compliance under the mandatory DSY1 2020 High50 weather file and all future weather files required for the BREEAM design for future thermal comfort credit.

Table 3.3 Summary of compliance with TM52 overheating criteria for the Fab Lab spaces, under a range of current and future weather files.

Weather file	Criterion 1 compliance rate (%)	Criterion 2 compliance rate (%)	Criterion 3 compliance rate (%)	TM52 compliance rate (%)	Maximum indoor operative temperature (°C)
BREEAM and GLA Mandatory weather files					
DSY1 2020 High50	9/9 (100%)	9/9 (100%)	9/9 (100%)	9/9 (100%)	31.0 °C
BREEAM Design for future thermal comfort climate change weather files					
DSY2 2050 Med50	9/9 (100%)	4/9 (44%)	9/9 (100%)	9/9 (100%)	33.3 °C
DSY3 2050 Med50	7/9 (77%)	9/9 (100%)	9/9 (100%)	9/9 (100%)	32.7 °C
GLA extreme weather and climate change weather files					
DSY2 2020 High50	9/9 (100%)	7/9 (77%)	9/9 (100%)	9/9 (100%)	32.3 °C
DSY3 2020 High50	9/9 (100%)	9/9 (100%)	9/9 (100%)	9/9 (100%)	31.6 °C
DSY1 2050 High50	8/9 (88%)	7/9 (77%)	9/9 (100%)	9/9 (100%)	32.4 °C

The full results of the TM52 overheating risk analysis are available on request.

4 Thermal Zoning and Controls

The thermal control strategy for the heating/cooling systems has been informed by the thermal comfort with the strategy to achieve the required comfort as noted below:

The comfort-cooled areas (shop and break room) are two separate zones. A wall mounted control will be provided to the shop to control heating, cooling, and ventilation.

4.1 Ventilation, Heating & Cooling:

Mechanical ventilation is provided by a local mechanical ventilation with heat recovery (MVHR) unit, natural ventilation will be via a mix of manual and actuated openings and heating and cooling is provided by VRF (controlled by wall mounted controller) and electric panel heater (controlled by thermostat) to provide accurately controlled individual room temperatures.

The heating and cooling services supplied to the conditioned zones are designed such that they do not conflict with core services.

4.2 Controllability

Control will be via wall mounted controls. Each zone within the scheme is individually controlled to ensure optimum thermal comfort.

For these spaces, the following has been considered:

- As the final occupants of the building are unknown, it must be assumed that occupants will have limited knowledge of building services.
- As the shop cooling unit is located in the shop, the management of the shop are able to have a significant degree of autonomy over the temperature of the zone in which they work. Therefore, it is beneficial to provide easy to use controls that allow occupants to tailor their thermal environment to optimise comfort.
- Space temperatures can be controlled via the wall mounted controls with the ability to change temperature set points per separate control zone. This will control heating, cooling and ventilation provided to the space.
- Differing control set points may be utilised dependent upon the season.
- The design should allow for flexibility to enable future modifications during fit out. This could include the introduction of mechanical ventilation to the Fab Labs based on an increased occupancy level.

5 Conclusions

The dynamic thermal modelling presented in this report demonstrates that both naturally ventilated and mechanically cooled spaces in the scheme achieve adequate summer comfort compliance under the mandatory DSY1 2020 weather file and BREEAM design for future comfort weather files. The fab lab spaces are likely to be too cold in the winter without supplementary heating. This thermal modelling has informed the thermal zoning and control strategy. This is achieved by following the cooling hierarchy and demonstrates compliance with Policy SI4 of the London Plan.

Figure 5.1 Summary of the design response to each step in the cooling hierarchy.

Cooling Hierarchy Step		Design response	
		Fab Labs	Shop
1.	Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure.	Low g-value glazing specified (0.21), high standards of insulation, glazing areas reduced to reasonable minimums including through the use of opaque louvre panels	Low g-value glazing specified (0.21), high standards of insulation, glazing areas reduced to reasonable minimums including through the use of opaque louvre panels
2.	Minimise internal heat generation through energy efficient design.	Use of electric panel heaters for space heating (frost protection only) and electric POU water minimises heat losses from hot water pipework. Good daylighting and the specification of efficient electrical lighting minimises heat gain from lighting provision.	Efficient VRF heating and cooling and electric POU water minimises heat losses from hot water pipework. Good daylighting and the specification of efficient electrical lighting minimises heat gain from lighting provision.
3.	Manage the heat within a building through exposed thermal mass and high ceilings	200mm exposed concrete floors to ground floor and 100mm exposed concrete blockwork partitions to support a night cooling strategy. 30mm plasterboard to internal walls and ceilings.	200mm exposed concrete floors to ground floor and 25mm plasterboard to internal walls and ceilings.
4.	Provide passive ventilation	Efficient night cooling through actuated and manual louvre panels for daytime thermal comfort. Adequate thermal comfort achieved after this step, eliminating the requirement for mechanical ventilation or active cooling.	Potential for natural ventilation found to be insufficient to eliminate cooling requirement in shop. Automated louvre included in comms room to provide free cooling to server equipment.
5.	Provide mechanical ventilation	-	Provision of mechanical ventilation found to be insufficient to eliminate cooling requirement.
6.	Provide active cooling systems	-	Mechanical cooling provided to shop space via VRF
Summary			
Compliance achieved with Policy SI4 of the London Plan			

Thermal comfort in the Shop area, assessed under the current and future weather files required for BREEAM Hea04 compliance.

Weather file	Percentage of occupied hours uncomfortable	PPD for 97th centile occupied hours	PMV for 97th centile PPD
DSY1 2020 High 50 (BREEAM current)	0.2%	9.6%	-0.47/0.47
DSY2 2020 High 50 (BREEAM future)	0.7%	9.7%	-0.47/0.47
DSY1 2020 High 50 (BREEAM future)	1.1%	9.8%	-0.48/0.48

Thermal comfort in the Break room, assessed under the current and future weather files required for BREEAM Hea04 compliance.

Weather file	Percentage of occupied hours uncomfortable	PPD for 97th centile occupied hours	PMV for 97th centile PPD
DSY1 2020 High 50 (BREEAM current)	0.1%	9.7%	-0.47/0.47
DSY2 2020 High 50 (BREEAM future)	1.1%	9.8%	-0.48/0.48
DSY1 2020 High 50 (BREEAM future)	1.4%	9.9%	-0.48/0.48

Summary of thermal comfort in the naturally ventilated Fab Lab spaces, assessed against TM52.

Weather file	TM52 compliance rate (%)
As designed	
DSY1 2020 High50 (Mandatory)	100%
DSY2 2050 Med50 (BREEAM future)	100%
DSY3 2050 Med50 (BREEAM future)	100%
DSY2 2020 High50 (GLA extreme)	100%
DSY3 2020 High50 (GLA extreme)	100%
DSY1 2050 High50 (GLA future)	100%

Appendices

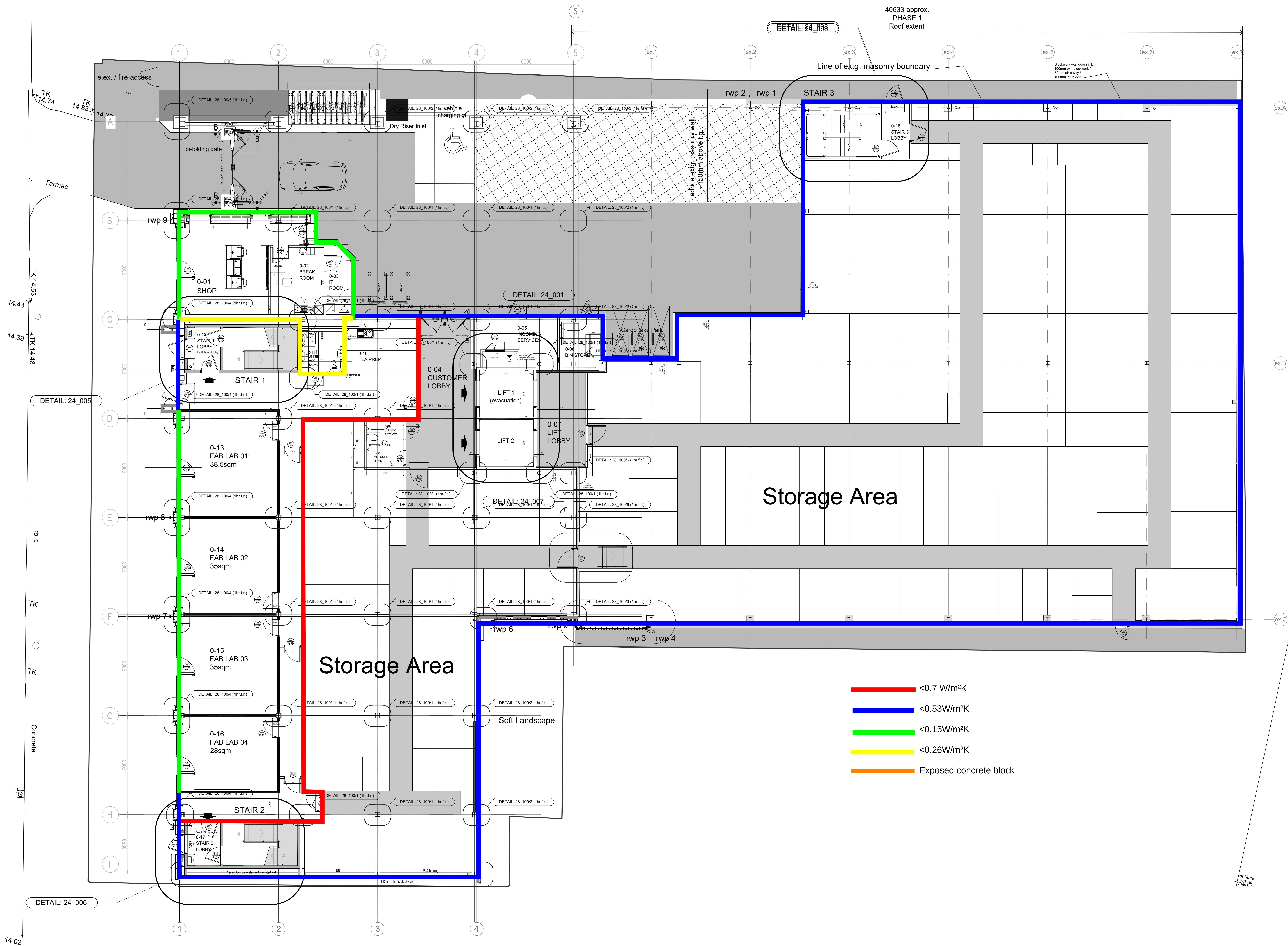
Appendix A - Full TM52 Outputs

Appendix B Thermal line U-value markup

Appendix A - Full TM52 Outputs

Available on request.

Appendix B Thermal line U-value markup



TENDER

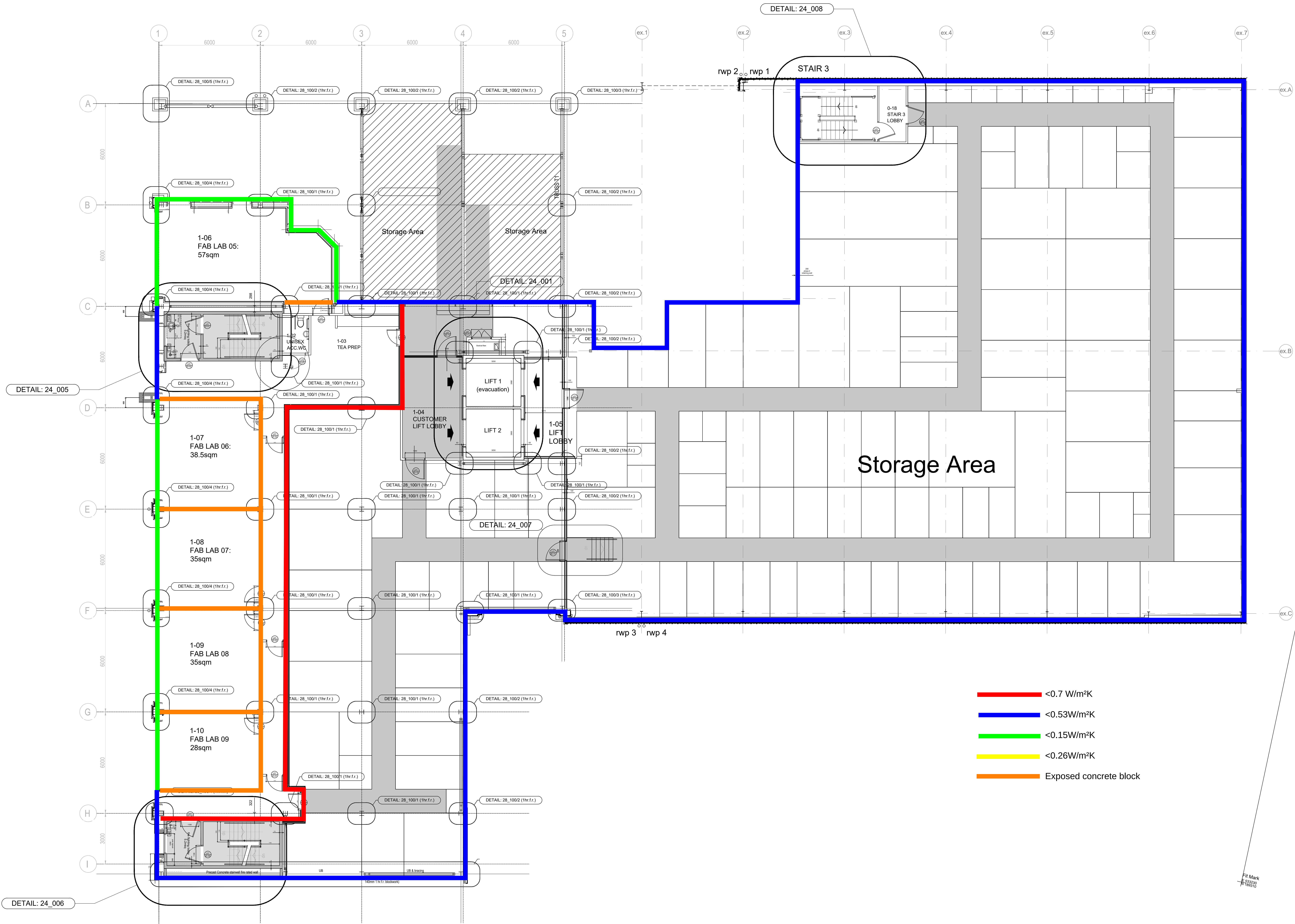
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PROJECT
STOREX SELF STORAGE
30-48 Lawrence Road, South
Tottenham, London N15 EG
DRAWING
Ground Floor Plan

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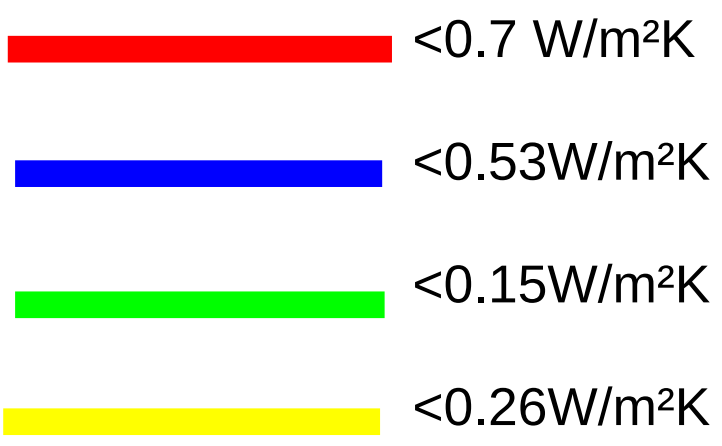
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First Floor Plan

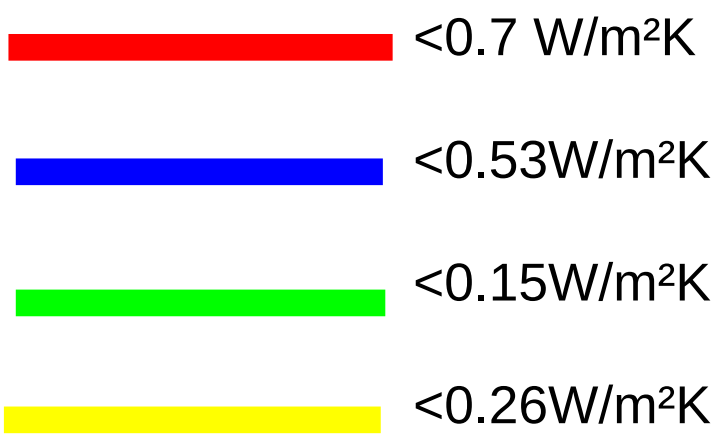




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Second Floor Plan



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Third Floor Plan

