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Dynamic Overheating Assessment

Quantum Group

Former ICL Private Ground

Final

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We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost effective solutions that respond to increasing demands for quality and construction efficiency.

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Executive Summary

This report details the methodology and findings of a study into the overheating risk of five residential units in the proposed Former ICL Private Ground development, by Quantum Group, within the London Borough of Richmond Upon Thames, using dynamic thermal modelling.

The reason for undertaking the work is to investigate the potential overheating risk and to provide possible mitigation strategies to minimise the likelihood of high internal temperatures.

Five residential units that are likely to present a high risk of overheating have been selected based on a range on design characteristics, as required by CIBSE TM59:2017 guidance, outlined in Section 3 of this report.

The analysis has been undertaken in line with the Greater London Authority (GLA)'s guidance on preparing energy assessments (March 2016) and the London Plan's Policy 5.9 cooling hierarchy.

For the purposes of this report, it is assumed that units will utilise openable windows as the primary means of ventilation, with a background MVHR system running constantly for mitigation of the risk of overheating. Additionally, internal shading via high reflectance blinds has been specified, to prevent the build-up of solar gains and keep internal temperatures low.

Assessment Criteria

The performance of the units has been assessed against guidance published by the Chartered Institute of Building Services Engineers (CIBSE) guidance documents TM52 and TM59.

The recently published **CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017)** is based on **CIBSE TM52** and **CIBSE Guide A** guidance documents, and provides a standardised approach to predicting overheating risk for both naturally and mechanically ventilated residential buildings:

The TM59 Criteria for compliance when units are predominantly naturally ventilated are detailed below:

- **(i) For living rooms, kitchens and bedrooms**: the number of hours during which the operative temperature exceeds the threshold temperature by one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).
- **(ii) For bedrooms only**: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

Representative units have been modelled against **CIBSE Design Summer Year for London Gatwick** (representative of urban areas outside the Central Activity Zone), for the **2020s, high emissions, 50% percentile scenario** as required by CIBSE TM59.

Results

All five units demonstrate **an acceptable level of overheating** against the TM59 and CIBSE criteria. This is based on some key design features, as shown in the following table:

Key Design Features	Proposed Measures	Discussion
Solar control glazing	G-value: 0.50 – as per Energy Statement.	*Note that a low G-value reduces the solar gains therefore assists in the mitigation of overheating, however it has implications on CO_2 emissions, fabric energy efficiency and internal daylight levels.*
Mechanical Ventilation	Apartments: Mechanical ventilation system to achieve at least a rate of 1 ACH.	*Assumption made based on a mechanical ventilation system that will achieve ventilation rates beyond the minimum Part F requirements.*
Natural Ventilation	Based on the fact that there are no noise restrictions in the site, windows are assumed open during occupied hours (09:00-22:00). For bedrooms, windows should be open during night for the hottest days of the year. *Windows are openable when internal temperature exceeds 22°C.*	*Security restrictors of 200mm were assumed and included in the modelling for openable windows.*
Internal Shading	Internal blinds of high reflectance are specified as an overheating mitigation requirement.	*Internal shading can result in significant reduction in solar gains.*
External Shading	External shading in the form of balconies has already been effectively included in the architectural design.	*External shading can result in significant reduction in solar gains particularly to living rooms as the sun tracks around the building.*

There is no provision of active cooling for the development; units are instead using a combination of passive mechanical ventilation with heat recovery, in conjunction with natural purge ventilation to mitigate the overheating risk in line with the **Cooling Hierarchy of Policy 5.9 of the London Plan (2016).**

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Contents

1. INTRODUCTION

1.1 This dynamic overheating assessment has been completed by Hodkinson Consultancy, a specialist energy and environmental consultancy, for the proposed development at Former ICL Private Ground site within the London Borough Richmond Upon Thames. The development location is illustrated in Figure 1.

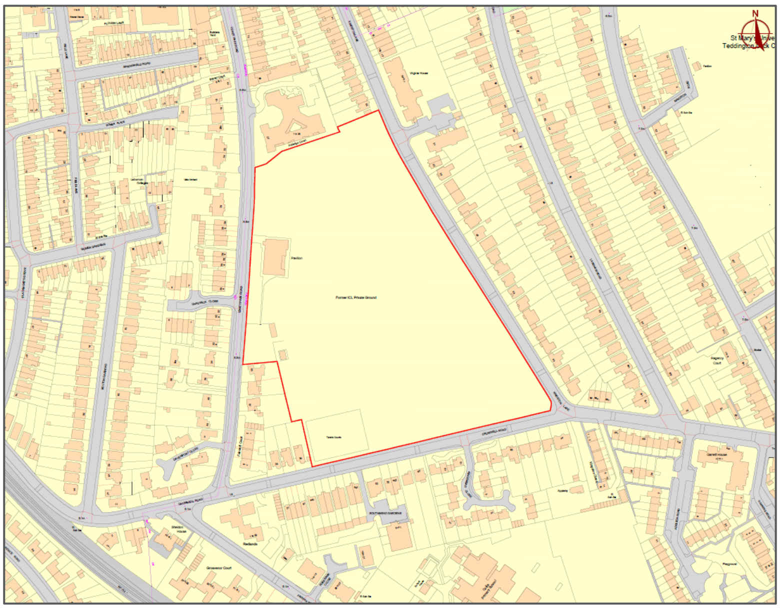

Figure 1: The Development Site (Quantum Group Location Plan - Ref. 900-SK01)

Overheating and Thermal Comfort

1.2 Maintaining thermal comfort conditions in the face of increased temperatures is one of the biggest challenges now facing designers of buildings in the UK. A particular concern will be to achieve thermal comfort without recourse to conventional air-conditioning systems, where typical technologies involve the emission of greenhouse gases.

1.3 A dynamic assessment has been undertaken to determine if the residential units within the development are at risk of overheating.

1.4 Dynamic thermal simulations have been carried out for five units that are considered to have higher risk of overheating. These have been modelled to assess their potential for overheating and to determine appropriate mitigation measures to minimise this risk.

2. REQUIRED STANDARDS

Regional Policy: Richmond Upon Thames Local Plan & London Plan

2.1 In line with the **London Borough of Richmond Upon Thames Strategy**, adopted in January 2017, planning applications should demonstrate implementation of the London Plan**.**

2.2 The **London Plan** (2016) sets out an integrated framework for the development of London over the next 20 – 25 years. On 10 March 2016, the Mayor adopted the Further Alterations to the London Plan (FALP). From this date, the FALP are operative as formal alterations to the London Plan and form part of the development plan for Greater London.

2.3 Policy **5.9 Overheating And Cooling** of the London Plan, outlines key policies relevant to the proposed development and this Overheating Assessment:

Strategic

A) The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

Planning decisions

B) Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

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

C) Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New *development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy. LDF preparation*

D) Within LDFs boroughs should develop more detailed policies and proposals to support the avoidance of overheating and to support the cooling hierarchy.

2.4 Further guidance on overheating modelling is given in the Greater London Authority (GLA)'s guidance on preparing energy assessments (March 2016).

2.5 It is expected that dynamic thermal modelling of the overheating risk will be undertaken to support the energy assessment, unless the applicant can demonstrate exceptional circumstances where opportunities for reducing cooling demands via passive measures are constrained.

2.6 The dynamic thermal modelling should be in addition to any assessment of overheating risk obtained from the Part L Building Regulation compliance tools SAP and SBEM. Evidence of how the development performs against the overheating criteria should be presented along with an outline of the assumptions made (e.g. around internal gains).

2.7 On 1st December 2017 the Mayor published the Draft New London Plan. This will be consulted on from this date up to 2nd March 2018.

CIBSE TM59 (2017) Assessment Criteria: Dwellings

2.8 The latest guidance for the assessment of overheating risk has been prepared by the Chartered Institute of Building Services Engineers (CIBSE) in the recently published **CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017)**. CIBSE TM59 is based on **CIBSE TM52** and **CIBSE Guide A** guidance documents and provides a standardised approach to predicting overheating risk for both naturally and mechanically ventilated residential buildings.

2.9 CIBSE TM52 suggests that three criteria are assessed:

- **Criterion 1: Hours of Exceedance:** The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more during the occupied hours of a typical non-heating season (1 May to 30 September). The indoor operative temperature should not exceed the threshold comfort temperature by 1 K or more for more than 3 per cent of occupied hours.
- **Criterion 2: Daily Weighted Exceedance:** The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. To allow for the severity of overheating the weighted exceedance (We) should be less than or equal to 6 in any one day.
- **Criterion 3: Upper Limit Temperature:** The third criterion sets an absolute maximum daily value temperature for a room, beyond which the level of overheating is unacceptable. The

indoor operative temperature should not exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 4 K or more during the occupied hours of a typical non-heating season.

2.10 The new **CIBSE TM59** guidance suggests that **the following two criteria must be met** in order to demonstrate compliance:

> **(i)** For living rooms, kitchens and bedrooms: the number of hours during which the operative temperature exceeds the threshold temperature by one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance);

> **(ii)** For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

3. MODELLING APPROACH

Methodology

3.1 The dynamic thermal modelling software Design Builder (DSB) has been used to set up the model and run dynamic simulations for overheating risk.

3.2 The performance of the units has been assessed under CIBSE TM59 adaptive comfort model for a primarily natural ventilated scenario.

Units Selected

3.3 The five units (Figures 2-6) that were chosen as most likely to suffer from overheating were:

> Upper floor units with large glazing;

> Single aspect rooms;

> Units with glazing facing south, east and west that are particularly susceptible to summertime solar gains as well as north facing units;

> Units located in different floor levels;

3.4 The drawings that were used for modelling purposes were received from Quantum Group in August 2017.

3.5 The internal layouts of the dwellings selected for assessment are indicated in Appendix A.

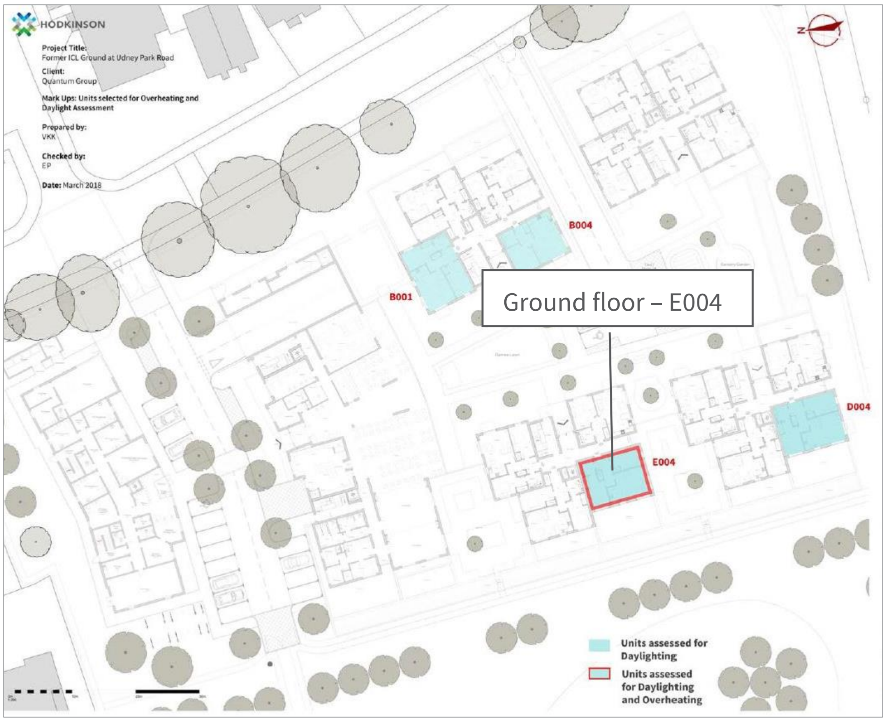

Figure 2: Selection of units assessed in Plot A, ground floor (Quantum Group Planning drawings received in August 2017).

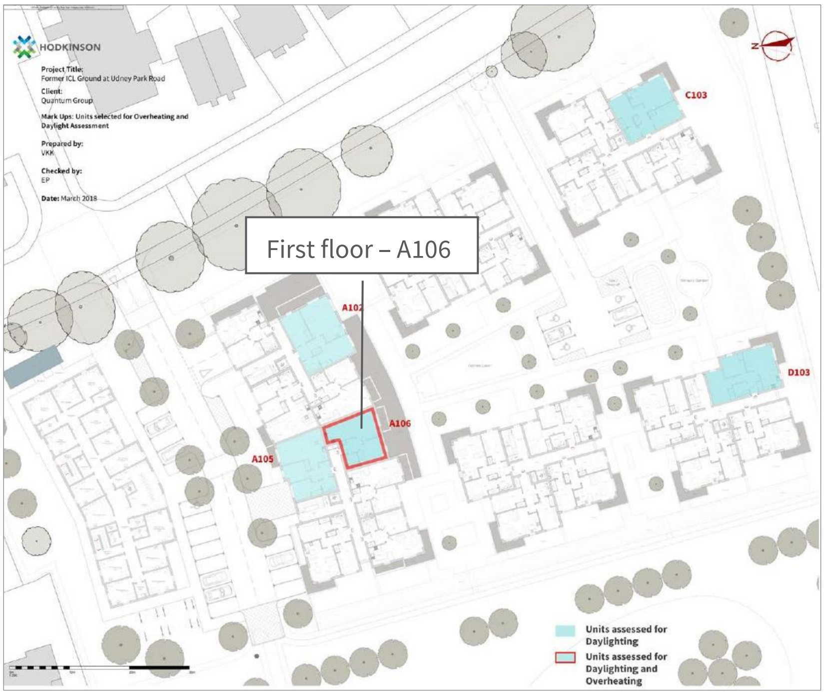

Figure 3: Selection of units assessed in Plot A, first floor (Quantum Group Planning drawings received in August 2017).

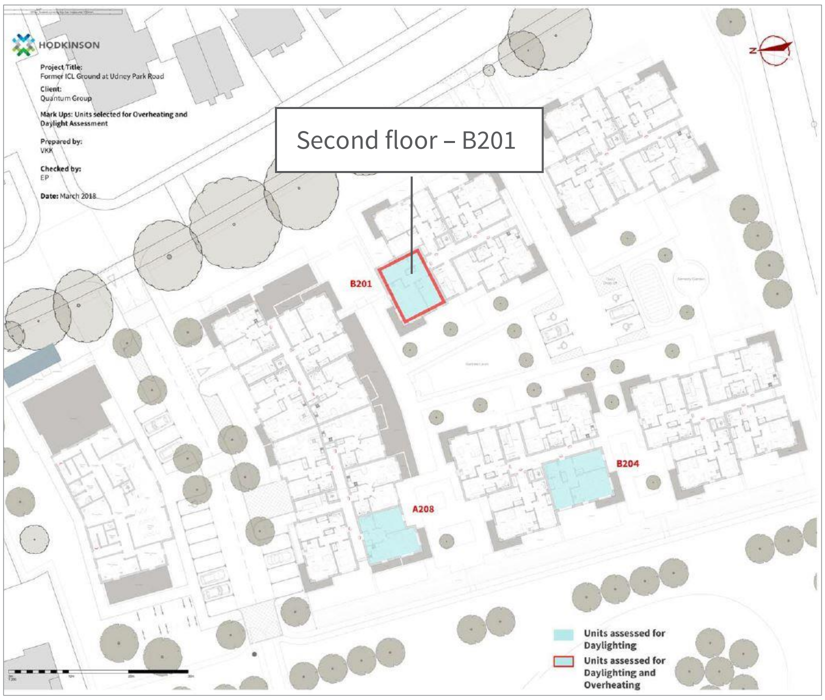

Figure 4: Selection of units assessed in Plot A, second floor (Quantum Group Planning drawings received in August 2017).

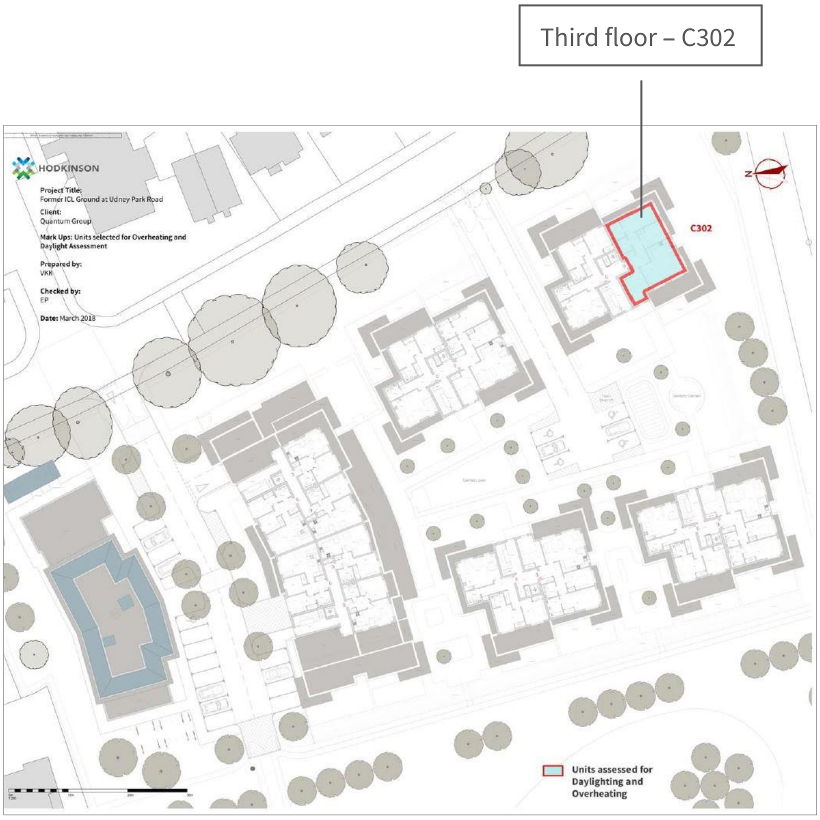

Figure 5: Selection of units assessed in Plot A, third floor (Quantum Group Planning drawings received in August 2017).

Figure 6: Selection of units assessed in Plot C, first floor (Quantum Group Planning drawings received in August 2017).

3.6 It should be noted that dwellings are care-led for the elderly, and therefore a high level of occupancy was applied for the simulations (Category I from CIBSE TM52).

Site External Weather Conditions

3.7 The effects of external conditions are vital in an overheating assessment as, in particular, they influence:

> Solar heat gains (a function of incident direct & diffuse solar radiation and solar altitude);

> Calculated natural ventilation rates (a function of external temperature, wind directions and speeds).

3.8 CIBSE Design Summer Year weather data for London Gatwick (representative of urban areas outside the Central Activity Zone) has been used for the 2020s, high emissions, 50% percentile scenario as required by CIBSE TM59.

Model Geometry and Local Shading

3.9 Shading forms an integral part of overheating mitigation strategies. Horizontal shading devices such as balconies/overhangs are more efficient when applied in south oriented façades and during midday when the solar angle is high. Their role in reducing solar gains in the summer period is considered to be paramount.

3.10 External shading has already been effectively included in the architectural design in the form of balconies. Their shading effect is more important where they are located in south façades. Their application reduces the solar heat gains, particularly in living rooms where windows are larger.

Design Modelling Inputs

3.11 The following modelling inputs (Tables 1-3) have been set up in the baseline dynamic thermal simulation, in line with SAP calculation inputs. CIBSE TM59 Guidance has been used for all occupancy rates and internal heat gain assumptions which will contribute to the risk of overheating.

Table 1: Dynamic Thermal Modelling Design Assumptions

Data Input			Discussion
Weather data	**Location**	CIBSE London Weather Centre Design Summer Years (DSYs) for 2020s, high emissions, 50% percentile scenario.	Geographically closest and most representative industry-standard CIBSE weather data file.
Building Fabric	**External walls**	0.16W/m²/K	As per Planning Energy Statement.
	Flat roof	0.15W/m²/K	High thermal mass roof assumed.

Construction details	**Ceilings/floors**	Assumed to be adiabatic between adjacent floors.	These are thermally massive and will add to the thermal capacity of the building. Since there are units above and below all simulated units heat loss through ceilings and floors was assumed to be zero (adiabatic).
	Party walls between units	Lightweight partitions.	Walls adjacent to other units were assumed to be lightweight partitions. Adjacent units were included in the dynamic simulation calculations.
	Partitions within units	Steel-stud partitions.	Assumed, thicknesses as per planning Quantum Group drawings.
	Internal doors	Internal doors: 0.9m width	Measured from planning Quantum Group drawings.
Windows	**Windows and Glazed Doors**	U value 1.4W/m²K	Double glazed, Low-E, in line with Energy Statement.
		G value 0.50	Based on Energy Statement.
	Shading	External shading from balconies, structural elements and recesses where present	These elements will provide some solar shading as the sun tracks around the building.
		Internal blinds of high reflectance. Assumed on during occupied hours.	Specified to reduce solar gains.
	Reveal depth	External reveal: 50mm	Measured from Quantum Group planning drawings received on August 2017.
		Internal reveal: 200mm	
Ventilation and infiltration	**Air Tightness**	5m³/hr-m2@50 pascals	As per Planning Energy Statement.
	Natural Ventilation	Internal doors are only open during the day (09:00-22:00).	Window opening calculated for assumed restrictor of 200mm. Nigh time cooling is very effective during hot days as it provides purge ventilation when external temperatures drop.
		Living rooms: windows assumed open during occupied hours only.	
		Bedrooms: windows assumed open during occupied hours. When external temperatures are extremely high (occurring for a few days in a year) windows should be left open during night time.	
	Mechanical ventilation	Mechanical ventilation achieving minimum 1 ach.	Assumption made based on a mechanical ventilation system that will achieve ventilation rates beyond the minimum Part F requirements.

Internal Gains

3.12 The following internal gains assumptions (Table 2) have been made in the dynamic thermal simulations in line with the CIBSE TM59 guidance.

Table 2: Occupancy & Equipment gains (CIBSE TM59)

Unit/room type	Occupancy	Equipment Load
1-bedroom apartment: living room/kitchen	1 person from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2-bedroom apartment: living room/kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
3-bedroom apartment: living room/kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
Double bedroom	2 people at 70% gains from 11 pm to 8 am, 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm, 1 person at full gain in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single bedroom	1 person at 70% gains from 11 pm to 8 am, 1 person at full gains from 8 am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
All rooms - Lighting	N/A	Lighting assumed 2 W/m2 from 6pm to 11pm

4. NATURAL VENTILATION

4.1 Since there are no noise restrictions in the site, windows are assumed open during occupied hours (09:00-22:00) regarding living rooms. There is a need of having openable windows during night time for the top floor living room (C302 unit) as well as the living room of Block C as the external shading in the form of balconies, is not sufficiently sized.

4.2 Regarding bedrooms, windows are also assumed open during occupied hours (09:00-22:00). When external temperatures are extremely high (occurring for a few days in a year) windows should be left open additionally during sleeping hours (Table 3) with 200mm restrictors applied.

Table 3: Calculation of number of days required to have windows open during night time (on annual basis)

Units	Number of days
E004	24-29
A106	12
B201	24-27
C302	17-29
Block C	48-57

5. SUMMARY OF RESULTS

5.1 Since this is a natural ventilation strategy, units have been assessed against the adaptive comfort model, as set out in CIBSE Guidance document *TM52: The limits of Thermal Comfort (2013)*.

5.2 According to the new **CIBSE TM59** guidance**, Criterion 1 of TM52 (i)** should be met for all rooms and **bedrooms should not exceed 26°C for more than 1% of the occupied hours (ii)** in order to demonstrate that overheating is within acceptable levels.

5.3 Criteria 2 and 3 of CIBSE TM52 may fail to be met, but both (i) and (ii) above must be passed for all relevant rooms.

5.4 Table 4 summarises the results given by running dynamic thermal simulations for the buildings under the current design summer year (DSY1) for the 2020s high emission, 50% percentile scenario, as required by TM59.

5.5 Results presented in Table 4 indicate that, based on the assumptions of Tables 1, 2 and 3 all rooms meet the TM59 criteria, therefore demonstrate an acceptable level of overheating risk.

Table 4: Overheating Results for DSY1 2020s

DSY1 2020s		TM59: i) Criterion 1 - Hours of exceedance (Pass - <3%)	TM59: ii) Bedroom Temperature %>26oC	PASS TM59 Crit i & ii CRITERIA?
E004	Bed1	1.81%	0.15%	PASS
	Bed 2	0.03%	0.24%	PASS
	Living Room/Kitchen	2.58%	N/A	PASS
A106	Bed1	0.00%	0.15%	PASS
	Living room/Kitchen	0.00%	N/A	PASS
B201	Bed1	0.00%	0.05%	PASS
	Bed2	0.48%	0.35%	PASS
	Living Room / Kitchen	2.30%	N/A	PASS
C302	Bed1	0.00%	0.00%	PASS
	Bed2	0.05%	0.20%	PASS
	Bed 3	0.05%	0.02%	PASS
	Living Room / Kitchen	1.70%	N/A	PASS
Block C	Bed1	0.05%	0.09%	PASS
	Bed2	0.14%	0.23%	PASS
	Bed 3	0.32%	0.18%	PASS
	Living Room / Kitchen	0.43%	N/A	PASS

6. SUMMARY & RECOMMENDATIONS

6.1 This report details the methodology and findings of a study into the overheating risk of five residential units, in the proposed Former ICL Private Ground development, by Quantum Group, within the London Borough of Richmond Upon Thames, using dynamic thermal modelling.

6.2 The reason for undertaking the work is to investigate the potential overheating risk and to provide possible mitigation strategies to minimise the likelihood of high internal temperatures.

6.3 Five residential units that are likely to present a high risk of overheating have been selected based on a range on design characteristics, as required by CIBSE TM59:2017 guidance, outlined in Section 3 of this report.

6.4 The analysis has been undertaken in line with the Greater London Authority (GLA)'s guidance on preparing energy assessments (March 2016) and the London Plan's Policy 5.9 cooling hierarchy.

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Assessment Criteria

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6.9 Representative units have been modelled against **CIBSE Design Summer Year for London Gatwick** (representative of urban areas outside the Central Activity Zone), for the **2020s, high emissions, 50% percentile scenario** as required by CIBSE TM59.

Results

6.10 All five units, demonstrate **an acceptable level of overheating** against the TM59 and CIBSE criteria. This is based on some key design features, as shown in the following table:

Key Design Features	Proposed Measures	Discussion
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APPENDICES

Appendix A

Layouts of Tested Units

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Layouts of Tested Units

Plot A – Ground Floor E004

Plot A – First Floor A106

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Plot A – Second Floor B201

Plot A – Third Floor C302

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Plot C – First Floor