Thermal Comfort Assessment

(CIBSE TM59)

Site Location:
17 Brook Road
19 Chequers Drive
42 Chequers Drive
4 Park Avenue
8 School Lane
7 Southern Avenue
11 Southern Avenue
15 Southern Avenue
in Surrey

Prepared on behalf of:
Ravens Housing trust
Raven House,
29 Linkfield Lane,
Redhill,
Surrey,
RH1 1SS

Job No: 33542

Date: December 2021

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Authorised for Issue:

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For and on behalf of Baily Garner LLP

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BRE Ref:	
Address:	
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Executive Summary

Baily Garner LLP was instructed by Ravens Housing Trust to provide a dynamic thermal comfort assessment in connection with the various properties undergoing deep retrofit in the Surrey area. We have taken 5 common archetypes of the 7 properties and carried out our investigations.

The thermal comfort study was completed using IES-VE2021 dynamic simulation software. The thermal model of the proposed properties and all other architectural features, such as orientation, external shadings and fenestration were referenced to the latest architectural drawings prepared for planning. Values of fabric thermal performance are provided by Baily Garner LLP.

The results show that 100% of the occupied areas assessed meet the thermal comfort criteria requirements set out by CIBSE TM59 using DSY1 London LGW 2020 High emissions 50% percentile weather file on the conditions that all mitigating measures outlined below are fully implemented:

- Glazing with a maximum g-value of 0.55 to all windows.
- Living area windows can open to 45° during occupied hours. Bedrooms to have secured opening of 20° during the night to allow secure ventilation during the cooler hours.
- Blinds would further reduce solar gains in the rooms. If blinds are provided by developer, then designers must ensure they must not interfere with the opening of windows, or the reduction in free area when they are operating. If not provided by the developer then further advise would need to be provided to the end occupier to ensure these mitigation measures is implemented correctly during occupancy.
- Mechanical ventilation with heat recovery (MVHR) units to have summer by-pass mode in the Bungalows.

Raven Housing Trust set a summer overheating target so that less than 11 summer days per year are over a comfort temperature of 26°C. This has not been achieved in Architypes 2, 3 and 4. However this is not a requirement under TM59 guidance.

Additional results using DSY 2 and DSY3 weather files show that there are rooms that are failing under these extreme weather conditions. Please note passing with these weather files is not mandatory but included for information.

Introduction

Baily Garner LLP was instructed by Ravens Housing Trust to provide a dynamic thermal comfort assessment in connection with the various properties undergoing deep retrofit in the Surrey area. We have taken 5 common archetypes of the 7 properties and carried out our investigations.

The purpose of this thermal comfort study is to investigate the risk of overheating via dynamic thermal simulation in accordance with the latest requirements of comfort adopted across the industry. This document intends to highlight potential overheating issues and make recommendations on suitable design solutions to optimize comfort conditions across all habitable areas.

As best practice the adopted London Plan Policy SI4 `Managing heat risk`, 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. Design criteria should also take in consideration the contribution from the temperature rise expected in the near future due to the impact of climate change.

It is also made clear that development proposals should reduce potential overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

- minimise internal heat generation through energy efficient design
- reduce the amount of heat entering a building through orientation, shading, albedo, fenestration, insulation and the provision of green roofs and walls
- manage the heat within the building through exposed internal thermal mass and high ceilings
- provide passive ventilation
- provide mechanical ventilation
- provide active cooling systems.

The thermal comfort study was completed using IES-VE2021 dynamic simulation software.

Assessment Criteria

Overheating assessments for domestic areas are completed against the criteria set out by Chartered Institute of Building Services Engineers (CIBSE) TM52 - The Limits of Thermal Comfort Avoiding Overheating in European Buildings against CIBSE TM59 weather files.

CIBSE TM59: Simulation results were assessed against the criteria set out by the Chartered Institute of Building Services Engineers (CIBSE) TM59 guide – Design methodology for the assessment of overheating risk in homes for all the residential dwellings. The proposal was tested against the DSY1 London GTW 2020 High emissions 50% percentile weather conditions. Internal gains for each type of occupied area were accounted for as indicated in CIBSE TM59.

CIBSE TM59 methodology require the development with homes predominantly naturally ventilated to comply by: Passing both of the following two criteria:

(a) For living rooms, kitchens and bedrooms: the number of hours during which DT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 percent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).

(b) 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).

CIBSE TM52 - seeks to outline a balanced, adaptive approach to assess the risk of overheating in buildings in the UK and Europe. It is widely recognized across the industry as a robust, reliable tool to predict the likelihood of experiencing discomfort conditions by occupants. CIBSE TM59 guide states the assessment should be using the adaptive method of TM52 guide.

Here is the criteria from CIBSE TM52:

- Criteria 1 sets a limit of 3.0% for the number of hours that the operative temperature can exceed the threshold comfort temperature by 1°C or more during the occupied hours of a typical non-heating season (1 May to 30 September);

- Criteria 2 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 temperatures rise and its duration. A daily limit of 6.0 for the `weighted exceedance` is indicated as acceptable.

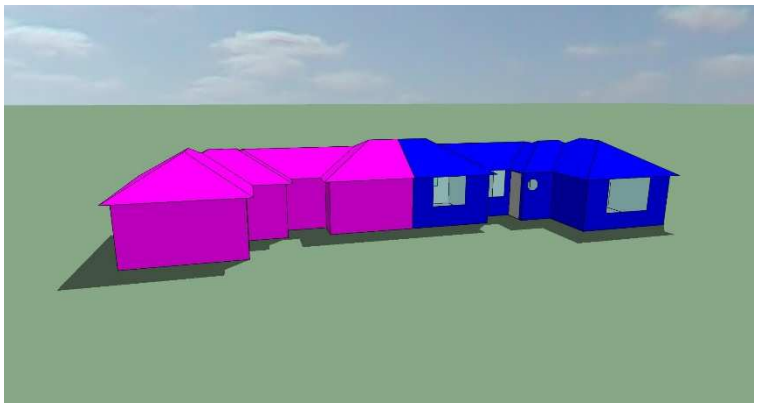
- Criteria 3 sets an absolute maximum daily temperature excess of 4°C for the operative temperature, beyond which the level of overheating is considered to be unacceptable.

Methodology

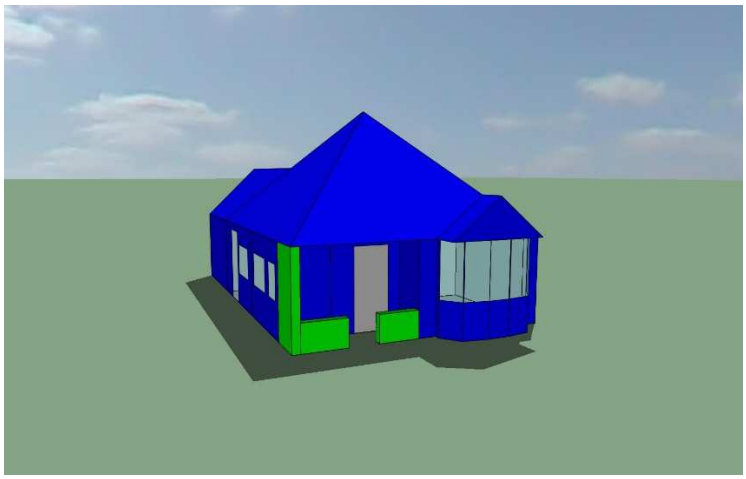
This thermal comfort study was carried out using IES dynamic simulation software and all habitable areas were assessed against the adaptive thermal comfort criteria set out by CIBSE TM59 guidelines.

This thermal comfort study was carried out using IES-VE 2021 dynamic thermal simulation software. Simulations are assessed using the DSY1 London GTW 2020 High emissions 50% percentile weather conditions.

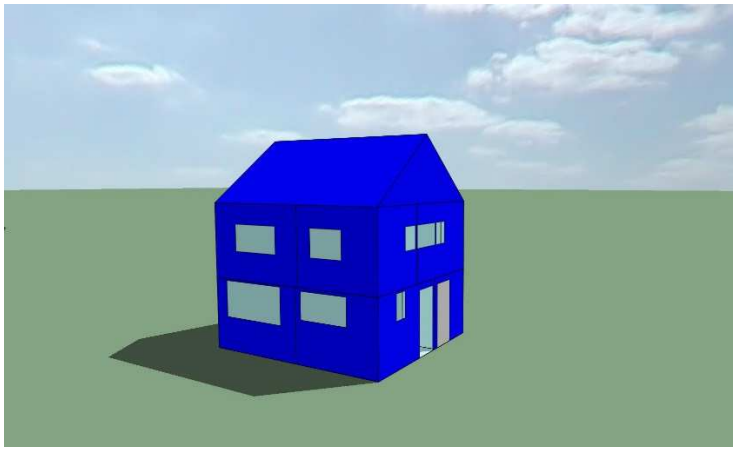
The 3D model geometry of the buildings was created from the architectural drawings issued for planning, as current on the 9th December 2021. A prospective view of the 3D IES models are shown below.



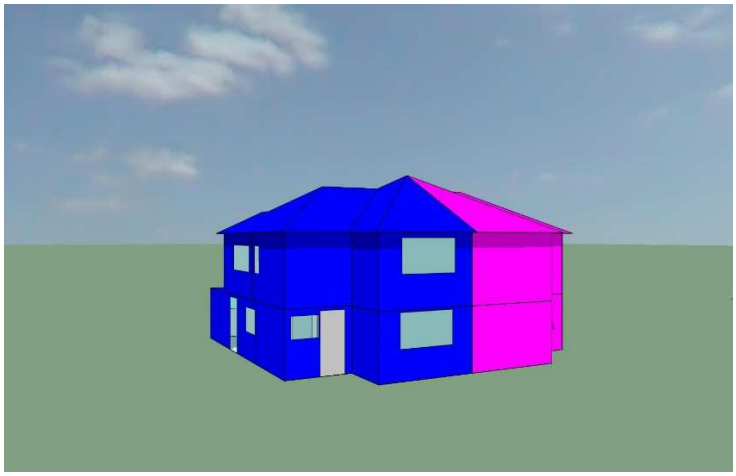
Archetype 1– 11 Southern Avenue – 1 bedroom semi-detached bungalow



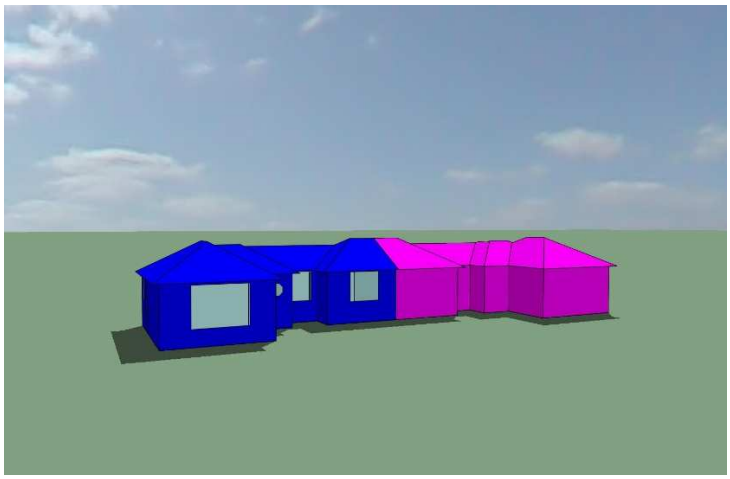
Archetype 2 – 4 Park Avenue – 2 Bedroom detached bungalow



Archetype 3 – 42 Chequers Drive – 2 Bedroom detached house



Archetype 4 – 17 Brook Road – 3 bedroom semi-detached house



Archetype 5 – 19 Chequers Drive - 1 bedroom semi-detached bungalow

The areas were identified as occupied across the development for the purpose of this study and therefore assessed against the thermal comfort criteria. The Table below shows the fabric performance, along with details of internal gains taken into account.

Lighting energy was accounted as 2.0 W/m2/100lux 24hr across all assessed occupied areas.

Equipment Gains and occupancy are based on CIBSE Guide A, a maximum sensible heat gain of 75 W/person and a maximum latent heat gain of 55 W/person and assigned in occupied spaces.

Kitchens/living rooms are unoccupied during the sleeping hours and occupied during the rest of the day. This is the worst-case scenario since the room will be modelled as occupied only during the hottest hours of the day.

Sources of internal gains were discounted for all unoccupied spaces, such as storage areas and other unheated areas.

All fabric specifications, i.e., U-values and g-value and thermal mass of construction elements were taken in accordance with information provided by the Architects. The fabric performance is based on the figures below:

Fabric performance

<table>
<tr><th>Name</th><th>Type</th><th>Wall
W/m2.k</th><th>Roof
W/m2.k</th><th>Floor
W/m2.k</th><th>Window
W/m2.k</th><th>Door
W/m2.k</th></tr>
<tr><td>Archetype 1
11 Southern Avenue</td><td rowspan="4">Bungalow</td><td rowspan="4">0.09</td><td rowspan="8">0.11</td><td rowspan="4">0.59</td><td rowspan="8">0.80</td><td rowspan="8">1.00</td></tr>
<tr><td>Archetype 1
15 Southern Avenue</td></tr>
<tr><td>Archetype 1
7 Southern Avenue</td></tr>
<tr><td>Archetype 2
4 Park Avenue</td></tr>
<tr><td>Archetype 3
42 Chequers Drive</td><td rowspan="3">Houses</td><td>0.15</td><td>0.22</td></tr>
<tr><td>Archetype 4
17 Brook Road</td><td rowspan="3">0.09</td><td rowspan="3">0.59</td></tr>
<tr><td>Archetype 4
8 School Lane</td></tr>
<tr><td>Archetype 5
19 Chequers Drive</td><td>Bungalow</td></tr>
</table>

The thermal model of the proposal and all other architectural features, such as orientation, external shadings, and fenestration were referenced to the latest architectural drawings prepared for planning. Values of fabric thermal performance were calculated by Baily Garner Energy Assessor.

CIBSE TM52 methodology is required to assess commercial occupied areas in conjunction with the TM59 weather files. Passive measures have been implemented according to the cooling hierarchy. Glazed windows are to have a 0.55 g-value.

Ventilation

Variable intakes of fresh air through external openings were taken into consideration by using the `MacroFlo` module of IES-VE 2021. A semi-exposure assumption was made for all external walls on the basis of the surrounding urban density; openable area of casements was assumed to be 70% of the structural measurement for the openable windows as shown on the architectural elevations. doors are assumed to open 100%.

Windows in each room are controlled separately and modelled as open when both the internal dry bulb temperature exceeds 22 °C and the room is occupied.

Opening directions were entered as indicated in the elevations drawings and assumed to be operated as detailed in the table below. Ground floor bedroom windows are also assumed to be securely locked open at 20° angle at night to benefit from free cooling as the temperature drops overnight.

Internal doors are included and left open in the model in the daytime, but assumed to be closed when the occupants are sleeping.

The modelled air speed in the spaces is set at 0.1 m/s.

Window and door openings

Opening Type	Category	Proportion	Opening	Occupancy
Living area Windows	Side hung	70%	45° > 22°C	9am-22pm
Glazed Doors	Side hung	100%	90° > 22°C	9am-22pm
Bedroom Windows	Side hung	70%	20° > 22°C	22pm-7am
Internal doors	Side hung	100%	90° > 22°C	9am-22pm

Results

The results show that 100% of occupied areas assessed meet the thermal comfort criteria requirements set out by CIBSE TM59 using DSY1 London GTW 2020 High emissions 50% percentile weather file on the conditions that all mitigating measures outlined below are fully implemented:

- Improved glazing with a maximum g-value of 0.55 to all windows.
- Living area windows can open to 45° during occupied hours. Bedrooms to have secured opening of 20° during the night to allow secure ventilation during the cooler hours.
- Blinds would further reduce solar gains in the rooms. If blinds are provided by developer, then designers must ensure they must not interfere with the opening of windows, or the reduction in free area when they are operating. If not provided by the developer then further advise would need to be provided to the end occupier to ensure these mitigation measures is implemented correctly during occupancy.
- Mechanical ventilation with heat recovery units to have summer by-pass mode.

Table summary of results

Solution	No of rooms Pass	No. of rooms fail
As Designed	19	0

CIBSE TM52 (DSY1) – A moderately warm summer.

Room Name	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
Architype 1 Double Bedroom	100	0	0	0	-
Architype 1 Living Room	100	0.5	16	3	2
Architype 1 Kitchen	100	0.8	20	4	2
Architype 3 Double Bedroom	100	0.6	14	3	2
Architype 3 Double Bedroom	100	0.7	15	3	2
Architype 4 Living Dining	100	1.2	24	4	2
Architype 4 Kitchen	100	1.6	24	4	2
Architype 4 Single Bedroom	100	0.4	5	1	-
Architype 4 Double Bedroom	100	0.1	4	1	-
Architype 4 Double Bedroom	100	0	0	0	-
Architype 5 Bedroom	100	0.2	9	2	2
Architype 5 Living Room	100	0.6	15	3	2
Architype 5 Kitchen	100	0.7	22	4	2
Architype 2 Double Bedroom	100	0.4	15	3	2

Room Name	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
Architype 2 Living Room	100	1.1	21	4	2
Architype 2 Double Bedroom	100	0.2	12	2	2
Architype 3 Living Room	100	1.6	28	4	2
Architype 2 Kitchen	100	1.3	28	4	2
Architype 3 Kitchen	100	3	33	4	2

CIBSE TM59 Criterion B

Location	Operative temperature (°C) - hours in range
	> 26.00
Architype 1 Double Bedroom	2
Architype 3 Double Bedroom	10
Architype 3 Double Bedroom	13
Architype 4 Single Bedroom	6
Architype 4 Double Bedroom	5
Architype 4 Double Bedroom	7
Architype 5 Double Bedroom	4
Architype 2 Double Bedroom	11
Architype 2 Double Bedroom	15

Raven Housing Trust summer comfort target

Raven Housing Trust set a summer overheating target so that less than 11 summer days per year are over a comfort temperature of 26°C. This is based on occupied hours from 9am to 10pm in the living areas. This is not a requirement under TM59.

Location	Operative temperature (°C) - hours in range	Days
	> 26.00	> 26.00
Architype 1 Living Room	96	7.4
Architype 1 Kitchen	119	9.1
Architype 3 Living Room	195	15
Architype 4 Living Dining	170	13
Architype 4 Kitchen	203	15.6
Architype 5 Living Room	123	9.46
Architype 5 Kitchen	144	11
Architype 2 Living Room	171	13.1
Architype 2 Kitchen	204	15.7

Additional weather files including the more extreme DSY2 and DSY3 files have been used to further test the designs and advise the developer if they wish to create a plan to prepare for more extreme weather events such as a heatwave. This helps to address the most critical health concerns associated with overheating: vulnerable people (i.e. elderly people, disabled people and babies) who tend to be at home most of the day.

A pass in DSY2 and DSY 3 is not mandatory. The results are below.

CIBSE TM52 (DSY2) A summer with a short intense warm spell.

Room Name	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
Architype 1 Double Bedroom	100	0	0	0	-
Architype 3 Double Bedroom	100	2	24	4	2
Architype 3 Double Bedroom	100	2.3	26	4	2
Architype 4 Single Bedroom	100	1.6	10	2	2
Architype 4 Double Bedroom	100	0.6	7	1	2
Architype 4 Double Bedroom	100	0.4	7	1	2
Architype 5 Bedroom	100	1	20	4	2
Architype 2 Double Bedroom	100	1.8	25	4	2
Architype 2 Double Bedroom	100	1.4	22	4	2
Architype 1 Living Room	100	2.5	32	5	2 & 3
Architype 1 Kitchen	100	2.9	39	6	2 & 3
Architype 3 Living Room	100	4.3	44	7	1 & 2 & 3
Architype 4 Living Dining	100	3.9	44	7	1 & 2 & 3
Architype 4 Kitchen	100	4.4	44	7	1 & 2 & 3
Architype 5 Living Room	100	2.9	31	5	2 & 3
Architype 5 Kitchen	100	3.4	41	6	1 & 2 & 3
Architype 2 Living Room	100	3.6	36	6	1 & 2 & 3
Architype 2 Kitchen	100	3.9	43	7	1 & 2 & 3
Architype 3 Kitchen	100	5	52	8	1 & 2 & 3

CIBSE TM52 (DSY3) A summer with a long less intense warm spell.

Room Name	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
Architype 1 Double Bedroom	100	0	0	0	-
Architype 3 Double Bedroom	100	2.9	29	4	2
Architype 4 Single Bedroom	100	1.8	10	2	2
Architype 4 Double Bedroom	100	0.8	8	1	2
Architype 4 Double Bedroom	100	0.6	8	1	2
Architype 5 Bedroom	100	1.2	14	2	2
Architype 2 Double Bedroom	100	2.3	24	3	2
Architype 2 Double Bedroom	100	1.6	16	2	2
Architype 1 Living Room	100	3.1	23	3	1 & 2
Architype 1 Kitchen	100	4.1	27	4	1 & 2
Architype 3 Living Room	100	6.2	40	5	1 & 2 & 3
Architype 3 Double Bedroom	100	3.3	28	3	1 & 2
Architype 4 Living Dining	100	5.5	34	4	1 & 2
Architype 4 Kitchen	100	5.9	36	5	1 & 2 & 3
Architype 5 Living Room	100	3.8	25	3	1 & 2
Architype 5 Kitchen	100	4.5	27	4	1 & 2

Room Name	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
Architype 2 Living Room	100	4.9	32	4	1 & 2
Architype 2 Kitchen	100	5.7	37	5	1 & 2 & 3
Architype 3 Kitchen	100	7.3	46	6	1 & 2 & 3

Conclusion

The results show that 100% of occupied areas assessed meet the thermal comfort criteria requirements set out by CIBSE TM59 using DSY1 London GTW 2020 High emissions 50% percentile weather file on the conditions that all mitigating measures outlined below are fully implemented:

- Glazing with a maximum g-value of 0.55 to all windows.

- Living area windows can open to 45° during occupied hours. Bedrooms to have secured opening of 20° during the night to allow secure ventilation during the cooler hours.

- Blinds would further reduce solar gains in the rooms. If blinds are provided by developer, then designers must ensure they must not interfere with the opening of windows, or the reduction in free area when they are operating. If not provided by the developer then further advise would need to be provided to the end occupier to ensure these mitigation measures is implemented correctly during occupancy.

- Mechanical ventilation with heat recovery (MVHR) units to have summer by-pass to the bungalows.