HAVERSTOCK HILL, LONDON

CIBSE TM52 OVERHEATING ANALYSIS

PROJECT NUMBER: P1863

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R01	17/09/2020	Issued for planning	C Armstrong	S Richardson
R02	10/11/2020	Minor amendments following design team comments	C Armstrong	S Richardson

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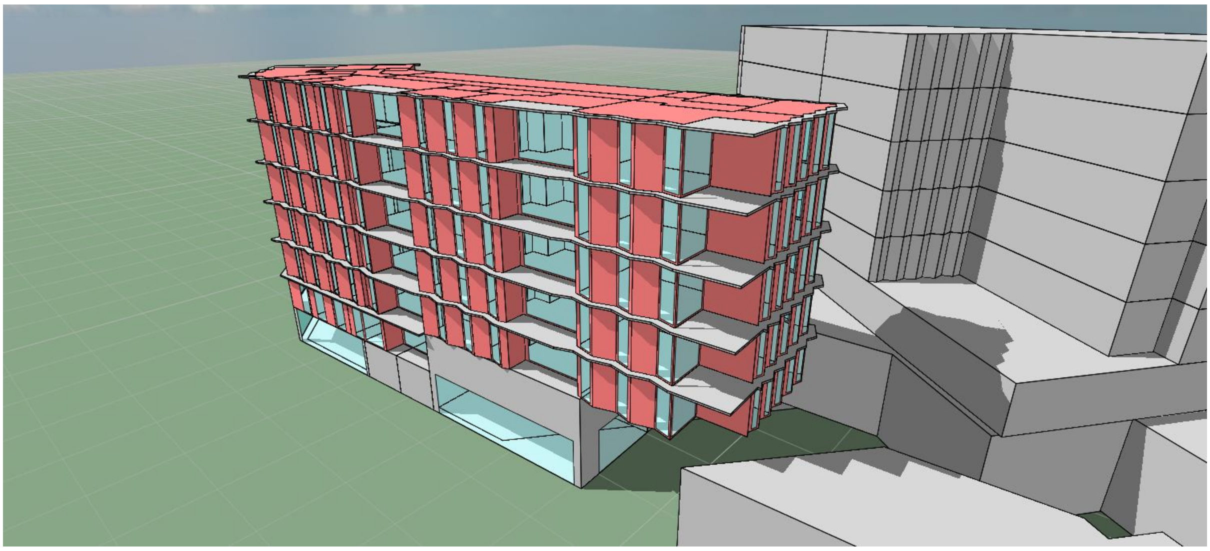
1.0 EXECUTIVE SUMMARY

Quinn Ross Consultants has carried out a Chartered Institute of Building Services Engineers (CIBSE) Technical Memoranda (TM) 52 thermal comfort assessment of the design for the Haverstock Hill residential development, London, to ensure the compliance requirements with respect to overheating are met.

Please note the residential areas are split into social and private. Only the social dwellings are intended for natural and mechanical ventilation and therefore require analysis. All the private dwellings will be air conditioned in line with the acoustic requirements, and therefore do not require testing.



CIBSE's TM52 is widely regarded as the most stringent and sophisticated of current overheating criteria. This is due to it being based on three CIBSE Design Summer Year's (DSY's) which simulate a variety of particularly "hot" years and it is based on the latest research into the rate at which people adapt to changes in climate. Designing according to TM52 criteria leads to much better thermal comfort and a superior living space compared to other criteria such as the previously used CIBSE Guide A. It is also mandatory to perform the calculations using a Dynamic Simulation Modelling (DSM) software capable of running hourly simulations for a whole year using approved weather data.

Factors affecting overheating include occupancy patterns and internal gains, which are not under the control of the designers. TM52 does not define any of these inputs specifically, however CIBSE's latest TM59 *Design methodology for the assessment of overheating risk in homes* does outline a database of applicable inputs. Although the TM59 criteria differs slightly to TM52 it does outline a standard database of input and variation data used for residential thermal comfort assessment approved by CIBSE. This data has been applied to this building for this study to avoid any ambiguity.

The DSM software used is the Integrated Environmental Suite (IES) software Virtual Environment (VE) Version 2019.1.0.0. IES is one of the world leaders in developing DSM software and is used internationally for all manner of dynamic simulation calculations, including TM52, Part L2A and ASHRAE 90.1 calculations. The software was used to create a 3-D model based on information provided by the design team as defined in the following section. Hourly simulations for a year were run as part of the overheating thermal analysis using the relevant weather file for the location to produce the hourly results for assessment.

The following overheating mitigating measures are incorporated into the design of the development:

- **Solar control glazing -** Optimised glazing has been used, with a solar transmittance (g-value) reduced to 0.55.

- **Opening windows and doors –** Natural ventilation through opening windows has been applied to the whole development.
- **Night ventilation –** All opening windows will be openable during night hours, to enable night purging of hot air built up during the hottest summer days.
- **External shading –** The façade of the building has overhangs and balconies specifically designed to obscure as much solar gains as possible.
- **Mechanical Ventilation –** Mechanical supply units, with heat recovery, have been incorporated into all apartments.

With the above design features applied the social dwellings achieve the following results:

Zone Name	Criteria 1 (%Hrs Top-Tmax>=1K) Target <3	Criteria 2 (Max. Daily Deg.Hrs) Target <6	Criteria 3 (Max. DeltaT) Target <4	Criteria Failing	Results
Upper Ground: Flat 01	0.9	20.0	2.5	2	PASS
Upper Ground: Flat 02	1.2	20.0	3.0	2	PASS
Level 01: Flat 04	0.5	18.0	2.0	2	PASS
Level 01: Flat 05	0.5	15.0	2.0	2	PASS
Level 01: Flat 06	0.4	13.0	2.0	2	PASS
Level 01: Flat 07	0.8	14.3	2.7	2	PASS
Level 02: Flat 04	0.3	7.7	2.0	2	PASS
Level 02: Flat 05	0.3	7.3	2.0	2	PASS
Level 02: Flat 06	0.2	5.7	1.3	None	PASS
Level 02: Flat 07	0.2	5.7	1.3	None	PASS
Level 03: Flat 04	0.0	0.0	0.0	None	PASS
Level 03: Flat 05	0.0	0.0	0.0	None	PASS
Level 03: Flat 06	0.3	8.5	2.0	2	PASS
Level 03: Flat 07	0.2	4.3	0.7	2	PASS
Level 04: Flat 05	0.5	18.0	2.0	2	PASS
Level 04: Flat 06	0.4	13.5	2.0	2	PASS
Level 04: Flat 07	0.3	11.0	1.7	2	PASS
Level 05: Flat 01	0.5	18.0	2.0	2	PASS
Level 05: Flat 02	0.2	7.5	1.5	2	PASS
Level 05: Flat 03	0.8	15.0	3.0	2	PASS
Level 05: Flat 04	0.4	11.3	2.7	2	PASS

Table 1: Results per apartment

As the results above show all apartments will not overheat during a moderately warm summer for the year 2020.

2.0 INTRODUCTION

This report assesses the design of the new Haverstock Hill residential development, London, under the overheating criteria set out within the Chartered Institute of Building Services Engineers (CIBSE) Technical Memorandum 52 (TM52), *The Limits of Thermal Comfort: Avoiding Overheating in European Buildings*. The relevant targets will be outlined along with the methodology and strategies used to achieve compliance.

The new development is expected to comprise 35 no. residential units, one, two and three-bedroom apartments over 7 storeys.

3.0 CRITERIA FOR COMPLIANCE

As mentioned above, the overheating assessment will be undertaken using CIBSE's TM52 thermal comfort criteria and will assess all occupied areas of the development. An "occupied" area is defined as an internal space in the building that has occupants for more than 30 mins at any one time, in this case bedrooms and living room / Kitchens. The assessment requires that all occupied spaces must pass as "free-running" areas. "Free running" is defined by a space having no active cooling systems, such as air conditioning.

Consistent overheating in buildings affects health and well-being of occupants and their productivity. Assessing overheating and thermal comfort is required to ensure free-running buildings do not overheat and the need for comfort cooling is avoided. The thermal comfort criteria for the assessment are defined in CIBSE's TM52. This criteria states that a room or building that fails any two of the following three criteria is classed as overheating:

- **Criterion 1 -** "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)."
- **Criterion 2 -** "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. This criterion sets a daily limit for acceptability."
- **Criterion 3 -** "The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable."

The above criteria will be tested for each relevant occupied zone to show that the zones (rooms) in question are not overheating.

Factors affecting overheating include occupancy patterns and internal gains, which are not under the control of the designers. TM52 does not define any of these inputs specifically, however CIBSE's latest TM59 *Design methodology for the assessment of overheating risk in homes* does outline a database of applicable inputs. Although the TM59 criteria differs slightly to TM52 it does outline a standard database of input and variation data used for residential thermal comfort assessment approved by CIBSE. This data has been applied to this building and can be found in Section 5.0 of this report and the appendices.

3.01 Cooling Hierarchy

The design team has adhered to the *London Plan's Cooling Hierarchy* approach to thermal comfort which sets out a six-level hierarchy of cooling designed to maximise passive measures to minimise the need for active cooling. As the residential areas of this building are not "free-running", as they will have active cooling systems installed, this overheating assessment therefore aims to show that most, if not all, of the overheating risk is mitigated by measures other than active cooling. The cooling hierarchy is set out below:

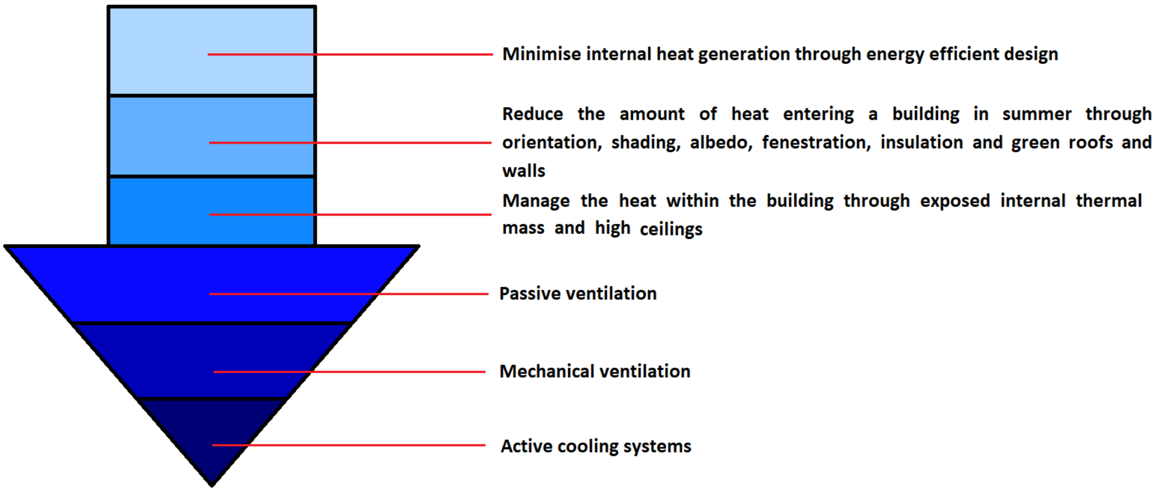


Figure 1: Cooling hierarchy

3.02 External Weather Data

Design Summer Year (DSY) weather files contain a whole year's weather variables for various locations throughout the UK designed for use in dynamic thermal simulation. The approach for which weather files to use is open to interpretation and TM52 simply states "an appropriate" weather file should be used. It is deemed suitable for the simulation to be run using a predicted weather file for the year 2020 using a high emissions 50th percentile scenario.

4.0 DYNAMIC SIMULATION MODELLING (DSM) SOFTWARE

The DSM software used is the Integrated Environmental Suite (IES) software Virtual Environment (VE) Version 2019.1.0.0. IES is one of the world leaders in developing DSM software and is used internationally for all manner of dynamic simulation calculations, including TM52, Part L2A and ASHRAE 90.1 calculations. The software was used to create a 3-D model based on information provided by the design team as defined in the following section. Hourly simulations for a year were run as part of the overheating thermal analysis using the relevant weather file for the location to produce the hourly results for assessment.

5.0 BUILDING INPUT DATA

The following section highlights the key inputs that were used to model the development. The image below shows the 3D geometry of the development:

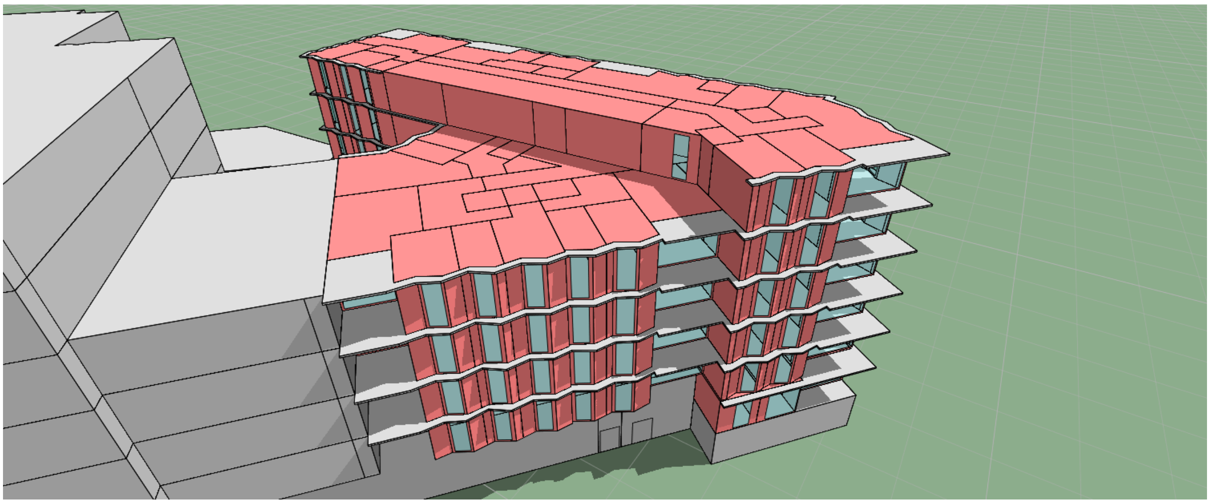


Figure 2: 3D model images as modelled in IES

5.01 Drawings

The 3D model of the building used was created using drawings from *Shepherd Robson* Architects.

5.02 Construction U-values

The following construction U-values were used:

Construction U-values W/m².K	
Ground floor	0.10
External wall	0.15
Roof	0.10

Table 2: Construction U-values

5.03 Glazing Parameters

The following glazing details were as advised by the architect:

Glazing Parameters	
Overall U-value (including frame)	1.20 W/m².K
g-value	0.55

Table 3: Glazing and parameters

5.04 Air permeability / Infiltration

As the building is existing and several decades old it is assumed it will have an air permeability of 5.0 $m^3/h/m^2$ @ 50 Pascals, in line with the EPC conventions. This equates to an infiltration rate of 0.15 air changes per hour at atmospheric pressure for this type of building.

5.05 Natural Ventilation

There are two types of opening windows in this development:

- Sliding double doors – These will have a 50% opening/free area.
- Top hung windows – These will have a 30% opening/free area.

5.06 Mechanical Ventilation

Each apartment will have a Mechanical Ventilation Heat Recovery unit (MVHR) supplying outside air at the rates as outlined below.

5.07 Internal Gains & Inputs Summary

The following internal gains are applied to the spaces. As stated above all gains and their hours of use are taken from CIBSE's TM59:

Room Group	Temp Set-Point (°C)		Occupancy	Lighting Gains W/m²	Miscelaneous Gains W		Mech Vent l/s	Infiltration ach
	Heating	Cooling			Sens	Latent		
Living / Kitchen	18.00	-	2 people	2.0	450	-	10.0	0.15
Bedroom	18.00	-	2 people	2.0	80	-	5.00	0.15
Bathroom / Ensuite	18.00	-	-	-	-	-	-	0.15
Lobby / Corridor	18.00	-	-	2.0	-	-	-	0.15
Cupboard / Store	-	-	-	-	-	-	-	0.15

Table 4: Internal gains

All occupancy gains are based on 75 W/person sensible and 55 W/person latent.

6.0 RESULTS

Using the input data outlined above the DSM calculations were performed for each individual room and the following results were produced:

Zone Name	Criteria 1 (%Hrs Top-Tmax>=1K) Target <3	Criteria 2 (Max. Daily Deg.Hrs) Target <6	Criteria 3 (Max. DeltaT) Target <4	Criteria Failing	Results
Upper Ground: Flat 01 - Bedroom	0.8	24	3	2	PASS
Upper Ground: Flat 01 - Kitchen / Lounge	1	16	2	2	PASS
Upper Ground: Flat 02 - Bedroom 01	1.3	25	4	2	PASS
Upper Ground: Flat 02 - Bedroom 02	0.6	20	3	2	PASS
Upper Ground: Flat 02 - Bedroom 03	0.4	7	1	2	PASS
Upper Ground: Flat 02 - Kitchen / Lounge	2.3	28	4	2	PASS
Level 01: Flat 04 - Bedroom 01	0.5	18	2	2	PASS
Level 01: Flat 04 - Bedroom 02	0.4	12	2	2	PASS
Level 01: Flat 04 - Bedroom 03	0.2	9	2	2	PASS
Level 01: Flat 04 - Kitchen/Lounge	1.8	22	4	2	PASS
Level 01: Flat 05 - Bedroom 01	0.2	9	2	2	PASS
Level 01: Flat 05 - Bedroom 02	0.3	12	2	2	PASS
Level 01: Flat 05 - Kitchen/Lounge	0.5	9	3	2	PASS
Level 01: Flat 06 - Bedroom 01	0.1	2	1	-	PASS
Level 01: Flat 06 - Bedroom 02	0.3	11	2	2	PASS
Level 01: Flat 06 - Bedroom 03	0.1	4	1	-	PASS
Level 01: Flat 06 - Kitchen/Lounge	0.1	2	1	-	PASS
Level 01: Flat 07 - Bedroom 01	0	0	0	-	PASS
Level 01: Flat 07 - Bedroom 02	0	0	0	-	PASS
Level 01: Flat 07 - Kitchen/Lounge	0	0	0	-	PASS
Level 02: Flat 04 - Bedroom 01	0.5	18	2	2	PASS
Level 02: Flat 04 - Bedroom 02	0.2	9	2	2	PASS
Level 02: Flat 04 - Bedroom 03	0.2	6	1	-	PASS
Level 02: Flat 04 - Kitchen/Lounge	1.7	21	4	2	PASS
Level 02: Flat 05 - Bedroom 01	0.2	9	2	2	PASS
Level 02: Flat 05 - Bedroom 02	0.4	15	3	2	PASS
Level 02: Flat 05 - Kitchen/Lounge	0.6	10	3	2	PASS
Level 02: Flat 06 - Bedroom 01	0.2	6	1	-	PASS
Level 02: Flat 06 - Bedroom 02	0.4	15	3	2	PASS
Level 02: Flat 06 - Bedroom 03	0.2	8	2	2	PASS
Level 02: Flat 06 - Kitchen/Lounge	0.2	4	2	-	PASS
Level 02: Flat 07 - Bedroom 01	0.2	7	1	2	PASS
Level 02: Flat 07 - Bedroom 02	0	0	0	-	PASS
Level 02: Flat 07 - Kitchen/Lounge	0.1	1	1	-	PASS
Level 03: Flat 04 - Bedroom 01	0.5	18	2	2	PASS
Level 03: Flat 04 - Bedroom 02	0.2	9	2	2	PASS
Level 03: Flat 04 - Bedroom 03	0.2	6	1	-	PASS
Level 03: Flat 04 - Kitchen/Lounge	1.6	20	3	2	PASS
Level 03: Flat 05 - Bedroom 01	0.3	11	2	2	PASS
Level 03: Flat 05 - Bedroom 02	0.5	15	3	2	PASS
Level 03: Flat 05 - Kitchen/Lounge	0.6	10	3	2	PASS
Level 03: Flat 06 - Bedroom 01	0.2	6	1	-	PASS
Level 03: Flat 06 - Bedroom 02	0.4	15	3	2	PASS
Level 03: Flat 06 - Bedroom 03	0.2	8	2	2	PASS
Level 03: Flat 06 - Kitchen/Lounge	0.2	5	2	-	PASS
Level 03: Flat 07 - Bedroom 01	0.4	9	1	2	PASS
Level 03: Flat 07 - Bedroom 02	0	0	0	-	PASS
Level 03: Flat 07 - Kitchen/Lounge	0.2	4	1	-	PASS

Zone Name	Criteria 1 (%Hrs Top-Tmax>=1K) Target <3	Criteria 2 (Max. Daily Deg.Hrs) Target <6	Criteria 3 (Max. DeltaT) Target <4	Criteria Failing	Results
Level 04: Flat 04 - Bedroom 01	0.5	17	2	2	PASS
Level 04: Flat 04 - Bedroom 02	0.2	9	2	2	PASS
Level 04: Flat 04 - Bedroom 03	0.2	6	1	-	PASS
Level 04: Flat 04 - Kitchen/Lounge	1.6	20	3	2	PASS
Level 04: Flat 05 - Bedroom 01	0.3	12	2	2	PASS
Level 04: Flat 05 - Bedroom 02	0.5	17	3	2	PASS
Level 04: Flat 05 - Kitchen/Lounge	0.7	11	3	2	PASS
Level 04: Flat 06 - Bedroom 01	0.2	8	2	2	PASS
Level 04: Flat 06 - Bedroom 02	0.5	16	3	2	PASS
Level 04: Flat 06 - Bedroom 03	0.2	9	2	2	PASS
Level 04: Flat 06 - Kitchen/Lounge	0.3	6	2	-	PASS
Level 04: Flat 07 - Bedroom 01	0.5	12	2	2	PASS
Level 04: Flat 07 - Bedroom 02	0.1	4	1	-	PASS
Level 04: Flat 07 - Kitchen/Lounge	0.3	4	1	-	PASS
Level 05: Flat 01 - Bedroom 01	0.2	7	1	2	PASS
Level 05: Flat 01 - Bedroom 02	0.3	8	1	2	PASS
Level 05: Flat 01 - Kitchen/Lounge	0.9	13	2	2	PASS
Level 05: Flat 02 - Bedroom	0.7	19	3	2	PASS
Level 05: Flat 02 - Kitchen/Lounge	1	16	3	2	PASS
Level 05: Flat 03 - Bedroom	0.5	16	2	2	PASS
Level 05: Flat 03 - Kitchen/Lounge	0.7	12	2	2	PASS
Level 05: Flat 04 - Bedroom 02	0.2	9	2	2	PASS
Level 05: Flat 04 - Bedroom 03	0	0	0	-	PASS
Level 05: Flat 04 - Bedroom 03	0.1	5	1	-	PASS
Level 05: Flat 04 - Kitchen/Lounge	1.2	19	3	2	PASS

Table 5: TM52 DSY1 results

7.0 CONCLUSIONS

Please note only the social dwellings require analysis under the overheating criteria. All private dwellings will be air conditioned, due to acoustic implications with opening windows on these apartments.

The results for each apartment as a whole can be summarised as follows:

Zone Name	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria Failing	Results
	Target <3	Target <6	Target <4		
Upper Ground: Flat 01	0.9	20.0	2.5	2	PASS
Upper Ground: Flat 02	1.2	20.0	3.0	2	PASS
Level 01: Flat 04	0.5	18.0	2.0	2	PASS
Level 01: Flat 05	0.5	15.0	2.0	2	PASS
Level 01: Flat 06	0.4	13.0	2.0	2	PASS
Level 01: Flat 07	0.8	14.3	2.7	2	PASS
Level 02: Flat 04	0.3	7.7	2.0	2	PASS
Level 02: Flat 05	0.3	7.3	2.0	2	PASS
Level 02: Flat 06	0.2	5.7	1.3	None	PASS
Level 02: Flat 07	0.2	5.7	1.3	None	PASS
Level 03: Flat 04	0.0	0.0	0.0	None	PASS
Level 03: Flat 05	0.0	0.0	0.0	None	PASS
Level 03: Flat 06	0.3	8.5	2.0	2	PASS
Level 03: Flat 07	0.2	4.3	0.7	2	PASS
Level 04: Flat 05	0.5	18.0	2.0	2	PASS
Level 04: Flat 06	0.4	13.5	2.0	2	PASS
Level 04: Flat 07	0.3	11.0	1.7	2	PASS
Level 05: Flat 01	0.5	18.0	2.0	2	PASS
Level 05: Flat 02	0.2	7.5	1.5	2	PASS
Level 05: Flat 03	0.8	15.0	3.0	2	PASS
Level 05: Flat 04	0.4	11.3	2.7	2	PASS

Table 6: Results per apartment

As the results above show all social apartments will not overheat during a moderately warm summer for the year 2020.