Method Consulting

Intelligent engineering, sustainable buildings

10-12 Cave Street

Thermal Comfort Analysis

Rengen Limmer Cave Ltd

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Document History

This document has been revised and issued as below:

Revision	Date	Description	Created by	Approved by
P01	30/11/22	Thermal Comfort Report	MXP	RDM
P02	05/12/22	Updated following comments	MXP	KPM
P03	12/01/23	Updated following BCC comments	MXP	DMS
P04	15/02/23	Updated following comments	MXP	DMS
P05	23/02/24	Updated to address planning pre-commencement conditions	DMS	MAS

Executive Summary

A Thermal Comfort Analysis was performed for the proposed site, 10-12 Cave Street, on behalf of the client, Atlas Hive 2 Limited.

The development is an existing building located in St Paul’s, Bristol that is being converted into new studio apartments for student accommodation. The building is Grade II listed, meaning that limited alterations can be made without altering the building’s character. However, adequate measures were taken where possible to comply with the thermal comfort requirements as set out in CIBSE Technical Memorandum 59 (TM59).

Based on the assumptions and methodology adopted, the site was modelled using dynamic simulation software with the following results:

- The building complies with the mandatory thermal comfort requirements as set out in CIBSE TM59 “*Design methodology for the assessment of overheating risk in homes*” for the current weather file, demonstrating the building should cope under predicted climate change up to the year 2040.
- All studio apartments comply with Criterion 1 of CIBSE TM59 for the current and future weather files.
- Majority of studio apartments additionally pass Criterion 2 of CIBSE TM59 for the 2050 weather file, with only four ground floor and basement studio flats failing due to restrictions on available natural ventilation, owing to security issues, and inability to include additional window/louvre openings due to the listed building status.
- It is noted that these security restrictions could be overridden by an alternative management regime and reduced security risk in the future. However, to be conservative, 100mm restrictors were assumed on all bottom sash window panels on the ground and basement floors.
- While a higher portion of studios also do not meet CIBSE TM59 Criterion 2 requirements for the 2080 weather file, future retrofit measures such as a reversible heat pump cooling system is recommended to mitigate overheating beyond 2050, as discussed in Section 6.3.1.
- Nevertheless, design measures were included in the studios posing an overheating risk, such as lower g-value secondary glazing and maximising extract ventilation rates, to reduce overheating risk as far as possible.
- Other design measures such as use of MVHR, solar shading and thermal mass were investigated, but deemed to be either insufficient or unsuitable to gain compliance for the future weather files.
- All corridors pass non-mandatory requirements for TM59 overheating risk for both current and future weather files.

These results were achieved based on the following assumptions:

- No internal blinds were included in occupied spaces, in line with Part O restrictions.
- Natural ventilation through available operable windows, with opening profiles based on TM59 specifications, and opening angles sufficient to provide adequate ventilation to meet thermal comfort requirements, unless restricted for security reasons.
- Continuous mechanical extract ventilation maximised in kitchens, bathrooms, and utility rooms.
- Internal gains based on CIBSE TM59 specifications.
- Chosen U-values:

Construction Type	U-Value	G-Value
External Walls	2.10	-
Roof	0.14	-
Ground Floor	1.20	-
New secondary windows only (and glazed doors)	1.60	0.60
New secondary windows only in spaces posing overheating risk (and glazed doors)	1.60	0.50
Existing primary and new secondary windows (combined)	0.96*	0.46*
Existing Doors	3.00	-
New Doors	1.80	-
Air Permeability – 15 $m^3/(h.m^2)$		

**Combined U-value/g-value calculated within IES software.*

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1 Introduction

Method Consulting LLP has been appointed to carry out a thermal comfort analysis of the proposed development, 10-12 Cave Street, on behalf of the client, Atlas Hive 2 Limited.

The development is a Grade II listed building in Bristol that is being converted into new studio apartments, meaning that possible design changes to the building are limited. However, where possible, relevant measures were taken to comply with the thermal comfort requirements as set out in CIBSE Technical Memorandum 59 (TM59).

This report has been written to summarise the process undertaken and outline the results of the thermal comfort analysis, and covers the following:

- The methodology and assumptions for performing the thermal comfort analyses, in line with CIBSE TM59 guidance.
- Thermal comfort analysis for naturally ventilated and mechanically conditioned spaces using CIBSE TM59 guidance.
- Thermal comfort analysis for naturally ventilated and mechanically conditioned spaces using CIBSE Guide A and CIBSE TM52 guidance.

The following weather files have been used:

- Current: Cardiff Design Summer Year (DSY1) 2020 50% High emissions
- Future: Cardiff Design Summer Year (DSY1) 2050 50% Medium emissions
- Future: Cardiff Design Summer Year (DSY1) 2080 50% Medium emissions

2 Methodology

Analysis was carried out using the dynamic simulation software IES VE (Integrated Environmental Solutions Virtual Environment), Version 2022.1.2.0. The analysis was conducted by a qualified and competent person.

The following drawings were used to set up the model in the Virtual Environment:

- 1704-ASH-XX-ZZ-M2-A-00002 GA drawings Windows retained.dwg (Studio Hive Limited)
- 1704-ASH-XX-ZZ-M2-A-22300 Room elevations.dwg (Studio Hive Limited)
- 1704-ASH-XX-ZZ-M2-A-70100 Details.dwg (Studio Hive Limited)
- 1704-ASH-XX-ZZ-M2-A-90100 Location.dwg (Studio Hive Limited)

The development site is located in Cave Street, Bristol and contains nineteen studio apartments. For the sake of this analysis, all the studios were analysed. The constructed model is shown in Figures 2.1.1 and 2.1.2.

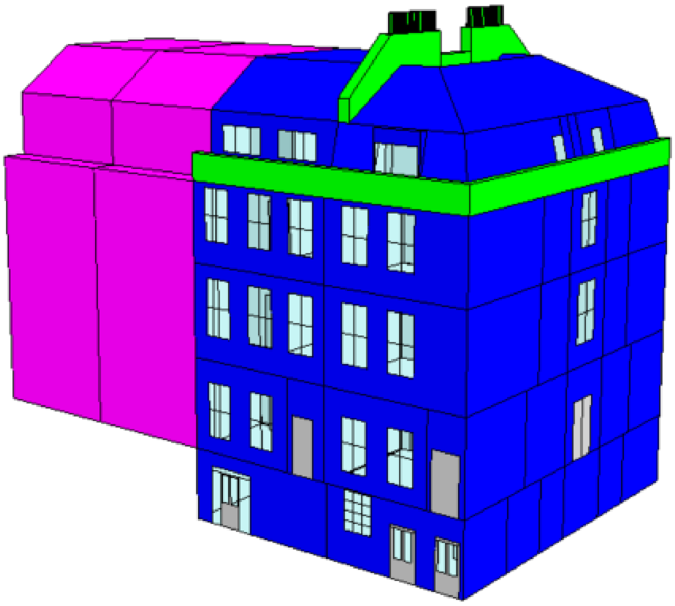

Figure 2.1.1: IES Virtual Environment Model of 10-12 Cave Street.

Figure 2.1.2: IES Virtual Environment Model of 10-12 Cave Street.

3 Assumptions

3.1 Building Fabric

3.1.1 U-Values

The u-values and g-values of the building constructions are as described in Table 3.1.1.1:

Construction Type	U-Value	G-Value
Existing External Walls	2.10	-
Roof	0.14	-
Ground Floor	1.20	-
New secondary windows only	1.60	0.60
New secondary windows only in spaces posing overheating risk	1.60	0.50
Existing primary and new secondary windows (combined)	0.96*	0.46*
Existing Doors	3.00	-
New Doors	1.80	-
Air Permeability – 15 $m^3/(h.m^2)$		

**Combined U-value/g-value calculated within IES software.*

Table 3.1.1.1: Construction U-values and G-values.

3.1.2 Thermal Mass

The thermal mass of the building constructions is as described in Table 3.1.2.1:

Element	Construction Type	Location	Thermal Mass
External Walls	Stone	All	Mediumweight
Roof	Slate tiled with insulation	All	Lightweight
Ground Floor	Concrete slab	All	Heavyweight
Floor/Ceiling	Timber joists	All	Lightweight
Internal Walls	Timber partition	All except stairs	Lightweight
Internal Walls	Solid brick	Stairs	Mediumweight

Table 3.1.2.1: 10-12 Cave Street construction types.

3.2 Ventilation Strategy

The building is naturally ventilated, with continuous mechanical extract in the kitchen, bathroom and utility areas as described below.

3.2.1 Natural Ventilation

In order to achieve sufficient natural ventilation, there were several windows and doors assumed to be operable, with their dimensions and opening angles provided in Table 3.2.1.1. These opening angles supply sufficient natural ventilation to achieve overheating requirements for all occupied spaces, for the current weather file.

As the proposed development is a listed building, there were restrictions on changes to the external façade, and therefore the introduction of additional new openings was not possible for future weather file compliance.

The bottom panels of basement and ground floor sash windows were restricted to 100 mm for security reasons, with the top panels open to 200 mm to maximise natural ventilation into the studios. Side-hung windows were restricted to 650 mm in line with Part O.

Opening No.	Opening Type	Opening Category	Dimensions (mm)	Opening Angle/Percentage
1	Window	Sash (bottom)	780x720	13%
2	Window	Sash (bottom)	1000x1000	10%
3	Window	Sash (bottom)	1120x1030	9%
4	Window	Sash (bottom)	1070x1040	9%
5	Window	Sash (bottom)	710x1110	14%
6	Window	Sash (bottom)	850x710	95%
7	Window	Sash (bottom)	Variable	95%
8	Window	Sash (bottom)	Variable	95%
9	Window	Side-hung	520x960	51°
10	Window	Side-hung	670x1100	44°
11	Window	Side-hung	690x960	43°
12	Window	Side-hung	570x960	48°
13	Window	Side-hung	320x2100	17°
14	Window	Side-hung	540x2020	10°
15	Window	Side-hung	420x2020	13°
16	Rooflight	Centre-hung	670x1060	30°
17	Rooflight	Centre-hung	750x850	35°
18	Window	Sash (top)	1110x710	28%
19	Window	Sash (top)	780x720	27%
20	Window	Sash (top)	1000x1000	20%
21	Window	Sash (top)	1070x1040	19%

Opening No.	Opening Type	Opening Category	Dimensions (mm)	Opening Angle/Percentage
22	Window	Sash (top)	1120x1030	19%
23	Window	Sash (top)	1040x1040	19%
24	Window	Sash (top)	1040x980	20%
25	Window	Sash (top)	1080x890	22%
26	Window	Sash (top)	1070x900	22%
27	Window	Sash (top)	1000x850	23%
28	Window	Sash (top)	1060x660	30%
29	All	Fixed	-	-

Table 3.2.1.1: 10-12 Cave Street opening types.

The detailed modelling assumptions of the window opening types can be found in Appendix A. All openings are manually controlled, and the following opening profiles have been assumed:

<u>All studios:</u>

- The studio windows are set to open to the restrictions specified in Table 3.2.1.1. when the internal temperature reaches 22°C or the internal CO_2 concentration reaches 1,000 ppm. These windows open throughout the day, 00:00 to 24:00.
- Communal space windows are set to open when the internal temperature reaches 25°C, throughout the day, 00:00 to 24:00.

Additionally, internal doors were included in the studios and left open from 08:00 to 23:00 when occupants are awake.

3.2.2 *Mechanical Ventilation*

Continuous mechanical extract is provided in kitchens, utility rooms and bathrooms. The ventilation rates for each space can be seen in Appendix B. Active cooling is not provided to any space. However, it is recommended as a future mitigation measure, as discussed in Section 6.3.1.

4 NCM Profiles

The Department of Communities and Local Government set up the NCM database to support the implementation of the Energy Performance of Buildings Directive. This database takes data from the BRE, CIBSE and BS/ISO standards to form templates of typical energy demand, occupancies, lighting gains, equipment gains, etc. for a range of different room and building types. These templates are used to provide data for our buildings where alternatives are not provided. See Appendix C for which NCM templates have been selected for each space.

5 Internal Gains

Please see Appendix D for lighting, occupancy and equipment gains used in the model.

6 Overheating Risk Assessment

6.1 Adaptive Thermal Comfort (CIBSE TM52)

Historically, overheating in buildings has been quantified by the number of occupied hours per year that the indoor temperature exceeds a particular temperature, irrespective of external temperatures (for as example, as per the design criteria in CIBSE Guide A). However, recent research has shown that one’s perception of comfortable room temperature alters relative to the external air temperature, meaning that occupants feel comfortable with higher room temperatures during warmer weather. This is known as Adaptive Thermal Comfort. A methodology for the assessment of Adaptive Thermal Comfort is presented in CIBSE Technical Memorandum 52 (TM52) *The Limits of Thermal Comfort: Avoiding Overheating in European Buildings*. There are three criteria for CIBSE TM52 and two out of three must be met in order to demonstrate compliance.

The TM52 assessment is based on comparison of room temperature with a maximum acceptable room temperature, which is calculated from the running mean of the outdoor temperature. The running mean used places greater weight on the temperature for days closer to the present as these have more influence on a person’s comfort temperature. The criteria are all defined in terms of ΔT, which s the difference between the actual operative temperature in the room at any time and the maximum acceptable temperature and can be summarised as follows:

Criterion 1: “Hours of Exceedance” The number of hours where $\Delta T > 1^{o}C$ should not exceed 3% of the occupied hours.

Criterion 2: "Daily Weighted Exceedance" As the extent of overheating is as important as the frequency, a value W_e is calculated which combines the frequency and severity of overheating into one number. In any one day, $W_e \leq 6$.

Criterion 3: "Upper Limit Temperature" $\Delta T \leq 4^oC$ at all times.

6.2 Overheating Risk in Homes (CIBSE TM59)

Domestic overheating is becoming an increasing problem in the UK due to factors such as climate change, increased urbanisation and construction of high-rise apartment blocks. All of these amplify high internal temperatures, causing overheating in homes, which can lead to significant discomfort and stress of occupants. CIBSE TM59 *Design Methodology for the assessment of overheating risk in homes* makes use of the principles of CIBSE TM52 as its basis and provides a design methodology for the assessment of overheating risk in homes.

Therefore, as the buildings in this project are residential in use, they should be assessed for overheating risk based on CIBSE TM59. Passing TM52 criteria is an additional achievement, and not requirement.

In order to achieve TM59 compliance, there are two criteria to be met, as stated below:

1. *For living rooms, kitchens and bedrooms*: They must meet 'criterion 1: hours of exceedance' as set out in CIBSE TM52.
2. *For bedrooms only*: During sleeping hours (22:00 to 07:00) the temperature should not exceed 26°C for more than 1% of annual hours (33 hours).

In addition to the above, the corridors should be tested for overheating by ensuring the temperature does not exceed 28°C. While this is not mandatory, if the temperature exceeds 28°C for more than 3% of the hours, it should be reported as a risk.

The following weather files have been used for this simulation:

- Cardiff Design Summer Year (DSY1) 2020 50% High emissions
- Cardiff Design Summer Year (DSY1) 2050 50% Medium emissions
- Cardiff Design Summer Year (DSY1) 2080 50% Medium emissions

While it is not required by the client to pass overheating requirements for the 2050 and 2080 weather files, the analysis was performed for both current and future weather files.

It is also not required to pass Criteria 2 and 3 of TM52 for TM59 compliance, hence the building was not assessed for adaptive thermal comfort.

6.3 Results

6.3.1 TM59 – Overheating Risk in Homes

All spaces pass CIBSE TM59 overheating requirements for the current weather file through inclusion of sufficient natural ventilation and mechanical extract ventilation provided in each studio. Additionally, for all weather files, all studios meet Criterion 1 of TM59, and all corridors pass the specified overheating requirement.

Majority of studio apartments additionally pass Criterion 2 of CIBSE TM59 for the 2050 weather file, with only four ground floor and basement studios failing due to restrictions on available natural ventilation owing to potential security issues and it being a listed building. These are: B – R.0.1, B – R.0.3, 00 – R.1.1, 00 – R.1.9.

A higher portion of the studios do not meet TM59 Criterion 2 requirements for the 2080 weather file. It is noted that the security restrictions on the ground floor and basement windows could be overridden by an alternative management regime and reduced security risk in the future. However, to provide conservative results, a worst-case scenario was assumed.

The development is a Grade ll listed building, meaning that new windows/louvres cannot be installed. Therefore, in addition to opening the bottom panels of the sash windows (to 100mm in security restricted studios) the top panels of the sash windows were assumed as openable with a 200mm restrictor. The opening of the top panel, in addition to the bottom, and inclusion of continuous mechanical extract ventilation at 18l/s in the studio kitchen areas, enabled all spaces to pass TM59 targets for the current weather file. The results can be seen in Appendix E.

Moreover, different design measures have been investigated and tested to mitigate overheating risk for the future weather files. These included increasing the ventilation rate to 30l/s, such that the duct size is not too large for the riser and ceiling void space and dropping the g-value of the secondary glazing to 0.5 in the spaces posing an overheating risk, resulting in most of the studios passing for the

2050 weather file. The only rooms which do not comply are those with window openings restricted due to security reasons, as noted above.

In order for all rooms to pass the 2050 weather file, other design measures have been considered and tested, such as increasing thermal mass via high-density plasterboard, however, this does not lead to an improvement in results due to insufficient ventilation being available in the problem apartments to remove the heat when released from the thermal mass. The inclusion of mechanical ventilation with Heat recovery (MVHR) has also been tested and did not have a substantial effect on the results, resulting in the same number of lower storey studios failing the overheating targets for the future weather files.

Recommendations for future retrofit strategies to combat the risk of overheating include the use of reversible heat pump cooling in the apartments not passing the 2050 and 2080 weather files, and the potential implementation of external shading following the application process for Listed Building Consent explained on Historic England’s website.

Reversible heat pumps could be used in the future to provide chilled water cooling to the basement and ground floor apartments failing the 2050. This could be extended to all apartments to mitigate future overheating predicted by the 2080 weather file as well.

Modern heat pumps are currently designed to utilise R32 refrigerant, which has a lower Global Warming Potential (GWP) compared to previous refrigerants used (such as R410a). However, heat pumps are currently being developed to utilise even lower GWP refrigerants such as CO_2, which has a GWP of 1.

Therefore, as all the studios currently pass TM59 requirements using the 2020 weather file without the need for additional cooling, the building will be designed to allow installation of a chilled water cooling system in the future. This will be achieved by allowing additional space within the service distribution routes for chilled water circulation pipework and an external area designated for a future air-to-water condenser to be installed. Development of this technology over the next 15 years is likely to be significant and therefore it is deemed that this will provide a higher reduction in the developments overall CO_2 emissions and energy consumption compared to increasing the ventilation rates further via larger and more energy intensive fans.

All apartments pass CIBSE TM59 for both future weather files with the addition of chilled water cooling, as shown in Appendix E. Hence, this is proposed as a suitable mitigation measure without compromising the aesthetics or existing listed building structure.

The full results are included within Appendix E for both the current (DSY1 2020) and future (DSY1 2050 and DSY1 2080) weather files.

7 Conclusion

Method Consulting LLP has been appointed to carry out a thermal comfort analysis of the proposed development, 10-12 Cave Street, on behalf of the client, Atlas Hive 2 Limited. This report has been written to summarise the process undertaken and outline the results of the thermal comfort analysis.

The development is a Grade II listed building located in Bristol that is being converted into new studio apartments, therefore, limited changes can be made. However, adequate measures were taken where possible to comply with the thermal comfort requirements as set out in CIBSE Technical Memorandum 59 (TM59).

Based on the assumptions and methodology adopted, the site was modelled using dynamic simulation software with the following results:

- The building complies with the mandatory thermal comfort requirements as set out in CIBSE TM59 "*Design methodology for the assessment of overheating risk in homes*" for the current weather file, demonstrating the building should cope under predicted climate change up to the year 2040.
- All studio apartments comply with Criterion 1 of CIBSE TM59 for the current and future weather files.
- Majority of studio apartments additionally pass Criterion 2 of CIBSE TM59 for the 2050 weather file, with only four ground floor and basement studio flats failing due to restrictions on available natural ventilation, owing to security issues, and inability to include additional window/louvre openings due to the listed building status.
- It is noted that these security restrictions could be overridden by an alternative management regime and reduced security risk in the future. However, to be conservative, 100mm restrictors were assumed on all bottom sash window panels on the ground and basement floors.
- While a higher portion of studios also do not meet TM59 Criterion 2 requirements for the 2080 weather file, future retrofit measures such as a

reversible heat pump cooling system is recommended to mitigate overheating beyond 2050.

- Nevertheless, design measures were included in the studios posing an overheating risk, such as lower g-value secondary glazing and maximising extract ventilation rates, to reduce overheating risk as far as possible.
- Other design measures such as use of MVHR, solar shading and thermal mass were investigated, but deemed to be either insufficient or unsuitable to gain compliance for the future weather files.
- All corridors pass non-mandatory requirements for TM59 overheating risk for both current and future weather files.

This was based on the following key assumptions:

- No internal blinds were included in occupied spaces, in line with Part O restrictions.
- All secondary glazing to achieve a g-value of 0.5 in the spaces posing an overheating risk and a g-value of 0.6 in all other spaces
- Natural ventilation through operable windows, with opening profiles based on TM59 specifications, and opening angles sufficient to provide adequate ventilation to meet thermal comfort requirements, unless restricted for security reasons
- Mechanical extract ventilation in kitchens, bathrooms and utility rooms
- Internal gains based on TM59 specifications

The following weather files have been used:

- Current: Cardiff Design Summer Year (DSY1) 2020 50% High emissions
- Future: Cardiff Design Summer Year (DSY1) 2050 50% Medium emissions
- Future: Cardiff Design Summer Year (DSY1) 2080 50% Medium emissions

8 Appendices

8.1 Appendix A – Detailed Window Openings

Opening No.	Opening Type	Opening Category	Location	Dimensions (m)	Opening	Colour
1	Window	Sash (bottom)	Basement	780x720	13%	
2	Window	Sash (bottom)	Ground Floor	1000x1000	10%	
3	Window	Sash (bottom)	Ground Floor	1120x1030	9%	
4	Window	Sash (bottom)	Ground Floor	1070x1040	9%	
5	Window	Sash (bottom)	Basement	710x1110	14%	
6	Window	Sash (bottom)	Stair 1	850x710	95%	
7	Window	Sash (bottom)	Stair 2	Variable	95%	
8	Window	Sash (bottom)	First/Second/ Third Floor	Variable	95%	
9	Window	Side-hung	Third Floor	520x960	51°	
10	Window	Side-hung	Third Floor	670x1100	44°	
11	Window	Side-hung	Third Floor	690x960	43°	
12	Window	Side-hung	Third Floor	570x960	48°	
13	Window	Side-hung	Basement	320x2100	17°	
14	Window	Side-hung	Basement	540x2020	10°	
15	Window	Side-hung	Basement	420x2020	13°	
16	Rooflight	Centre-hung	Third Floor	670x1060	30°	
17	Rooflight	Centre-hung	Rooftop	750x850	35°	
18	Window	Sash (top)	Basement	1110x710	28%	
19	Window	Sash (top)	Basement	780x720	27%	
20	Window	Sash (top)	Ground Floor	1000x1000	20%	
21	Window	Sash (top)	Ground Floor	1070x1040	19%	
22	Window	Sash (top)	Ground Floor	1120x1030	19%	
23	Window	Sash (top)	First Floor	1040x1040	19%	
24	Window	Sash (top)	Second Floor	1040x980	20%	
25	Window	Sash (top)	Second Floor	1080x890	22%	
26	Window	Sash (top)	Second Floor	1070x900	22%	
27	Window	Sash (top)	Second Floor	1000x850	23%	
27	Window	Sash (top)	Third Floor	1060x660	30%	
28	All	Fixed	All	-	-	

Table 8.1.1: 10-12 Cave Street Opening Types.

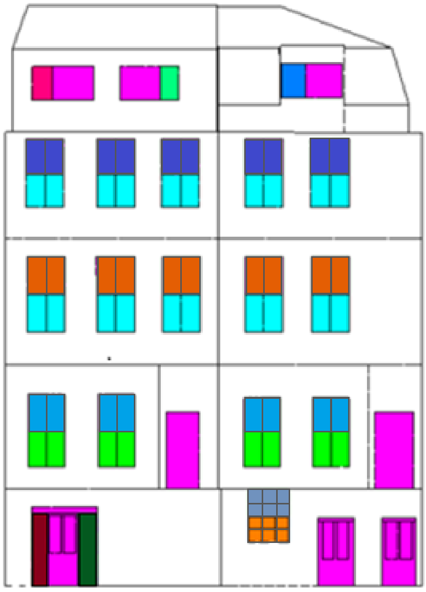

Figure 8.1.1: 10-12 Cave Street Opening Types – Front View.

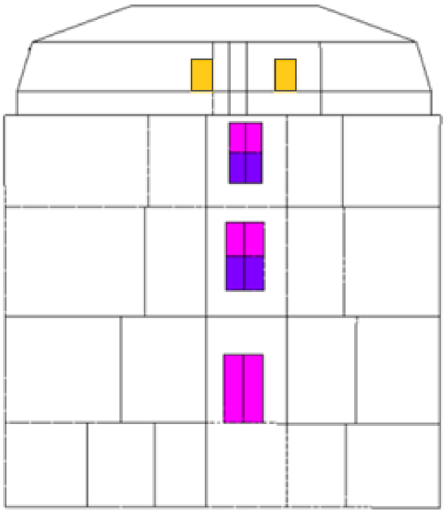

Figure 8.1.2: 10-12 Cave Street Opening Types: Side View.

Figure 8.1.3: 10-12 Cave Street Opening Types: Back View.

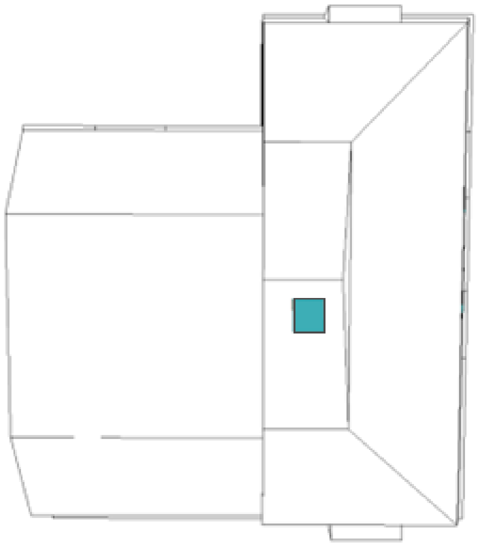

Figure 8.1.4: 10-12 Cave Street Opening Types: Top View.

8.2 Appendix B – Mechanical Ventilation Flow Rates

Space	Flow Rate (l/s)
B – R.0.4 Shower Room	8
B – R.0.6 Shower Room	8
B – R.0.2 Shower Room	8
B – Laundry Room	8
B – R.0.3 Studio	18
B – R.0.5 Studio	18
B – R.0.1 Studio	18
00 – R.1.5 Shower Room	8
00 – R.1.7 Shower Room	8
00 – R.1.2 Shower Room	8
00 – R.1.11 Shower Room	8
00 – R.1.3 Studio	18
00 – R.1.6 Studio	18
00 – R.1.1 Studio	18
00 – R.1.9 Studio	18
01 – R.2.4 Shower Room	8
01 – R.2.6 Shower Room	8
01 – R.2.2 Shower Room	8
01 – R.2.10 Shower Room	8
01 – R.2.3 Studio	18
01 – R.2.5 Studio	18
01 – R.2.1 Studio	18
01 – R.2.9 Studio	18
02 – R.3.4 Shower Room	8
02 – R.3.6 Shower Room	8
02 – R.3.2 Shower Room	8
02 – R.3.10 Shower Room	8
02 – R.3.3 Studio	18
02 – R.3.5 Studio	18
02 - R.3.1 Studio	18
02 – R.3.9 Studio	18
03 – R.4.4 Shower Room	8
03 – R.4.6 Shower Room	8
03 – R.4.2 Shower Room	8
03 – R.4.11 Shower Room	8
03 – R.4.3 Studio	18
03 – R.4.5 Studio	18
03 – R.4.1 Studio	18
03 – R.4.9 Studio	18

Table 8.2.1: Mechanical ventilation flow rates.

8.3 Appendix C – Assigned NCM Templates

Space	NCM template
Utility Spaces	Hotel: Laundry
Plant Room	Hotel: Light plant room
Studio	TM59 - Studio
Bathroom	TM59 - Bathroom
Stores	TM59 - Store
Stairs	TM59 - Stairs
Circulation	TM59 - Circulation - Corridors

Table 8.3.1: Assigned NCM Templates.

8.4 Appendix D – Internal Gains

8.4.1 Occupancy

The occupancy numbers and variations included in this model are shown in the table below. The percentage of occupancy for each of the “Occupancy Variation” time slots is also provided. The occupancy and variation profiles for the studios are provided by TM59, with the remaining rooms based on the NCM template.

Based on CIBSE Guide A, a maximum sensible heat gain of 75W/person and maximum latent heat gain of 55W/person were assumed.

Space	Max Occupancy (People)	Occupancy Variation
Studios	2	08:00-23:00 (100%**) 23:00-08:00 (70%**)
Drying/Utility Space	0.53*	From NCM Template
Plant room	2.21*	From NCM Template

Table 8.4.1.1: Occupancy numbers and variations.

* From NCM Templates
** Percentage of occupation during time period

The occupancy profiles for the TM59 spaces can also be seen in Figure 8.4.1.1.

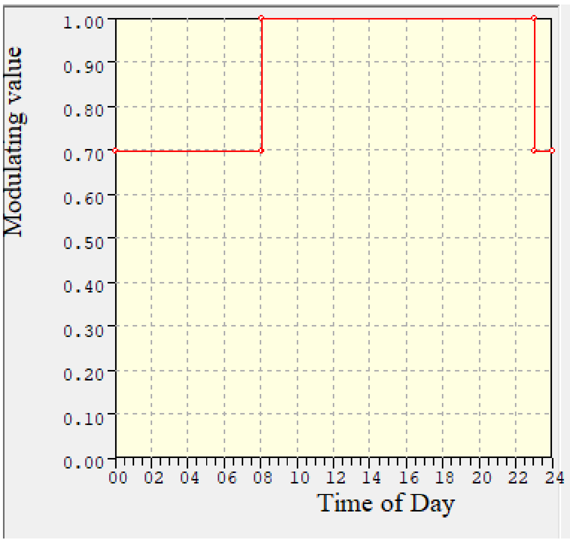

Figure 8.4.1.1: Studio occupancy variation profile.

8.4.2 Lighting

The gains from lighting for each space was provided by TM59, as shown in Table 8.4.2.1 and Figure 8.4.2.1.

Space	Lighting Gain (W/m²)	Lighting Variation
Studios	2	18:00-23:00
Bathrooms	2	
Corridors/Halls	2	
Drying/Utility space	2	
Plant room	2	

Table 8.4.2.1: Lighting gains and variations.

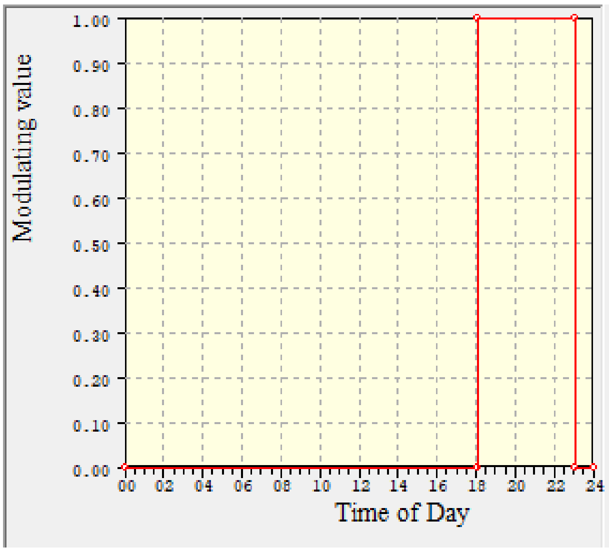

Figure 8.4.2.1: Lighting gains variation profile.

8.4.3 Equipment

The equipment gains included in the model are provided in Table 8.4.3.1. The gains and variation profiles for the studio apartments are provided by TM59, with the remaining rooms based on the NCM template.

Space	Equipment Gains (W)	Equipment Variation
Studios	450	00:00-09:00 (18.9%) 09:00-18:00 (24.4%**) 18:00-20:00 (100%**) 20:00-22:00 (44.4%**) 22:00-24:00 (24.4%**)
Bathrooms	1.75 W/m^2 *	From NCM Template
Drying/Utility Space	52.01 W/m^2 *	From NCM Template
Plant room	500	-

Table 8.4.3.1: Equipment gains and variations.

* From NCM Templates
** Percentage of equipment gain during time period

The variation profiles for the TM59 spaces can also be seen in Figure 8.4.3.1.

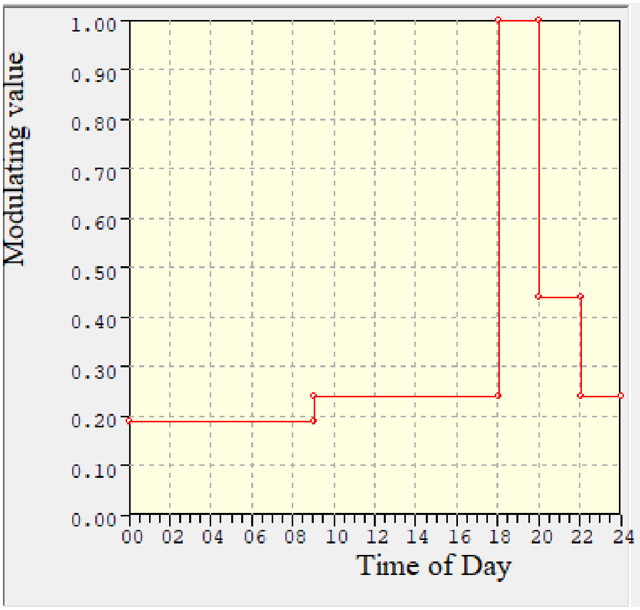

Figure 8.4.3.1: Equipment gains variation profile.

Heating pipework in corridors is constantly emitting heat, even if well-insulated. Therefore, heat gains from pipework into the corridors were calculated and taken into account, based on the TM59 guidelines. In this case, the outside pipe diameter is 28 mm.

Outside diameter of pipe (mm)	Maximum heat loss per metre run of pipe (W/m)
8	7.06
10	7.23
12	7.35
15	7.89
22	9.12
28	10.07
35	11.08
42	12.19
54	14.12

Table 8.4.3.2: TM59 guideline on outside pipe diameter and maximum heat loss.

8.5 Appendix E – TM59 Results – Current & Future Weather Files

The extract ventilation rates used for the current weather file and future weather files are 18 l/s and 30 l/s, respectively.

8.5.1 Studios overheating risk – Criterion 1 of TM59

Room Name	Percentage of occupied hours ΔT ≥ 1K (Criterion 1 – TM52) (%)		
	DSY1 2020	DSY1 2050	DSY1 2080
B – R.0.3 Studio	0.0	0.0	0.2
B – R.0.5 Studio	0.0	0.0	0.0
B – R.0.1 Studio	0.0	0.2	0.5
00 – R.1.3 Studio	0.3	0.7	1.1
00 – R.1.6 Studio	0.0	0.0	0.1
00 – R.1.1 Studio	0.0	0.2	0.5
00 – R.1.9 Studio	0.0	0.0	0.0
01 – R.2.3 Studio	0.3	0.6	1.0
01 – R.2.5 Studio	0.0	0.0	0.0
01 – R.2.1 Studio	0.0	0.2	0.4
01 – R.2.9 Studio	0.0	0.0	0.0
02 – R.3.3 Studio	0.4	0.8	1.0
02 – R.3.5 Studio	0.0	0.0	0.1
02 – R.3.1 Studio	0.0	0.2	0.5
02 – R.3.9 Studio	0.0	0.0	0.0
03 – R.4.3 Studio	0.5	0.7	1.1
03 – R.4.5 Studio	0.0	0.0	0.3
03 – R.4.1 Studio	0.0	0.2	0.4
03 – R.4.9 Studio	0.0	0.0	0.1

Table 8.5.1.1: Criterion 1 of TM59 results for living rooms, kitchens and bedrooms.

8.5.2 Bedrooms overheating risk – Criterion 2 of TM59

Room Name	Number of hours exceeding 26°C between 22:00 and 07:00		
	DSY1 2020	DSY1 2050	DSY1 2080
B – R.0.3 Studio	18	40	82
B – R.0.5 Studio	11	30	66
B – R.0.1 Studio	22	48	93
00 – R.1.3 Studio	15	32	60
00 – R.1.6 Studio	10	28	57
00 – R.1.1 Studio	15	34	67
00 – R.1.9 Studio	12	33	74
01 – R.2.3 Studio	4	13	23

Room Name	Number of hours exceeding 26°C between 22:00 and 07:00		
	DSY1 2020	DSY1 2050	DSY1 2080
01 – R.2.5 Studio	5	12	27
01 – R.2.1 Studio	6	15	32
01 – R.2.9 Studio	4	10	22
02 – R.3.3 Studio	4	13	23
02 – R.3.5 Studio	5	17	33
02 – R.3.1 Studio	6	15	33
02 – R.3.9 Studio	4	10	26
03 – R.4.3 Studio	14	26	49
03 – R.4.5 Studio	9	21	42
03 – R.4.1 Studio	11	26	47
03 – R.4.9 Studio	8	20	49

Table 8.5.2.1: Criterion 2 of TM59 results for bedrooms.

8.5.3 Corridors Overheating

Room Name	Percentage of hours exceeding 28°C (%)		
	DSY1 2020	DSY1 2050	DSY1 2080
B – Circulation	0.1	0.2	1.3
B – R.0.10 Circulation	0.0	0.0	0.3
B – R.0.8 Circulation	0.0	0.5	1.7
00 – R1.13 Circulation	0.0	0.4	1.4
00 – R1.13 Circulation	0.2	0.9	1.7
00 – R.1.10 Circulation	0.0	0.3	1.2
00 – R.1.3 Circulation	0.1	0.5	1.4
01 – R.2.13 Circulation	0.0	0.4	1.4
01 – R.2.11 Circulation	0.0	0.2	1.2
01 – R.2.8 Circulation	0.0	0.0	0.1
02 – R3.11 Circulation	0.0	0.4	1.3
02 – R.3.13 Circulation	0.0	0.5	1.4
02 – R.3.8 Circulation	0.0	0.0	0.1
03 – R.4.10 Circulation	0.0	0.2	0.7
03 – R4.8 Circulation	0.0	0.1	0.5

Table 8.5.3.1: Corridors overheating results.

8.5.4 Bedrooms Overheating – Criterion 2 of TM59 – Including Cooling

Room Name	Number of hours exceeding 26°C between 22:00 and 07:00		
	DSY1 2020	DSY1 2050	DSY1 2080
B – R.0.3 Studio	0	0	0
B – R.0.5 Studio	0	0	0
B – R.0.1 Studio	0	0	0
00 – R.1.3 Studio	0	0	0
00 – R.1.6 Studio	0	0	0
00 – R.1.1 Studio	0	0	0
00 – R.1.9 Studio	0	0	0
01 – R.2.3 Studio	0	0	0
01 – R.2.5 Studio	0	0	0
01 – R.2.1 Studio	0	0	0
01 – R.2.9 Studio	0	0	0
02 – R.3.3 Studio	0	0	0
02 – R.3.5 Studio	0	0	0
02 – R.3.1 Studio	0	0	0
02 – R.3.9 Studio	0	0	0
03 – R.4.3 Studio	0	0	0
03 – R.4.5 Studio	0	0	0
03 – R.4.1 Studio	0	0	0
03 – R.4.9 Studio	0	0	0

Table 8.5.4.1: Criterion 2 of TM59 results for bedrooms including cooling.

8.6 Appendix F – CIBSE Guide A Operative Temperatures

Building type	Winter Operative Temperatures (°C)	Summer Operative Temperatures (°C)
Bathrooms	20-22	23-25
Bedrooms	17-19	23-25
Halls/stairs/landings	19-24	21-25
Kitchen	17-19	21-25
Living Room	22-23	23-25

Table 8.6.1: CIBSE Guide A Operative Temperatures.

Method Consulting

Swindon Office
Berkeley House
Hunts Rise
Swindon SN3 4TG

Bristol Office
22-24 Queen Square
Bristol
BS1 4ND

Cornwall Office
Victoria Offices & Conference Centre
Station Approach
Victoria, St. Austell, PL26 8LG