

TECHNICAL NOTE

Yew Tree Care Home: Noise

Project	Yew Tree Care Home		
Document Number	XXX-BWB-ZZ-ZZ-RP-YA-0001_TN_S2_P01	BWB Ref	220454-TN-001
Authors	Michaela Moffatt BSc (Hons) MSc MIOA	Status	S2
Checked	Lucy Elmer BA (Hons) MSc MIOA	Revision	1.0
Approved	Dawit Abraham MSc MIOA	Date	07/03/2023

1. INTRODUCTION

1.1 BWB Consulting Ltd was appointed by Liberty Care Developments Ltd to provide an assessment to support the discharge of Planning Condition 7 associated with planning permission 134207/FO/2022. The planning permission relates to the erection of a part two, part three storey 59 bed care home facility including basement, access, landscaping and associated infrastructure following demolition of existing building at land to the north of Yew Tree Lane, Northern Moor.

1.2 Planning Condition 7 states that:

"Prior to development proceeding above damp-proof course level, a scheme for acoustically insulating the proposed residential accommodation against noise from Yew Tree Lane, Willenhall Road and the M60 shall be submitted to and approved in writing by the City Council as local planning authority. There may be other actual or potential sources of noise which require consideration on or near the site, including any local commercial/industrial premises.

The potential for overheating shall also be assessed and the noise insulation scheme shall take this into account. The approved noise insulation and ventilation scheme shall be completed before any of the dwelling units are occupied."

1.3 As such, this technical note details the impact of noise from Yew Tree Lane, Willenhall Road and the M60 informed by the proposed acoustic insulation. Noise from commercial/industrial premises is considered negligible due to the large separation distance between any such premises.

1.4 This note is intended to be read alongside the Noise Assessment (BWB Document Number: 'XXX-BWB-ZZ-ZZ-RP-YA-0001_NIA_S1_P02') dated June 2022.

2. STANDARDS & GUIDANCE

BS 8233:2014: Guidance on Sound Insulation and Noise Reduction For Buildings

- 2.1 This standard provides guidance for the control of noise in and around buildings. The guidance provided within the document is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building.
- 2.2 The guidance provided includes appropriate internal and external noise level criteria which are applicable to dwellings for steady external noise sources. It is stated that it is desirable that the internal ambient noise level does not exceed the following criteria set out in **Table 2.1**.

Table 2.1: Summary of Internal Ambient Noise Levels to be achieved in Habitable Rooms when Assessed in Accordance with BS 8233

Activity	Location	Period	
		07:00 to 23:00 Hours, i.e. Daytime	23:00 to 07:00 Hours, i.e. Night-time
Resting	Living Room	35 dB LAeq, 16 Hour	-
Dining	Dining Room/area	40 dB LAeq, 16 Hour	-
Sleeping (daytime resting)	Bedroom	35 dB LAeq, 16 Hour	30 dB LAeq, 8 Hour

- 2.3 Whilst BS 8233:2014 recognises that a guideline value may be set in terms of SEL or LA_{Fmax} for the assessment of regular individual noise events that can cause sleep disturbance during the night-time, a specific criterion is not stipulated. Accordingly, reference has been made in this assessment to the World Health Organisation (WHO) 1999: Guidelines for Community Noise.

3. BASELINE NOISE MONITORING

- 3.1 A baseline noise survey was undertaken in April 2022 in support of the planning stage noise assessment works and is fully documented in the noise assessment, which accompanied the planning submission (BWB Document Number: 'XXX-BWB-ZZ-ZZ-RP-YA-0001_NIA_S1_P02', dated June 2022).
- 3.2 The noise survey has been undertaken to determine noise levels incident on the Proposed Development Site due to the passage of road traffic on Yewtree Lane to the south, and to determine the noise level in the northern area of the Proposed Development Site. Noise Measurement Positions (NMPs) adopted during the survey are identified in **Figure 3.1**.

Figure 3.1: Baseline Noise Measurement Position



Measurement Results

- 3.3 A summary of daytime and night-time noise levels at NMP1 and NMP2 are presented in **Table 3.1** to **Table 3.4**. A full summary of the survey data is presented in **Appendix B** of the noise assessment.

Table 3.1: Summary of Measured Sound Pressure Levels at NMP1 (free-field levels)

Period	Start Time	Period (T)	dB LAeq,T	dB LA90,T ²	dB LAfmax ³
Daytime	27/04/2022 13:15	16-hours	55 ¹	49	-
Night-Time	27/04/2022 23:00	8-hours	48	41	69

¹ Logarithmic average LAeq,15mins level measured between 13:15 – 23:00 on 27/04/2022 and 07:00 – 13:15 on 28/04/2022
² arithmetic average LA90,15mins during measurement period
³ 10th Percentile LAfmax,15min noise levels during measurement period

Table 3.2: Summary of Octave Band Day & Night-time Sound Pressure Levels at NMP1

Period	Octave Band Sound Pressure Levels (Leq dB)								dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Daytime	62	56	51	51	52	45	42	38	55
Night-Time	55	48	43	43	45	40	38	34	48

Table 3.3: Summary of Measured Sound Pressure Levels at NMP2 (façade levels)

Period	Start Time	Period (T)	dB L _{Aeq,T}	dB L _{A90,T} ²	dB L _A Fmax ³
Daytime	27/04/2022 13:00	16-hours	54 ¹	50	-
Night-Time	27/04/2022 23:00	8-hours	48	42	68
¹ Logarithmic average L _{Aeq,15mins} level measured between 13:00 – 23:00 on 27/04/2022 and 07:00 – 13:00 on 28/04/2022 ² arithmetic average L _{A90,15mins} during measurement period ³ 10 th Percentile L _A Fmax,15min noise levels during measurement period					

Table 3.4: Summary of Octave Band Day & Night-time Sound Pressure Levels at NMP2

Period	Octave Band Sound Pressure Levels (L _{eq} dB)								dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Daytime	61	53	50	50	52	44	39	38	54
Night-Time	55	45	42	43	44	36	41	39	48

4. NOISE ASSESSMENT

- 4.1 Planning Condition 7 requires the submission and approval of a scheme for acoustically insulating the proposed residential accommodation against noise from Yew Tree Lane, Willenhall Road and the M60.
- 4.2 To determine suitability of the proposed noise insulation, this assessment has been informed by the results of the previous baseline noise survey and the guidance contained in BS 8233:2014.
- 4.3 The following criteria are to be met internally:
- Daytime: Living rooms/Studies/Bedrooms - 35 dB L_{Aeq,16hr}; and
 - Night-time: Bedrooms - 30 dB L_{Aeq,8hr} and 45 dB L_AFmax.

Internal Noise Levels

- 4.4 Regarding the glazing specification, it is understood that a double-glazed unit with a configuration of 4mm/20mm/4mm is proposed to achieve a R_w +C_{tr} performance of 25dB.
- 4.5 With respect to ventilation trickle vents with a D_{n,e,w} + C_{tr} performance of 32dB passive acoustic window vent or equivalent are proposed. Typical octave band performance for these elements have been provided in **Table 4.1**.

Table 4.1: Octave band specifications

Element	Type	Octave Band Reduction (dB)					
		125 Hz	250 Hz	500 Hz	1kHz	2kHz	4kHz
Glazing	4mm/12mm/ 4mm (Standard Thermal Double-Glazed Unit)	21	17	25	35	37	31
Vent	Trickle ventilation (Titon Trickle Vent)	32	32	31	33	31	31

- 4.6 The standard thermal double-glazed unit (4mm/12mm/4mm) specification is understood to be clear in accordance with Section N & L of the Building Regulations and to meet a nominal u-value of 1.4W/m²K. The double glazing is to comply to BS 6262. All external glazing to comply to BS 6206. All safety glazing must be fully marked with BS Kite Marks as appropriate. All double-glazed units below 800mm from First Floor Level to have toughened inner and outer glazing and laminated, refer to Building Regulations Part K.
- 4.7 The Titon trickle ventilation system (SF Xtra Sound Attenuator Vent Range) can come in combinations based on different sizes of inner (ventilator) and outer (canopy) to achieve a reduction up to $D_{n,e,w} (C;Ctr) = 44 (-2;-3)$ dB, when the vent is open.
- 4.8 Notwithstanding the above, it is understood that the client has taken a commercial decision on advice from the mechanical engineer on inclusion of MVHR Units to the bedrooms (approx. 10 no.) at ground floor level, which are most closest to and adjacent to the plant area, due to concerns regarding noise (with windows open) and overheating.
- 4.9 Detailed break-in calculations have been undertaken for the bedroom areas on the 3rd floor to provide a worst-case scenario. **Table 4.2** shows the resultant internal noise levels in the worst affected room.

Table 4.2: Predicted external and internal noise levels, dB

Room	Predicted External Noise Level, free field			Resultant Internal Noise Level		
	L _{Aeq,16h}	L _{Aeq,8h}	L _{Afmax}	L _{Aeq,16h}	L _{Aeq,8h}	L _{Afmax}
Bedroom	51	44	65	23	16	37

- 4.10 The results of the break-in calculations indicate that the internal criteria should be achieved in habitable rooms with the proposed acoustic insulation, as detailed in **Table 4.1**. It is considered that the criteria will also be achieved for the remaining rooms, as the internal noise levels will be similar or lower than those detailed above.

Overheating

- 4.11 Condition 7 also makes reference to overheating to be considered as part of the assessment.

4.12 An overheating assessment report has been undertaken by JJMTEC Limited (document reference; 'Northern Moor Care Home - Overheating Report (Full)', dated November 2021) in support of condition 7.

4.13 Full details of the Overheating assessment can be found appended to the rear of this report. A summary of the assessment was provided, which states that;

'The assessment was based on the windows opening at a 20°C internal air temperature (15° opening angle) and this generated a 100% pass rate throughout. In reality we feel this iteration is more realistic of the occupant use of the windows as most people tend to open the windows sooner knowing it's going to get warmer later in the day.'

4.14 Therefore, based on the results of the assessments, Condition 7 should be discharged.



CIBSE TM59 Overheating Report

**Northern Moor Care Home Development
Wythenshawe
Manchester
January 2023**

JJMTEC Ltd.
6 Northop Road
Wirral. CH45 4QD.
07747 690076
jjmtec.co.uk



OVERHEATING REPORT OF NORTHERN MOOR CARE HOME

Contents

1	Executive Summary	1
2	Introduction	2
3	Design Principles	4
4	Design Criteria	4
4.1	Air permeability	4
4.2	External Envelope	4
4.3	Glazing Specification.....	5
4.4	Weather.....	5
4.5	Site & Orientation	5
5	Reference data	6
6	Internal Gains	6
6.1	Occupancy	6
6.2	Lighting.....	7
6.3	Equipment.....	Error! Bookmark not defined.
7	Ventilation	9
7.1	Ventilation Strategies	9
7.2	Window Openings.....	Error! Bookmark not defined.
7.3	Alternative Window Openings Schedule – 20oC Opening Profile	10
8	Results.....	11
Appendix A: VS1.3 & VS2.2 Overheating Results		
Appendix B: VS1.4 Overheating Results		

Prepared by:	Signature	Date
Ben Dibb-Fuller	B Dibb-Fuller	10.02.23

Revision Record			
Rev	Date	By	Summary of Changes
01	10.02.23	BDF	
02	21.02.23	NH	MVHR Results inc. Blinds/Curtains

1 EXECUTIVE SUMMARY

This report documents the overheating analysis of Northern Moor Care Home, a care home development to be located on Wythenshawe, Manchester. The site consists of 59 apartments over 3 storeys (including ground floor) with a ground floor level containing main entrances, refuse storage, plant areas, and a hair salon. The apartments are all 1-bed, ensuite bedrooms with external window access.

All bedrooms are mechanically ventilated (either by DMEV or MVHR with boost mode) with 15° restricted windows openings in the final scenario to the majority of spaces.

CIBSE TM59 states the assessed spaces must pass the set overheating criteria against the current overheating weather file (2020s high emissions scenario, 50% percentile) however the design methodology recommends testing buildings against more extreme weather files where the design is of particular concern, such as the presence of vulnerable occupants.

The two future weather files, 2050 & 2080, have been modelled to explore how the building adapts to more extreme weather scenarios. It should be noted that these additional weather file tests are purely informative and not mandatory to pass.

The study found that increasing the flow rates from the mechanical ventilation would enable more rooms to pass the overheating criteria, culminating with 69% of the DMEV ventilation strategy bedroom spaces passing, and 60% of bedrooms with the MVHR ventilation strategy passing with the largest mechanical flow rates modelled.

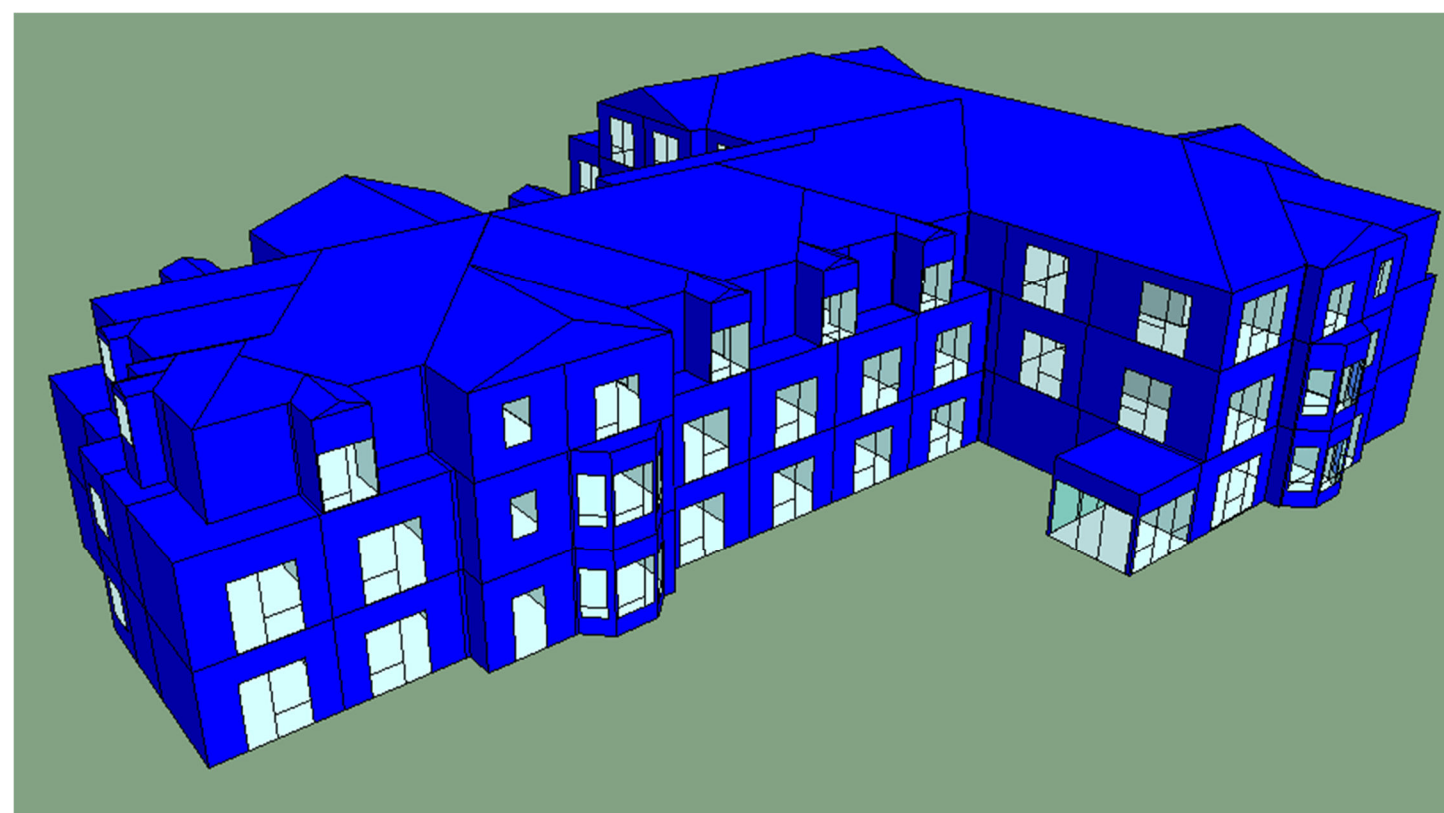
A further option, which should be noted does not comply with TM59 calculation methodology, whereby the windows are modelled to open when internal temperatures reach 20°C (as opposed to 22°C stipulated in CIBSE TM59 document). This option found all DMEV assessed spaces to pass the criteria 100%.

Although the regulations do not permit the use of blinds and curtains in the calculations, if the sun shines directly into a living space, the occupant should consider closing the curtains or blinds to limit solar gains and try and keep rooms as cool as possible.

An additional set of results for bedrooms with MVHR units and closed windows was assessed with blinds/curtains included and this demonstrated that all associated MVHR spaces achieved the criteria with 100% pass.

Mitigating overheating will rely on the end user operation and understanding of overheating. Heat comes into the house in two ways: solar radiation from the sun, and hot air. The occupants need to limit both to prevent overheating, which requires opening/closing both the windows and curtains on the warmest days to achieve overheating control.

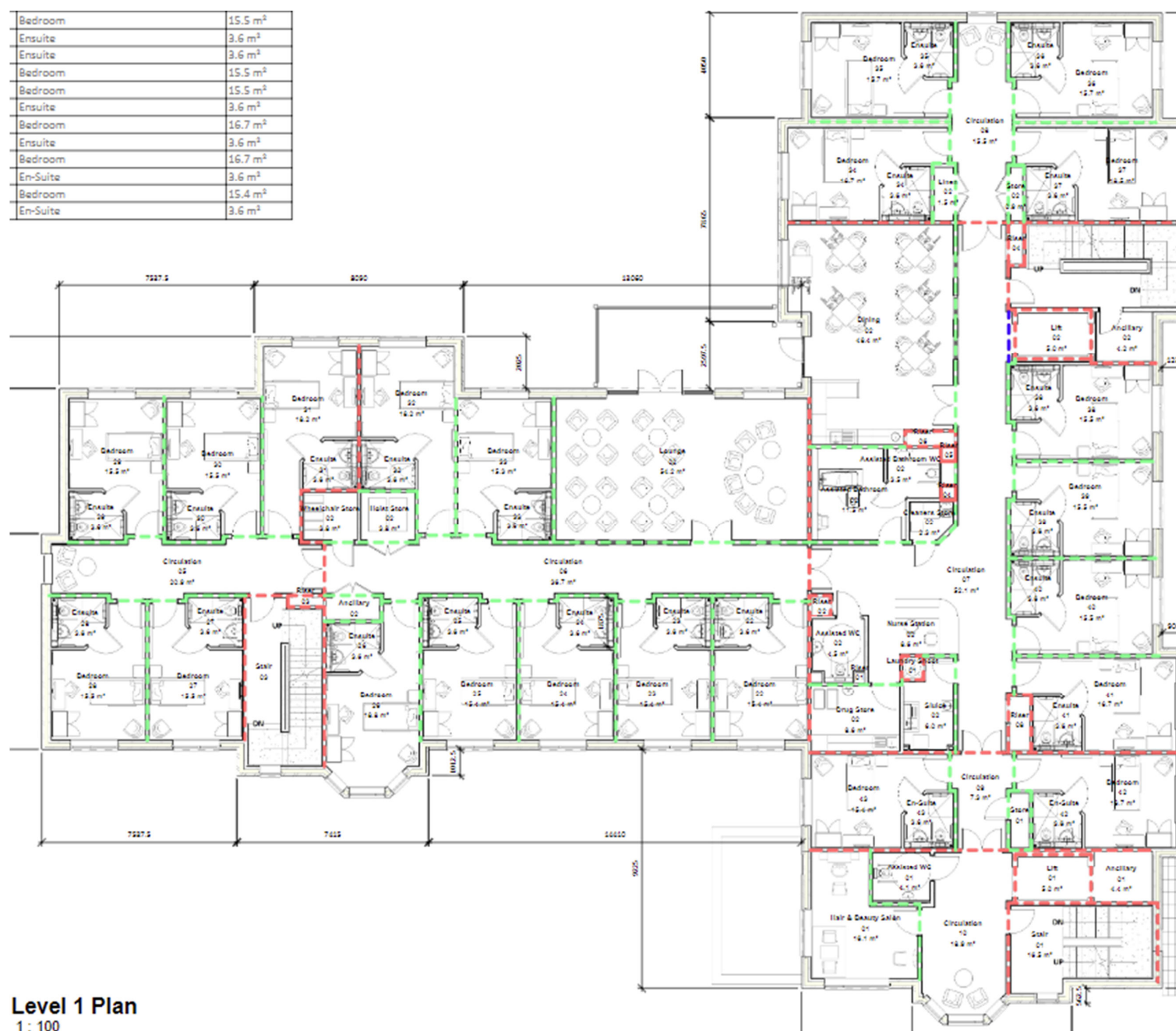
Communal corridors are not a heightened risk of overheating with none of them exceeding 28°C for more than 3% of the total annual hours.



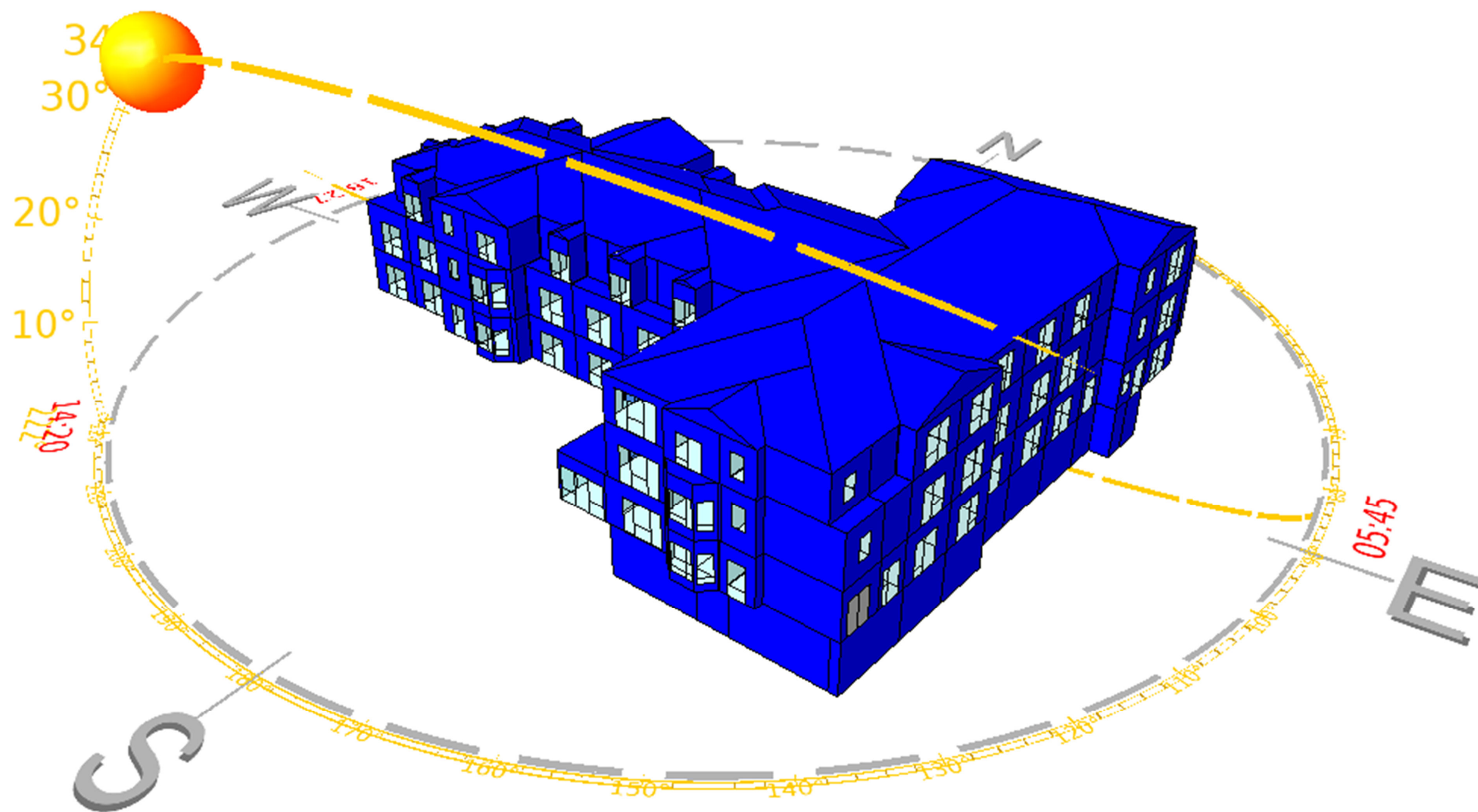
2 INTRODUCTION

The apartment layouts are similar throughout each floorplate. Communal corridors, stairwells, and lifts provide access to the apartments on each floor. Heating and domestic hot water are provided by a communal system connected to individual heat interface units in each apartment.

The analyses are to be carried out using IES Virtual Environment 2022 compliance version 1.1.0 and in line with CIBSE AM11 Building energy and environmental modelling.



Sample floor layouts



Building model

3 DESIGN PRINCIPLES

The apartments will be assessed against the following criteria:-

Predominantly naturally ventilated spaces

1. 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% of occupied hours.
2. For bedrooms only: the operative temperature from 10pm to 7am shall not exceed 26°C for more than 1% of annual hours (32 hours per annum).

Bedrooms must pass both criteria.

Corridors

Corridors are assessed on the number of annual hours the operative temperature of 28°C is exceeded. Whilst not mandatory, if the temperature is exceeded for more than 3% of the total annual hours this is considered a significant risk.

4 DESIGN CRITERIA

The following general criteria have been used throughout the simulation:-

4.1 AIR PERMEABILITY

An air infiltration rate of 0.25ACH has been applied to the apartments based on Table 4.24 of CIBSE Guide A.

4.2 EXTERNAL ENVELOPE

The following U-values have been used:-

Element	Proposed U-value (W/m ² K)	Part L1A U-value (W/m ² K)
External walls	0.20	0.30
Exposed floor	0.10	0.25
Roof (Pitched / flat)	0.15 / 0.20	0.20
Glazing	1.40	2.00

Building envelope U-values

4.3 GLAZING SPECIFICATION

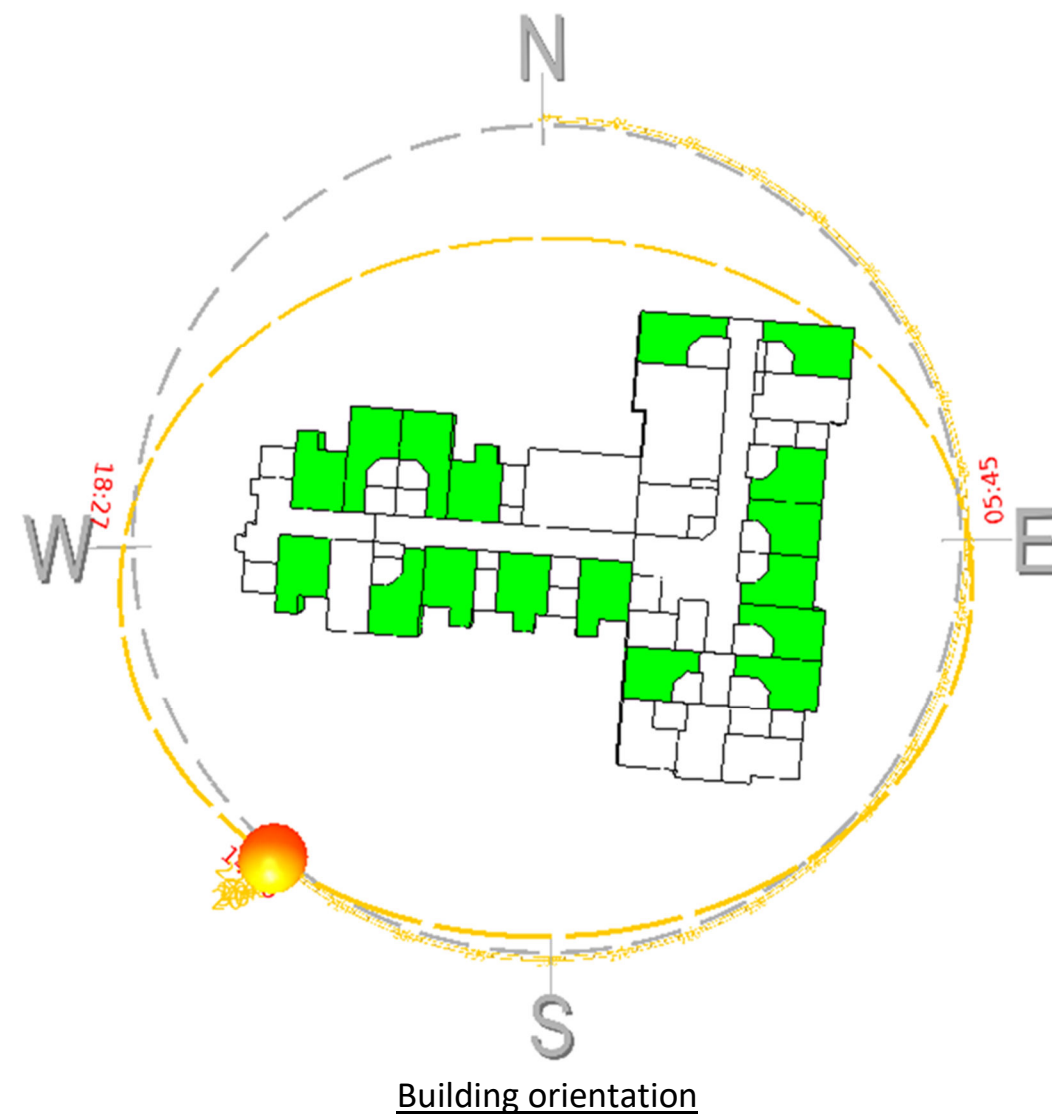
The glazing is based on a G-value of 0.40.

4.4 WEATHER

The building is to be located in Manchester. Weather file used in the calculation:- **Manchester_DSY1_2020High50_.epw** The peak summer temperature is 30.0°C.

4.5 SITE & ORIENTATION

The building has been modelled in the orientation represented by the image below. Adjacent buildings have been modelled as they may provide useful shading.



5 REFERENCE DATA

Architectural (C Squared Architects)

Basement	L0206-CSQ-XX-B1-DR-A-219
Ground Floor	L0206-CSQ-XX-00-DR-A-220
First Floor	L0206-CSQ-XX-01-DR-A-221
Second Floor	L0206-CSQ-XX-02-DR-A-222
North & South Elevation	L0206-CSQ-XX-ZZ-DR-A-225-P1
East & West Elevation	L0206-CSQ-XX-ZZ-DR-A-226-P1

6 INTERNAL GAINS

The internal gains used throughout the simulations are detailed below. No differences between weekdays and weekends are considered. Bedrooms are set with a 24 hour occupancy profile which means that one person is always considered in each bedroom during the daytime and two people in each double bedroom at night. Kitchen/living rooms are unoccupied during sleeping hours and occupied during the rest of the day. Occupied periods are totalled as 3672 hours per year for bedrooms (24/7 May to September) and 1989 hours for living areas (13 hours per day May to September).

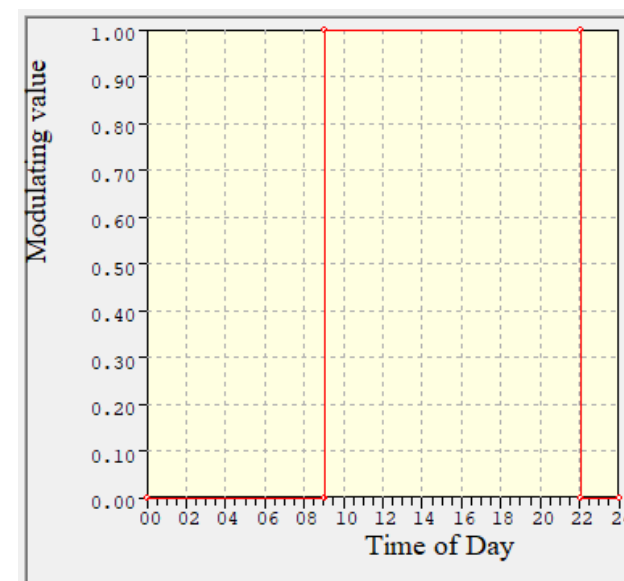
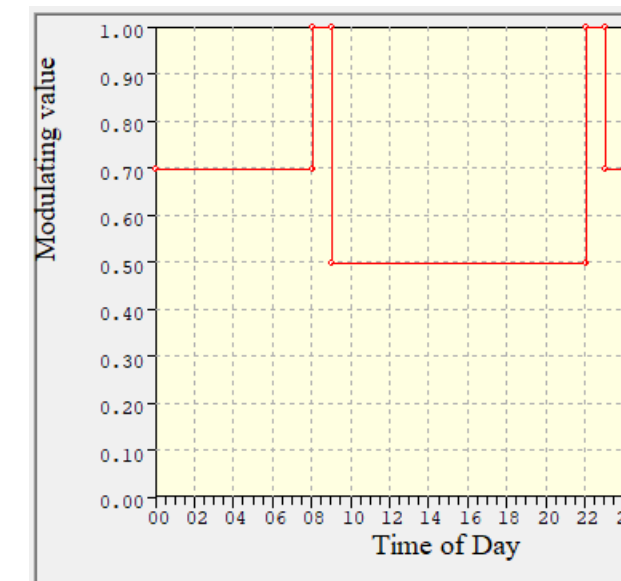
6.1 OCCUPANCY

Based on CIBSE Guide A (2015a), a maximum sensible heat gain of 75W/person is assumed in the living spaces. An allowance for 30% reduced gain during sleeping is based on Addendum g to ANSI/ASHRAE Standard 55-2010.

Activity	Sensible heat gain per person (W)
Standard	75
Sleeping	52.5

Occupant Gains

Unit/room type	Occupancy
~~1 bed living/kitchen~~	~~1 person from 9am to 10pm room is unoccupied for the rest of the day~~
~~2 bed living/kitchen~~	~~2 people from 9am to 10pm room is unoccupied for the rest of the day~~
~~3 bed living/kitchen~~	~~3 people from 9am to 10pm room is unoccupied for the rest of the day~~
~~Double bedroom~~	~~2 people at 70% gain from 11pm to 8am 2 people at full gain from 8am to 9am and from 10pm to 11pm 1 person at full gain from 9am to 10pm~~
~~Single bedroom~~	~~1 person at 70% gain from 11pm to 8am 1 person at full gain from 8am to 11pm~~
Communal corridors	Assumed to be zero

OccupancyTypical living/kitchen occupancy profileTypical double bedroom occupancy profile

6.2 LIGHTING

Lighting energy is assumed to be proportional to floor area. A default value of 2W/m² is applied to all occupied areas from 6pm to 11 pm. It is assumed that the communal corridors will have their lighting controlled by PIR detectors so no gain is applied.

Zone Type	Gain (W/m ²)
Studios, living/kitchen/dining areas, bedrooms	2
Corridors	0

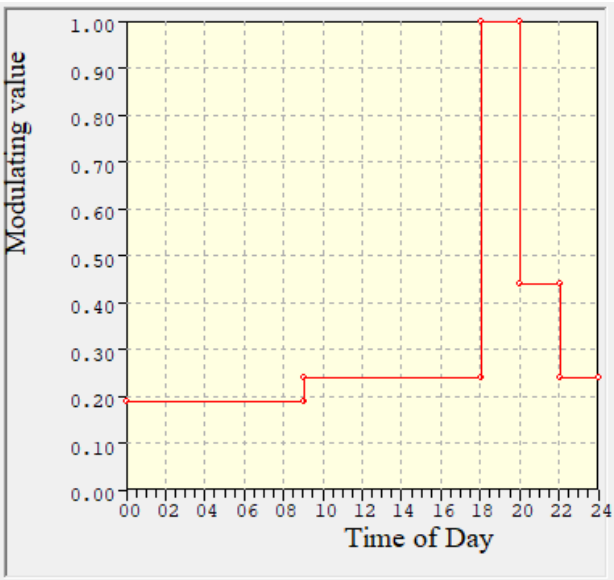
Lighting gains

6.3 EQUIPMENT

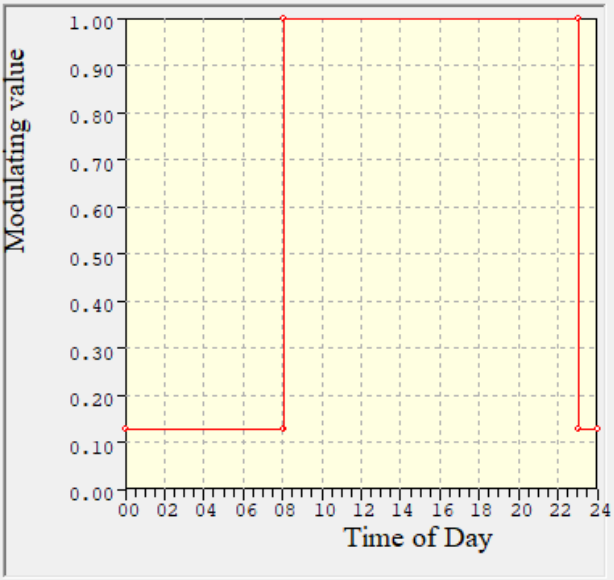
Equipment gains per room type are listed in the table below.

Unit/room type	Load
1 bed living/kitchen	Peak load of 450W from 6pm to 8pm 200W from 8pm to 10pm 110W from 9am to 6pm and 10pm to 12pm Base load of 85W for the rest of the day
2 bed living/kitchen	Peak load of 450W from 6pm to 8pm 200W from 8pm to 10pm 110W from 9am to 6pm and 10pm to 12pm Base load of 85W for the rest of the day
3 bed living/kitchen	Peak load of 450W from 6pm to 8pm 200W from 8pm to 10pm 110W from 9am to 6pm and 10pm to 12pm Base load of 85W for the rest of the day
Double bedroom	Peak load of 80W from 8am to 11pm Base load of 10W during sleeping hours
Single bedroom	Peak load of 80W from 8am to 11pm Base load of 10W during sleeping hours
Communal corridors	Assumed to be zero

Equipment gains



Typical living/kitchen equipment profile



Typical bedroom equipment profile

7 VENTILATION

7.1 NATURAL STRATEGIES

There are two core ventilation strategies to bedroom spaces of the development, each of which have variants to assess against the overheating criteria.

Ventilation Strategy 1 – DMEV (Extract Only) – Majority of Bedrooms

- VS1.1 – Closed window – continuous trickle vent @ 6 l/s (0.4 ACH)
- VS1.2 – Closed window – continuous trickle vent @ 10 l/s (1.0 ACH)
- VS1.3 – Open window (15°) – continuous trickle vent @ 6 l/s (0.4 ACH)
- VS1.4 – Open window (15°) @ 20°C – continuous trickle vent @ 6 l/s (0.4 ACH)

Ventilation Strategy 2 – MVHR Unit (Supply & Extract) – Specific Bedrooms Only

- VS2.1 – Closed window – continuous trickle vent @ 6 l/s (0.4 ACH) - Boosted to 20 l/s (2.0 ACH)
- VS2.2 – Closed window – continuous trickle vent @ 6 l/s (0.4 ACH) - Boosted to 30 l/s (3.0 ACH)
- VS2.3 – Closed window/curtains – continuous trickle vent @ 6 l/s (0.4 ACH) - Boosted to 30 l/s (3.0 ACH)

Ventilation Strategy 1 is the most common within the development, whereas strategy 2 is only applicable to specific rooms only (Bedrooms 14-17, 34-37 & 53-54) where acoustic performance may require the presence of MVHR units – see appendix for GA floor plans depicting room name tags.



Typical Window Schedule for Bedrooms of the Northern Moor Care Home Development

7.2 WINDOW OPENINGS

The typical window types found across the development have been summarised. The opening angle has is 15° **(in simulation VS1.3 & VS1.4 only)**.

The windows have been modelled using an opening profile that simulates the occupants within the rooms opening the windows when the internal air temperature reaches 22°C. The window opening percentage then increases until its fully open (to the maximum percentage area listed above) at 26°C. The same procedure operates in reverse as the air temperature cools.

7.3 ALTERNATIVE WINDOW OPENING SCHEDULE – 20°C OPENING PROFILE

An additional assessment has been undertaken whereby the windows have been modelled to be opened when internal temperatures surpassed 20°C – as opposed to 22°C threshold stipulated by TM59 guidance.

It should be noted that this opening schedule does not comply with TM59 guidance and is purely for comparative purposes when reported against the assessment criteria.

The results of this study can be found at the foot of the results.

8 RESULTS

A full set of results can be found in appendices A & B.

The Summary tab provides an overview which combines both the results of Criterion A & B. To achieve a pass under Criterion A the column labelled “% Occupied hours $\Delta T \geq 1^\circ K$ ” should not be more than 3% for both living spaces and bedrooms. In addition, the bedrooms should not exceed a value of 32 under Criterion B for the column labelled “Total hours $> 26^\circ C$ ” which represents 1% of the total occupied hours. A summary of the results can be found in the tables below.

TM59 Overheating Analysis – 2020 Weather File

Ventilation Strategy	Number of Assessed Spaces	Number of Rooms Passing	Number of Rooms Failing	Number of Rooms Passing (%)
VS1.1	49	0	49	0%
VS1.2	49	2	47	4%
VS1.3	49	34	15	69%
VS1.4	49	49	0	100%
VS2.1	10	0	10	0%
VS2.2	10	6	4	60%
VS2.3	10	10	0	100%

[See Appendix A](#)

[See Appendix B](#)

[See Appendix A](#)

[See Appendix B](#)

TM59 Overheating Analysis – 2050 Weather File

Ventilation Strategy	Number of Assessed Spaces	Number of Rooms Passing	Number of Rooms Failing	Number of Rooms Passing (%)
VS1.1	49	0	49	0%
VS1.2	49	0	49	0%
VS1.3	49	15	34	31%
VS2.1	10	0	10	0%
VS2.2	10	1	9	10%

[See Appendix A](#)

[See Appendix A](#)

TM59 Overheating Analysis – 2080 Weather File

Ventilation Strategy	Number of Assessed Spaces	Number of Rooms Passing	Number of Rooms Failing	Number of Rooms Passing (%)
VS1.1	49	0	49	0%
VS1.2	49	0	49	0%
VS1.3	49	1	48	2%
VS2.1	10	0	10	0%
VS2.2	10	0	10	0%

[See Appendix A](#)

[See Appendix A](#)

Communal corridors

The result should not exceed a value of 3 under the column labelled “% Annual hours $> 28^\circ C$ ”.

No corridors are an overheating risk under the 2020 weather file.

8.1 APPENDIX A – VS1.3 & VS2.2 OVERHEATING RESULTS

 DMEV Spaces
 MVHR Spaces

VS1.3 – DMEV - 2020 Weather File – Bedrooms

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 01	3.2%	FAIL	4	0.1%	PASS	FAIL
Bedroom 02	3.4%	FAIL	4	0.1%	PASS	FAIL
Bedroom 03	3.6%	FAIL	4	0.1%	PASS	FAIL
Bedroom 04	3.4%	FAIL	4	0.1%	PASS	FAIL
Bedroom 05	3.6%	FAIL	4	0.1%	PASS	FAIL
Bedroom 06	3.7%	FAIL	4	0.1%	PASS	FAIL
Bedroom 07	3.4%	FAIL	5	0.2%	PASS	FAIL
Bedroom 08	2.3%	PASS	4	0.1%	PASS	PASS
Bedroom 09	2.3%	PASS	4	0.1%	PASS	PASS
Bedroom 10	1.7%	PASS	4	0.1%	PASS	PASS
Bedroom 11	1.7%	PASS	4	0.1%	PASS	PASS
Bedroom 12	2%	PASS	4	0.1%	PASS	PASS
Bedroom 18	1.7%	PASS	0	0.0%	PASS	PASS
Bedroom 19	1.8%	PASS	2	0.1%	PASS	PASS
Bedroom 20	1.7%	PASS	2	0.1%	PASS	PASS
Bedroom 21	1.3%	PASS	2	0.1%	PASS	PASS
Bedroom 22	3.2%	FAIL	4	0.1%	PASS	FAIL
Bedroom 23	3.1%	FAIL	4	0.1%	PASS	FAIL
Bedroom 24	3.1%	FAIL	4	0.1%	PASS	FAIL
Bedroom 25	3.4%	FAIL	4	0.1%	PASS	FAIL
Bedroom 26	3.7%	FAIL	4	0.1%	PASS	FAIL
Bedroom 27	2.8%	PASS	2	0.1%	PASS	PASS
Bedroom 28	3%	FAIL	5	0.2%	PASS	FAIL
Bedroom 29	1.9%	PASS	4	0.1%	PASS	PASS
Bedroom 30	2.2%	PASS	4	0.1%	PASS	PASS
Bedroom 31	1.8%	PASS	4	0.1%	PASS	PASS
Bedroom 32	1.7%	PASS	4	0.1%	PASS	PASS
Bedroom 33	1.9%	PASS	4	0.1%	PASS	PASS
Bedroom 38	2.5%	PASS	4	0.1%	PASS	PASS
Bedroom 39	2.5%	PASS	4	0.1%	PASS	PASS
Bedroom 40	2.4%	PASS	4	0.1%	PASS	PASS
Bedroom 41	2.3%	PASS	0	0.0%	PASS	PASS
Bedroom 42	1.3%	PASS	0	0.0%	PASS	PASS
Bedroom 43	3.3%	FAIL	0	0.0%	PASS	FAIL
Bedroom 44	1%	PASS	0	0.0%	PASS	PASS
Bedroom 45	1.3%	PASS	0	0.0%	PASS	PASS
Bedroom 46	1.4%	PASS	2	0.1%	PASS	PASS

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 47	1.6%	PASS	0	0.0%	PASS	PASS
Bedroom 48	1.3%	PASS	0	0.0%	PASS	PASS
Bedroom 49	0.7%	PASS	0	0.0%	PASS	PASS
Bedroom 50	0.9%	PASS	0	0.0%	PASS	PASS
Bedroom 51	0.8%	PASS	0	0.0%	PASS	PASS
Bedroom 52	0.7%	PASS	4	0.1%	PASS	PASS
Bedroom 55	1.4%	PASS	0	0.0%	PASS	PASS
Bedroom 56	1.6%	PASS	1	0.0%	PASS	PASS
Bedroom 57	1.6%	PASS	0	0.0%	PASS	PASS
Bedroom 58	1.4%	PASS	1	0.0%	PASS	PASS
Bedroom 59	1.3%	PASS	0	0.0%	PASS	PASS
Bedroom 60	3.4%	FAIL	0	0.0%	PASS	FAIL

V2.2 – MVHR - 2020 Weather File – Bedrooms

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 14	3.7%	FAIL	2	0.1%	PASS	FAIL
Bedroom 15	3.6%	FAIL	4	0.1%	PASS	FAIL
Bedroom 16	2.1%	PASS	2	0.1%	PASS	PASS
Bedroom 17	1.6%	PASS	2	0.1%	PASS	PASS
Bedroom 34	3.7%	FAIL	2	0.1%	PASS	FAIL
Bedroom 35	3.5%	FAIL	4	0.1%	PASS	FAIL
Bedroom 36	2%	PASS	2	0.1%	PASS	PASS
Bedroom 37	1.7%	PASS	4	0.1%	PASS	PASS
Bedroom 53	2.9%	PASS	1	0.0%	PASS	PASS
Bedroom 54	1%	PASS	0	0.0%	PASS	PASS

Communal Corridors

Location	Number of Hours where 28°C is exceeded	Annual hours > 28°C	Status
Circulation 01	255	2.9%	PASS
Circulation 02	4	0%	PASS
Circulation 03	0	0%	PASS
Circulation 04	239	2.7%	PASS
Circulation 05	225	2.6%	PASS
Circulation 06	0	0%	PASS
Circulation 07	0	0%	PASS
Circulation 08	154	2%	PASS
Circulation 09	0	0%	PASS
Circulation 11	0	0%	PASS
Circulation 12	0	0%	PASS
Circulation 13	0	0%	PASS
Circulation 15	0	0%	PASS

 DMEV Spaces
 MVHR Spaces

V1.3 – DMEV - 2050 Weather File – Bedrooms

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 01	5.7%	FAIL	20	0.6%	PASS	FAIL
Bedroom 02	6.4%	FAIL	20	0.6%	PASS	FAIL
Bedroom 03	6.7%	FAIL	21	0.6%	PASS	FAIL
Bedroom 04	6.5%	FAIL	21	0.6%	PASS	FAIL
Bedroom 05	6.5%	FAIL	21	0.6%	PASS	FAIL
Bedroom 06	6.6%	FAIL	20	0.6%	PASS	FAIL
Bedroom 07	6.4%	FAIL	25	0.8%	PASS	FAIL
Bedroom 08	4.4%	FAIL	22	0.7%	PASS	FAIL
Bedroom 09	4.5%	FAIL	21	0.6%	PASS	FAIL
Bedroom 10	3.3%	FAIL	21	0.6%	PASS	FAIL
Bedroom 11	3.4%	FAIL	19	0.6%	PASS	FAIL
Bedroom 12	4.2%	FAIL	18	0.5%	PASS	FAIL
Bedroom 18	3.4%	FAIL	6	0.2%	PASS	FAIL
Bedroom 19	3.4%	FAIL	9	0.3%	PASS	FAIL
Bedroom 20	3.2%	FAIL	9	0.3%	PASS	FAIL
Bedroom 21	2.6%	PASS	9	0.3%	PASS	PASS
Bedroom 22	5.9%	FAIL	19	0.6%	PASS	FAIL
Bedroom 23	5.8%	FAIL	16	0.5%	PASS	FAIL
Bedroom 24	5.8%	FAIL	16	0.5%	PASS	FAIL
Bedroom 25	6.1%	FAIL	23	0.7%	PASS	FAIL
Bedroom 26	6.3%	FAIL	23	0.7%	PASS	FAIL
Bedroom 27	5%	FAIL	10	0.3%	PASS	FAIL
Bedroom 28	5.7%	FAIL	22	0.7%	PASS	FAIL
Bedroom 29	3.8%	FAIL	17	0.5%	PASS	FAIL
Bedroom 30	4.4%	FAIL	20	0.6%	PASS	FAIL
Bedroom 31	3.3%	FAIL	22	0.7%	PASS	FAIL
Bedroom 32	3.2%	FAIL	20	0.6%	PASS	FAIL
Bedroom 33	4%	FAIL	18	0.5%	PASS	FAIL
Bedroom 38	5.3%	FAIL	19	0.6%	PASS	FAIL
Bedroom 39	5.3%	FAIL	22	0.7%	PASS	FAIL
Bedroom 40	5%	FAIL	22	0.7%	PASS	FAIL
Bedroom 41	4.8%	FAIL	22	0.7%	PASS	FAIL
Bedroom 42	2.2%	PASS	6	0.2%	PASS	PASS
Bedroom 43	4.6%	FAIL	6	0.2%	PASS	FAIL
Bedroom 44	2%	PASS	6	0.2%	PASS	PASS
Bedroom 45	2.1%	PASS	6	0.2%	PASS	PASS
Bedroom 46	2.1%	PASS	6	0.2%	PASS	PASS
Bedroom 47	2.7%	PASS	11	0.3%	PASS	PASS
Bedroom 48	2.1%	PASS	6	0.2%	PASS	PASS

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 49	1.6%	PASS	5	0.2%	PASS	PASS
Bedroom 50	1.8%	PASS	6	0.2%	PASS	PASS
Bedroom 51	1.8%	PASS	6	0.2%	PASS	PASS
Bedroom 52	1.3%	PASS	5	0.2%	PASS	PASS
Bedroom 55	2.6%	PASS	6	0.2%	PASS	PASS
Bedroom 56	2.9%	PASS	7	0.2%	PASS	PASS
Bedroom 57	3%	FAIL	6	0.2%	PASS	FAIL
Bedroom 58	2.8%	PASS	6	0.2%	PASS	PASS
Bedroom 59	2.2%	PASS	6	0.2%	PASS	PASS
Bedroom 60	4.6%	FAIL	6	0.2%	PASS	FAIL

V2.2 – MVHR - 2050 Weather File – Bedrooms

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 14	5.5%	FAIL	18	0.5%	PASS	FAIL
Bedroom 15	5.7%	FAIL	23	0.7%	PASS	FAIL
Bedroom 16	4.4%	FAIL	18	0.5%	PASS	FAIL
Bedroom 17	3.3%	FAIL	16	0.5%	PASS	FAIL
Bedroom 34	5.4%	FAIL	17	0.5%	PASS	FAIL
Bedroom 35	5.6%	FAIL	23	0.7%	PASS	FAIL
Bedroom 36	3.6%	FAIL	18	0.5%	PASS	FAIL
Bedroom 37	3.2%	FAIL	15	0.5%	PASS	FAIL
Bedroom 53	4.5%	FAIL	9	0.3%	PASS	FAIL
Bedroom 54	2%	PASS	6	0.2%	PASS	PASS

Communal Corridors

Location	Number of Hours where 28°C is exceeded	Annual hours > 28°C	Status
Circulation 01	1144	13%	FAIL
Circulation 02	81	1%	PASS
Circulation 03	0	0%	PASS
Circulation 04	898	10%	FAIL
Circulation 05	512	6%	FAIL
Circulation 06	0	0%	PASS
Circulation 07	0	0%	PASS
Circulation 08	416	5%	FAIL
Circulation 09	0	0%	PASS
Circulation 11	0	0%	PASS
Circulation 12	0	0%	PASS
Circulation 13	0	0%	PASS
Circulation 15	0	0%	PASS

 DMEV Spaces
 MVHR Spaces

VS1.3 – DMEV - 2080 Weather File - Bedrooms

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 01	9%	FAIL	60	1.8%	FAIL	FAIL
Bedroom 02	9.7%	FAIL	63	1.9%	FAIL	FAIL
Bedroom 03	10%	FAIL	65	2.0%	FAIL	FAIL
Bedroom 04	9.9%	FAIL	67	2.0%	FAIL	FAIL
Bedroom 05	9.8%	FAIL	68	2.1%	FAIL	FAIL
Bedroom 06	9.9%	FAIL	57	1.7%	FAIL	FAIL
Bedroom 07	9.8%	FAIL	73	2.2%	FAIL	FAIL
Bedroom 08	7.6%	FAIL	63	1.9%	FAIL	FAIL
Bedroom 09	7.8%	FAIL	62	1.9%	FAIL	FAIL
Bedroom 10	6.5%	FAIL	64	1.9%	FAIL	FAIL
Bedroom 11	6.5%	FAIL	62	1.9%	FAIL	FAIL
Bedroom 12	7%	FAIL	59	1.8%	FAIL	FAIL
Bedroom 18	6.4%	FAIL	33	1.0%	PASS	FAIL
Bedroom 19	6.4%	FAIL	41	1.2%	FAIL	FAIL
Bedroom 20	6.2%	FAIL	38	1.2%	FAIL	FAIL
Bedroom 21	5.6%	FAIL	38	1.2%	FAIL	FAIL
Bedroom 22	9%	FAIL	61	1.9%	FAIL	FAIL
Bedroom 23	8.8%	FAIL	56	1.7%	FAIL	FAIL
Bedroom 24	8.9%	FAIL	55	1.7%	FAIL	FAIL
Bedroom 25	9.8%	FAIL	65	2.0%	FAIL	FAIL
Bedroom 26	9.7%	FAIL	67	2.0%	FAIL	FAIL
Bedroom 27	8.6%	FAIL	40	1.2%	FAIL	FAIL
Bedroom 28	8.9%	FAIL	65	2.0%	FAIL	FAIL
Bedroom 29	6.5%	FAIL	53	1.6%	FAIL	FAIL
Bedroom 30	7.3%	FAIL	61	1.9%	FAIL	FAIL
Bedroom 31	6.4%	FAIL	64	1.9%	FAIL	FAIL
Bedroom 32	6.4%	FAIL	63	1.9%	FAIL	FAIL
Bedroom 33	6.5%	FAIL	57	1.7%	FAIL	FAIL
Bedroom 38	9.3%	FAIL	59	1.8%	FAIL	FAIL
Bedroom 39	9.3%	FAIL	64	1.9%	FAIL	FAIL
Bedroom 40	9%	FAIL	64	1.9%	FAIL	FAIL
Bedroom 41	8.3%	FAIL	64	1.9%	FAIL	FAIL
Bedroom 42	5%	FAIL	34	1.0%	FAIL	FAIL
Bedroom 43	6.8%	FAIL	31	0.9%	PASS	FAIL
Bedroom 44	4.1%	FAIL	32	1.0%	PASS	FAIL
Bedroom 45	4.3%	FAIL	31	0.9%	PASS	FAIL
Bedroom 46	4.7%	FAIL	34	1.0%	FAIL	FAIL
Bedroom 47	5.4%	FAIL	42	1.3%	FAIL	FAIL
Bedroom 48	4.4%	FAIL	32	1.0%	PASS	FAIL

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 49	3.2%	FAIL	30	0.9%	PASS	FAIL
Bedroom 50	3.9%	FAIL	34	1.0%	FAIL	FAIL
Bedroom 51	4.2%	FAIL	33	1.0%	PASS	FAIL
Bedroom 52	2.9%	PASS	30	0.9%	PASS	PASS
Bedroom 55	5.5%	FAIL	32	1.0%	FAIL	FAIL
Bedroom 56	5.9%	FAIL	34	1.0%	FAIL	FAIL
Bedroom 57	5.9%	FAIL	34	1.0%	FAIL	FAIL
Bedroom 58	5.8%	FAIL	34	1.0%	FAIL	FAIL
Bedroom 59	5%	FAIL	31	0.9%	PASS	FAIL
Bedroom 60	7.1%	FAIL	31	0.9%	PASS	FAIL

VS2.2 – MVHR - 2080 Weather File - Bedrooms

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 14	8.6%	FAIL	51	1.6%	FAIL	FAIL
Bedroom 15	8.9%	FAIL	66	2.0%	FAIL	FAIL
Bedroom 16	8.1%	FAIL	53	1.6%	FAIL	FAIL
Bedroom 17	6.8%	FAIL	50	1.5%	FAIL	FAIL
Bedroom 34	8.5%	FAIL	49	1.5%	FAIL	FAIL
Bedroom 35	8.6%	FAIL	67	2.0%	FAIL	FAIL
Bedroom 36	7.2%	FAIL	53	1.6%	FAIL	FAIL
Bedroom 37	6.8%	FAIL	49	1.5%	FAIL	FAIL
Bedroom 53	6.9%	FAIL	37	1.1%	FAIL	FAIL
Bedroom 54	4.5%	FAIL	31	0.9%	PASS	FAIL

Communal Corridors

Location	Number of Hours where 28°C is exceeded	Annual hours > 28°C	Status
Circulation 01	1718	20%	FAIL
Circulation 02	242	3%	PASS
Circulation 03	0	0%	PASS
Circulation 04	1497	17%	FAIL
Circulation 05	980	11%	FAIL
Circulation 06	0	0%	PASS
Circulation 07	0	0%	PASS
Circulation 08	877	10%	FAIL
Circulation 09	0	0%	PASS
Circulation 11	0	0%	PASS
Circulation 12	0	0%	PASS
Circulation 13	0	0%	PASS
Circulation 15	0	0%	PASS

8.2 APPENDIX B – VS1.4 OVERHEATING RESULTS

 DMEV Spaces
 MVHR Spaces

VS1.4 Windows Open @ 20°C - 2020 Weather File - Bedrooms

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 01	2.6%	PASS	3	0.1%	PASS	PASS
Bedroom 02	2.9%	PASS	4	0.1%	PASS	PASS
Bedroom 03	2.9%	PASS	4	0.1%	PASS	PASS
Bedroom 04	2.7%	PASS	4	0.1%	PASS	PASS
Bedroom 05	2.7%	PASS	4	0.1%	PASS	PASS
Bedroom 06	2.9%	PASS	3	0.1%	PASS	PASS
Bedroom 07	2.9%	PASS	4	0.1%	PASS	PASS
Bedroom 08	1.7%	PASS	4	0.1%	PASS	PASS
Bedroom 09	1.9%	PASS	3	0.1%	PASS	PASS
Bedroom 10	1.1%	PASS	3	0.1%	PASS	PASS
Bedroom 11	1.1%	PASS	3	0.1%	PASS	PASS
Bedroom 12	1.6%	PASS	3	0.1%	PASS	PASS
Bedroom 18	1.4%	PASS	0	0.0%	PASS	PASS
Bedroom 19	1.4%	PASS	1	0.0%	PASS	PASS
Bedroom 20	1.4%	PASS	1	0.0%	PASS	PASS
Bedroom 21	1.1%	PASS	1	0.0%	PASS	PASS
Bedroom 22	2.6%	PASS	3	0.1%	PASS	PASS
Bedroom 23	2.6%	PASS	3	0.1%	PASS	PASS
Bedroom 24	2.6%	PASS	3	0.1%	PASS	PASS
Bedroom 25	2.8%	PASS	4	0.1%	PASS	PASS
Bedroom 26	2.7%	PASS	4	0.1%	PASS	PASS
Bedroom 27	2.5%	PASS	1	0.0%	PASS	PASS
Bedroom 28	2.5%	PASS	4	0.1%	PASS	PASS
Bedroom 29	1.6%	PASS	2	0.1%	PASS	PASS
Bedroom 30	1.8%	PASS	3	0.1%	PASS	PASS
Bedroom 31	1.2%	PASS	3	0.1%	PASS	PASS
Bedroom 32	1.2%	PASS	3	0.1%	PASS	PASS
Bedroom 33	1.6%	PASS	2	0.1%	PASS	PASS
Bedroom 38	2.3%	PASS	2	0.1%	PASS	PASS
Bedroom 39	2.2%	PASS	3	0.1%	PASS	PASS
Bedroom 40	2%	PASS	3	0.1%	PASS	PASS
Bedroom 41	1.7%	PASS	3	0.1%	PASS	PASS
Bedroom 42	1%	PASS	0	0.0%	PASS	PASS
Bedroom 43	2.8%	PASS	0	0.0%	PASS	PASS
Bedroom 44	0.8%	PASS	0	0.0%	PASS	PASS
Bedroom 45	0.8%	PASS	0	0.0%	PASS	PASS
Bedroom 46	0.9%	PASS	0	0.0%	PASS	PASS

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 47	1.1%	PASS	1	0.0%	PASS	PASS
Bedroom 48	0.8%	PASS	0	0.0%	PASS	PASS
Bedroom 49	0.6%	PASS	0	0.0%	PASS	PASS
Bedroom 50	0.6%	PASS	0	0.0%	PASS	PASS
Bedroom 51	0.6%	PASS	0	0.0%	PASS	PASS
Bedroom 52	0.5%	PASS	0	0.0%	PASS	PASS
Bedroom 55	1.2%	PASS	0	0.0%	PASS	PASS
Bedroom 56	1.3%	PASS	0	0.0%	PASS	PASS
Bedroom 57	1.4%	PASS	0	0.0%	PASS	PASS
Bedroom 58	1.2%	PASS	0	0.0%	PASS	PASS
Bedroom 59	1%	PASS	0	0.0%	PASS	PASS
Bedroom 60	2.9%	PASS	0	0.0%	PASS	PASS

V2.3 – MVHR/Curtains Closed - 2020 Weather File – Bedrooms

Location	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 1 Status	Hours above threshold temp. of 26 C	% of time room is above threshold temperature	Results based on over all % of time over threshold temperature	Overall Results
Bedroom 14	2.9%	PASS	2	0.1%	PASS	PASS
Bedroom 15	2.9%	PASS	3	0.1%	PASS	PASS
Bedroom 16	1.7%	PASS	2	0.1%	PASS	PASS
Bedroom 17	1.3%	PASS	1	0.0%	PASS	PASS
Bedroom 34	2.8%	PASS	2	0.1%	PASS	PASS
Bedroom 35	2.8%	PASS	2	0.1%	PASS	PASS
Bedroom 36	1.6%	PASS	2	0.1%	PASS	PASS
Bedroom 37	1.4%	PASS	1	0.0%	PASS	PASS
Bedroom 53	2.3%	PASS	1	0.0%	PASS	PASS
Bedroom 54	0.7%	PASS	0	0.0%	PASS	PASS