UK OVERHEATING

Churchill Retirement Living

WORTHING ROAD, SOUTHWATER

Approved Document O Overheating Strategy



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1. INTRODUCTION

1.1. PURPOSE

UK Overheating has been appointed by Churchill Retirement Living to develop an overheating strategy for the proposed retirement living accommodation on Roundstone Caravan Park, Worthing Road, Southwater RH13 9JF in accordance with Approved Document O 'Overheating' (2021 edition - England) of the Building Regulations 2010.

This report presents the agreed overheating strategy for the Site.

This report is necessarily technical in nature. To assist the reader, a glossary of technical terms is provided in Appendix A.

Compliance checklists for the Site are provided in Appendix B.

1.2. ASSESSMENT CRITERIA

1.2.1. APPROVED DOCUMENT O

Approved Document O (2021 edition – England) [AD-O] was released in December 2021 and came into force for all Building Regulations building notices, full plans applications and initial notices submitted from 15 June 2022.

Requirement O1 states:

O1 Overheating mitigation

(1) Reasonable provision must be made in respect of a dwelling, institution or any other building containing one or more rooms for residential purposes, other than a room in a hotel ("residences") to—

(a) limit unwanted solar gains in summer;

(b) provide an adequate means to remove heat from the indoor environment.

(2) In meeting the obligations in paragraph (1)—

(a) account must be taken of the safety of any occupant, and their reasonable enjoyment of the residence; and

(b) mechanical cooling may only be used where insufficient heat is capable of being removed from the indoor environment without it.

There are two routes to demonstrate compliance with Requirement O1(1):

- The Simplified Method: a prescriptive approach, which defines maximum glazed areas and minimum window open areas, which can only be used where apartment district heating systems are not distributed in the common areas and where the measures detailed in Requirement O1(2) are met; and
- Dynamic Thermal Modelling: a computational method offering additional design flexibility over the Simplified Method, and it can be used to develop strategies for:

- Residential buildings with very high levels of insulation and airtightness
- Residential buildings with specific site conditions
- Residential buildings that are highly shaded by neighbouring properties, structures or landscape

If adopting the Dynamic Thermal Modelling method for demonstrating compliance, the modelling should follow the requirements of CIBSE TM 59, with additional limits on the modelling as follows:

- Specific operating profiles for openings to rooms occupied in the daytime (8am to 11pm)
- Assumptions for openings to first floor rooms and rooms that are not easily accessible at night
- Assumptions for openings to unoccupied ground floor or easily accessible rooms during the daytime and night-time

The statutory guidance to support Requirement O1(2)(a) contains standards relating to noise at night, pollution, security, protection from falling and protection from entrapment.

For noise at night, paragraph 3.3 states:

> **Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits:**
>
> **a) 40dB $L_{Aeq,T}$ averaged over 8 hours (between 11pm and 7am)**
>
> **b) 55dB L_{AFmax} more than 10 times a night (between 11pm and 7am)**

For pollution, paragraph 3.5 states:

> **Buildings located near to significant local pollution sources should be designed to minimise the intake of external air pollutants. Guidance is given in Section 2 of Approved Document F, Volume 1: Dwellings.**

These two paragraphs place environmental constraints on the extent of the use of an open window or a natural ventilation opening within the overheating strategy.

To maintain sufficient security, only the proportion of openings that can be opened securely should be considered to provide useful ventilation.

To prevent the risk of falling, only the proportion of openings which can be opened with a very low risk of occupants falling from height should be considered to form part of the overheating mitigation strategy.

To prevent the risk of entrapment of body parts within louvred shutters, window railings and ventilation grilles, there are standards for openings and looped cords which must be followed.

1.2.2. CIBSE TM59

CIBSE TM59 was published in April 2017 and provides a standardised assessment methodology to determine the risk of overheating in residential properties. It includes assumptions for internal heat gains and occupancy profiles and presents criteria which differ depending on whether the home is predominantly naturally ventilated, or it is predominantly mechanically ventilated.

For homes that are predominantly naturally ventilated, including homes that have mechanical ventilation with heat recovery [MVHR], with good opportunities for natural ventilation in the summer, compliance is based on passing *both* of the following two criteria:

Table 1: CIBSE TM59 Predominantly Naturally Ventilated Criteria

Criterion	Requirement
a)	*For living rooms, kitchens and bedrooms*: the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours.
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).

For homes predominantly mechanically ventilated, because they have either no opportunity or extremely limited opportunities for opening windows (e.g. due to noise levels or air quality), occupied rooms should not exceed an operative temperature of 26 °C for more than 3% of annual occupied hours.

Care homes and accommodation for vulnerable occupants, which are predominantly naturally ventilated, should use criteria (a) and (b), but should assume Type 1 occupancy, as defined in CIBSE TM52. This results in a reduction in the acceptable comfortable temperature range from ±3K to ±2K (and a reduction of predicted mean vote from ±0.5 to ±0.2), reflecting the higher sensitivity of vulnerable occupants to increases in internal temperature.

2. SITE DETAILS

2.1. ORIENTATION

The building is located on site as per the below site plan.

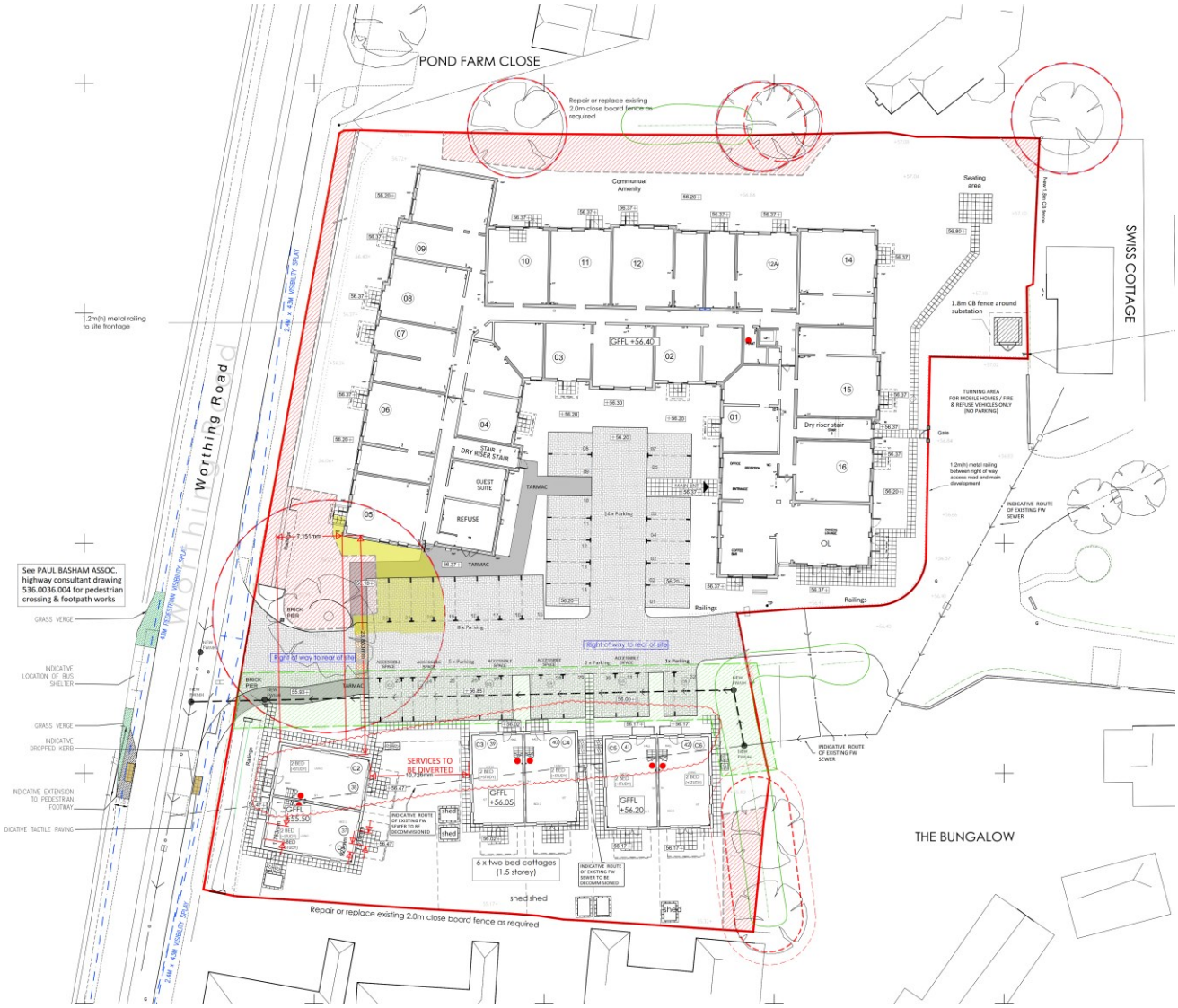


Figure 1: Site Location Plan

2.2. DESIGN

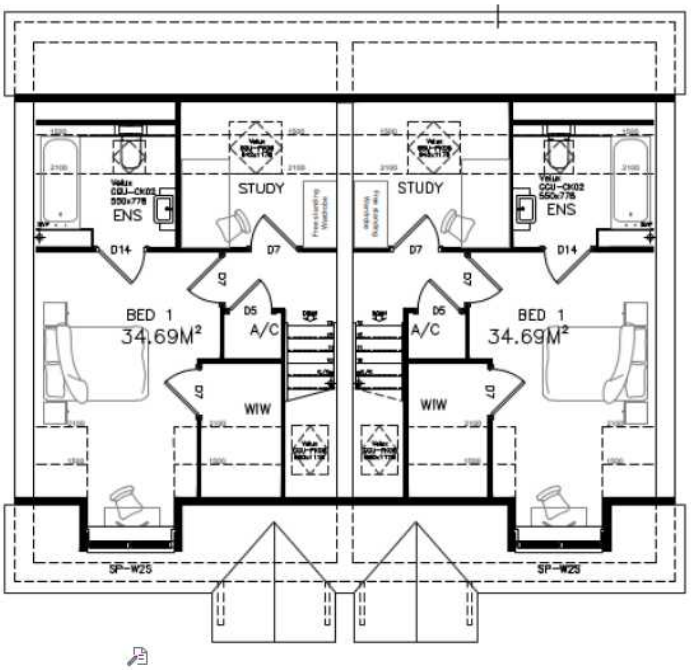
Ground floor and first floor layouts are shown below for the proposed retirement living block and 3 cottages.

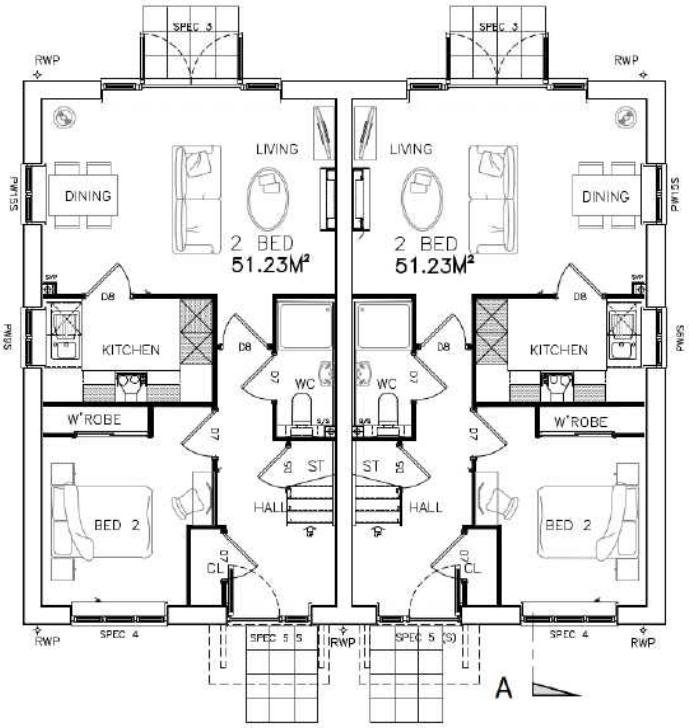


Figure 2: Ground Floor Layout of the apartment block

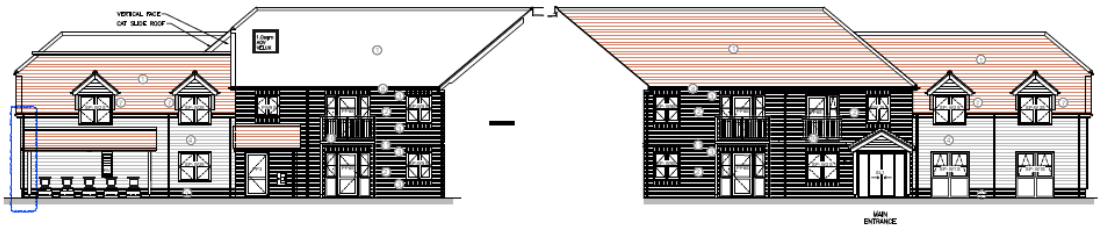


Figure 3: First Floor Layout of the apartment block





Ground & First Floor of the Cottage



ELEVATION C

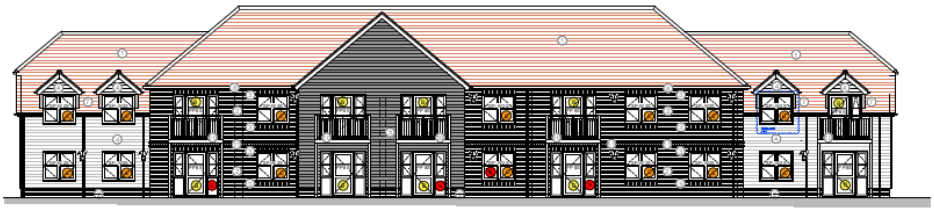
ELEVATION D



ELEVATION B1

ELEVATION B2

ELEVATION B3



ELEVATION A



Figure 6: Elevations

3. ENVIRONMENTAL CONSTRAINTS

3.1. AIR QUALITY

The air quality conditions are not known. Therefore, the strategy is applicable only where the limits stated in Appendix D are not exceeded.

3.2. NOISE

The noise assessment by Peninsular Acoustics (ref. PA0316-R01-P01, dated May 2024) has informed noise exposure on the site.

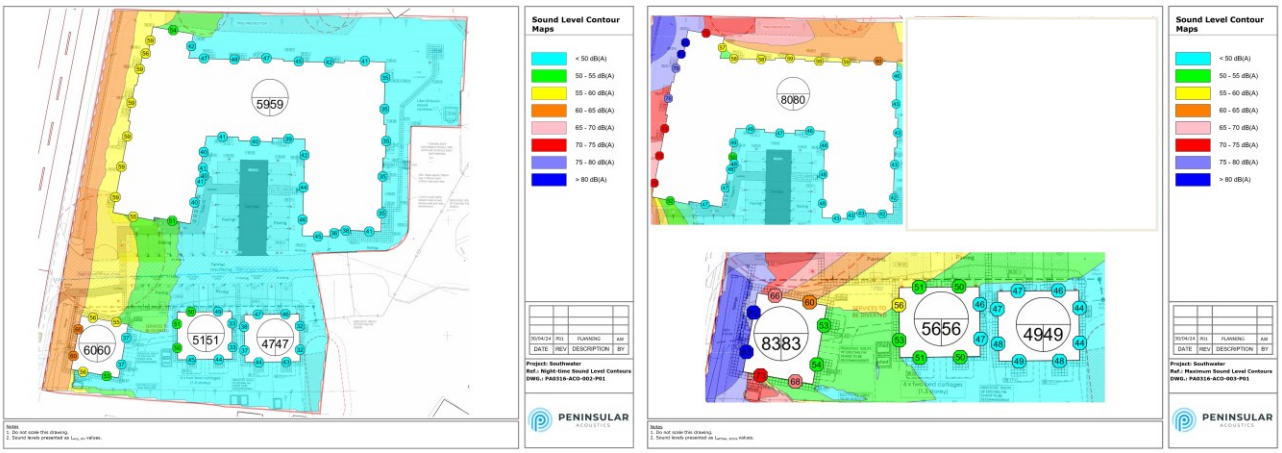


Figure 7: Night-time Noise Exposure

3.3. OPEN WINDOW CONSTRAINTS

These studies have led to identifying the following constraints in respect of opening a bedroom window:

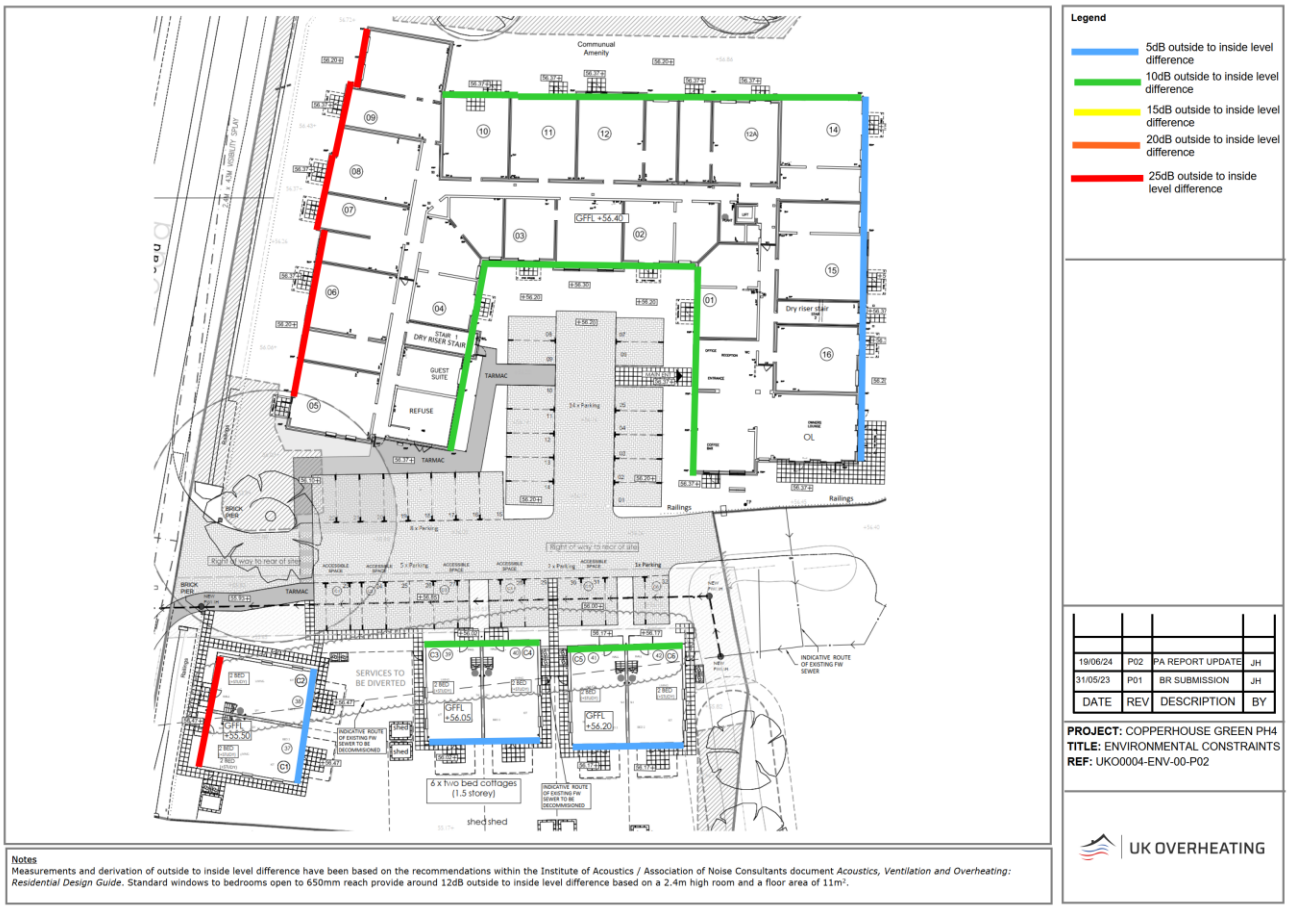


Figure 8: Open Window Environmental Constraints

4. ASSESSMENT METHODOLOGY

4.1.1. PREDICTIONS

4.1.1.1. Dynamic Thermal Modelling Software

Dynamic thermal modelling has been undertaken using 10-minute sample periods using IES Virtual Environment (version 2023.5.1.0).

4.1.1.2. Façade Sound Insulation Calculations

Façade sound insulation calculations are based on the guidance in BS EN ISO 12354-3:2017 'Building acoustics – Estimation of acoustic performance of buildings from the performance of elements. Part 3: Airborne sound insulation against outdoor sound'.

The calculations are also in line with the recommendations of the joint Association of Noise Consultants / Institute of Acoustics 'Guide to Demonstrating Compliance with the Noise Requirements of Approved Document O', currently in consultation form.

4.1.1.3. Aerodynamic Performance of Windows

The equivalent area performance of the window openings has been calculated using the Future Homes Hub Simplified Method tool.

4.1.2. MODELLING ASSUMPTIONS

4.1.2.1. Building Fabric

The building fabric for all variants assumes the following thermal parameters.

Building Fabric	Construction	U-value ($W/m^2 K$)	Thermal Mass ($kJ/m^2 K$)	Centre Pane G-value
External wall	Brick / block cavity masonry wall with 150mm cavity fully filled with insulation	0.17	110	n/a
Ground floor	NuSpan concrete insulated slab	0.12	211	n/a
Party floor	60mm screed onto 150mm pre-cast concrete slab and suspended plasterboard ceiling	1.06	9	n/a
Party wall	Cavity masonry wall with 70mm cavity fully filled with insulation	0.38	140	n/a
Internal walls	Plasterboard on 50mm stud	1.59	12	n/a
Glazing	4mm glass / 20mm air space / 4mm glass / 20mm air space / 4mm glass	0.70	n/a	0.42 / 0.63
Roof	Pitched roof	0.11	10	n/a

Table 2: Thermal and Solar Performance of Building Fabric Elements

4.1.2.2. Internal Gains

Solar Gain

Solar gains are calculated automatically by the modelling software based on the orientation of the building, the transmission coefficients of the glazing and the solar angles. The following weather file has been used:

- London Gatwick DSY1 2020 50th percentile high emissions

Occupancy, Equipment and Lighting Gains

Occupancy, equipment lighting gains for the residential spaces are based on the guidance in CIBSE TM59 Design methodology for the assessment of overheating risk in homes. The following table lists rooms and the associated TM59 profiles.

Room	TM59 Type
Bedrooms > 11.5m^2	Double Bedroom
Bedrooms ≤ 11.5m^2	Single Bedroom
1 Bedroom Living Room / Kitchens	1 Bed Living Room / Kitchen
2 Bedroom Living Room / Kitchens	2 Bed Living Room / Kitchen
Guestroom	Double Bedroom

Table 3: Room TM59 Assignment

There is no communal heating or pipework system within the communal corridors and thus no internal heat gains have been assumed beyond standard lighting.

4.1.2.3. Ventilation

Infiltration

An air permeability of 5.0 m³/hr/m² @ 50 Pa has been assumed and this has been taken to correspond to an average infiltration rate of 0.25 ach.

Background Ventilation (Approved Document F)

Year-round background ventilation has been assumed to provide 0.30l/s per m^2 for 1 Bed apartments and 0.34 l/s per m^2 for 2 Bed apartments as per Approved Document F.

Natural Ventilation

Openable windows are provided within all the units for ventilation and are assumed to be able to be opened by occupants in warm weather unless there is a constraint to opening the windows.

The following opening patterns are required by Approved Document O:

- Patio doors and all other ground floor openable windows are modelled as open during the day to 90 degrees angle of opening and closed at night
- All external doors and windows to habitable rooms above ground floor that are not easily accessible have been assumed to be opened (by occupants) when the internal temperature of the room exceeds 22°C (i.e. it's getting warm) and to be open to their full extent (so as not to create a risk of falling as defined in Approved Document O) when the room exceeds 26°C

- Where there is no noise constraint, bedroom windows are modelled as openable 24/7 and open to the defined restriction all night if bedrooms exceed 23° at 11pm
- Where there is a noise constraint, during the daytime bedroom windows are modelled as fully open within the fall restriction limits of Approved Document O and restricted to meet the outside to inside level difference as outlined in Figure 8.

All internal doors are assumed to be open during the day to allow cross ventilation between rooms, and closed at night when people are sleeping.

The following windows are proposed within the scheme.

Window Ref.	Window Pane Width (m)	Window Pane Height (m)	Window Sill Height When Used on Upper Floor (mm)	Opening Style	Fall Prevention When Used on Upper Floor
PP1, PP4 & PP8 Door	1.0	2.1	n/a	Side hung	Balcony 1.1m
PP1 & PP8 Top Window	0.5	1.2	900	Side hung	Balcony 1.1m
PW5	0.6	1.0	1100	Side hung	650mm reach.
PW8	0.5	1.0	1100	Side hung	650mm reach.
PW9	0.6	1.0	1100	Side hung	650mm reach.
PW10	0.6	1.1	1000	Side hung	650mm reach.
PW12	0.8	1.2	945	Side hung	650mm reach. Requires guard rail.
PW13	0.8	1.3	850	Side hung	650mm reach. Requires guard rail.
PW15	0.6	1.3	850	Side hung	650mm reach. Requires guard rail.
Skylight	0.7	0.7	n/a	Centre pivot	60 degree limit
SPEC 4	0.5	1.2	n/a	Side hung	n/a
SPEC 3 Window	0.6	1.0	n/a	Side hung	n/a
SPEC 3 Door	0.8	2.1	n/a	Side hung	n/a
SPEC 2	0.7	1.1	n/a	Side hung	n/a
SP-W1S	0.8	1.4	1000	Top hung	n/a
SP-W2S	0.8	1.4	850	Side hung	650mm reach. Requires guard rail.
SP-W5	0.6	1.3	900	Side hung	650mm reach. Requires guard rail.

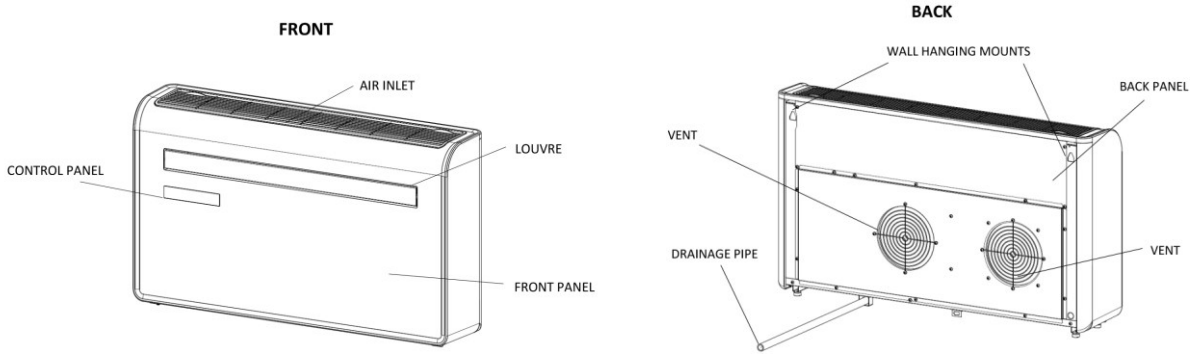
Table 4: Window Details

4.1.2.4. Additional Mechanical Ventilation for Overheating

Increased mechanical ventilation to provide air exchange from the rooms requiring it shall be provided by either a Mechanical Ventilation Heat Recovery unit or mechanical extract fans. If a mechanical extract system is proposed, supply air should be provided via external wall ventilators sized to provide sufficient air without placing any undue constraint on the operation of the fan system.

4.1.2.5. Mechanical Cooling

Where specified, mechanical cooling is to be provided via either an MVHR unit fitted with a tempered air coil or an in-room unit such as the electriQ IQOOL-SMART12HP air conditioner:

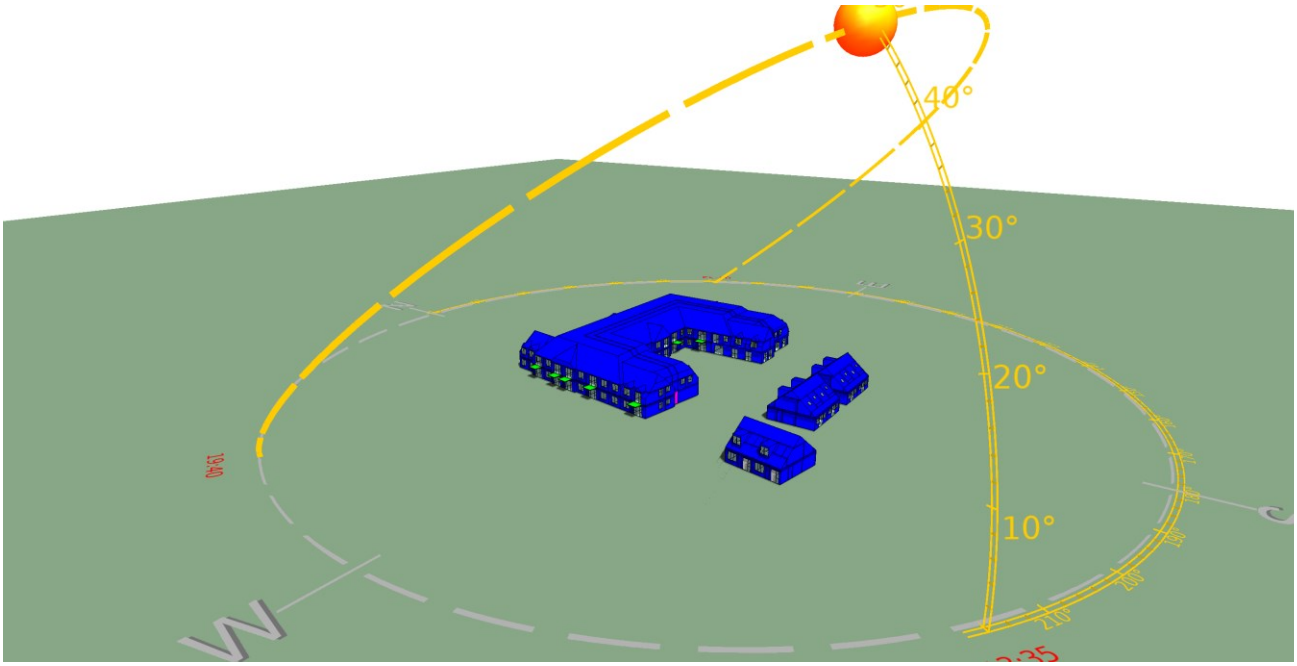


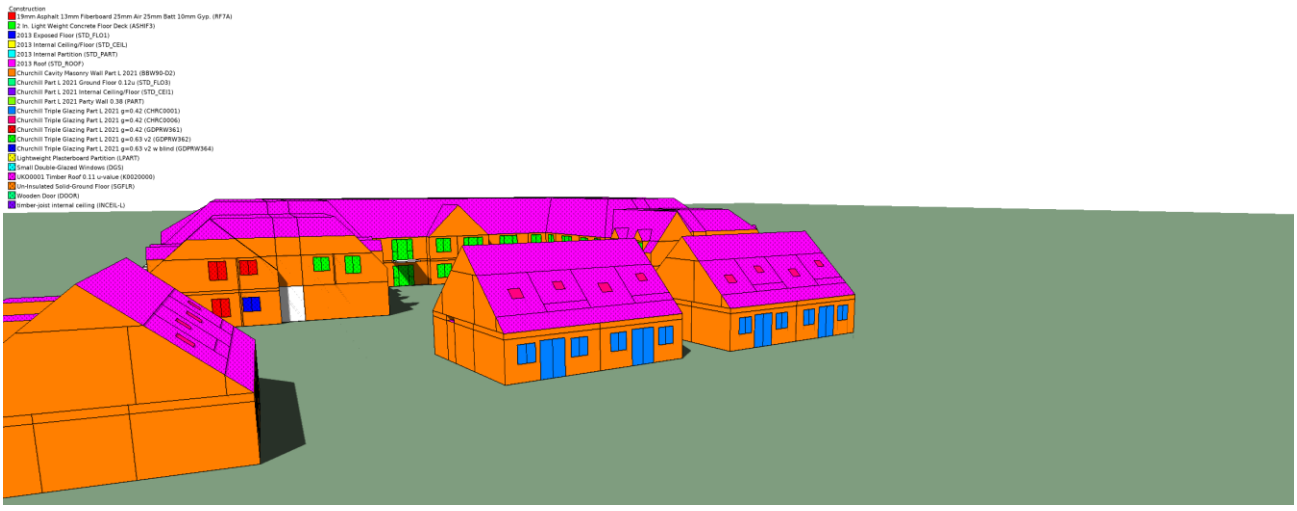
4.1.3. MODELLING APPROACH

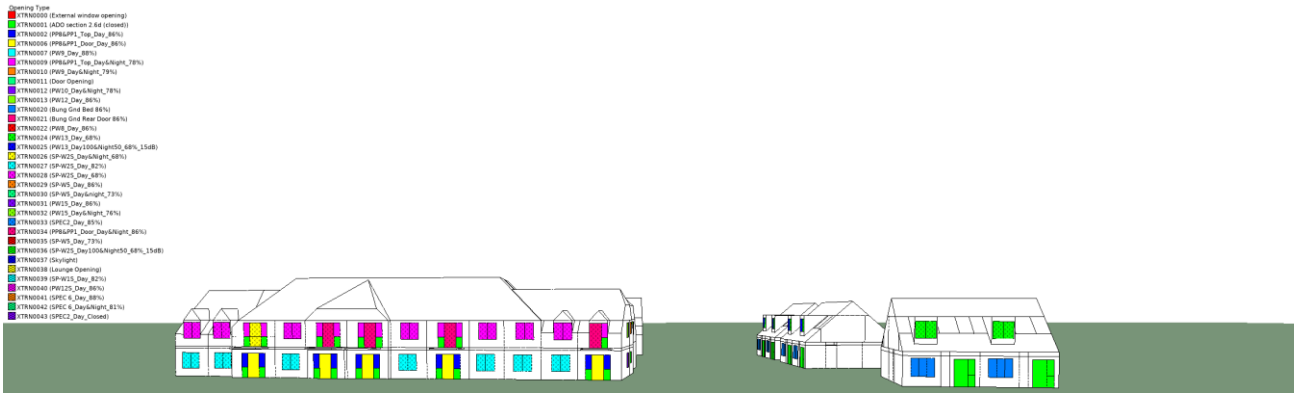
The modelling has taken the following approach:

- Receive the floor plans and elevations
- Develop a geometric model for all flats and cottages
- Apply the site location in terms of latitude and longitude and appropriate weather file
- Apply the TM59 gain profiles to the rooms
- Apply the thermal performance to the building elements and standard solar performance of the glass
- Set the opening profiles of the windows to their full reach for those rooms without a noise constraint and the opening profiles of the bedroom windows where there are window opening constraints
- Run the simulation
- For any rooms that do not pass the TM59 criteria, adopt the following approach in order:
  - Introduce mechanical ventilation up to a maximum of 50l/s per room
  - Introduce mechanical cooling where ventilation rates exceed 50l/s per room

4.1.4. MODEL IMAGES







5. OVERHEATING STRATEGY

5.1. DEVELOPMENT OF STRATEGY

The primary purpose of the strategy has been to avoid excessive internal heat gains and reduce solar gain to enable a passive means of removing excess heat.

The internal heat gain reducing measures have comprised:

- Placing some kitchens internally rather than on the façade
- Removing all doors between kitchens and living rooms

The solar gain reducing measures have comprised:

- Reducing the size of the study room windows in the cottages
- Adopting low g-value glazing where required
- Adopting external blinds to some rooms
- Introducing mechanical ventilation where required

5.2. RESULTS

After exhausting all passive means for as set out in the modelling approach, the following rooms failed the standards and will be subject to mechanical cooling:

- C1 Bed 1 (Crit 2: 40 hours)
- C2 Bed 1 (Crit 2: 39 hours)
- C3 Study (Crit 1: 3.7%)
- C4 Study (Crit 1: 3.9%)
- C5 Study (Crit 1: 3.7%)
- C6 Study (Crit 1: 3.9%)

The results of the dynamic thermal modelling are set out below, evaluated for TM52 occupant category Type 1, are contained in Appendix C.

The overheating strategy is repeated on the plans below.



Glazing Solar Gain

Centre-pane G-value

0.42

All other glazing: 0.63

Ventilator Requirements

Equivalent Area, mm²

Shading

Balcony

External shutter

Mechanical Services

Air Exchange

Cooling kW

Basis of Design

Architecture
Floor plan: 20079SW-220-C
Elevations: 20079SW-230 & 20079SW-231

Air permeability
Infiltration based on 5m³/(h.m²)

Thermal parameters (u-value, W/m² K / thermal mass, kJ/m² K)

Party wall: 0.38 / 140
Party floor: 1.06 / 9
Ground floor: 0.12 / 211
Roof: 0.11 / 8
External wall: 0.17 / 111
Glazing: 0.70 / n/a

Environmental constraints
Noise: Based on Peninsular Acoustics Report PA0316-R01-P01
Air quality: unknown

DATE	REV	DESCRIPTION	BY
19/06/24	P02	DETAILED DESIGN	JH
22/04/24	P01	DETAILED DESIGN	JH

PROJECT: CRL Southwater
GROUND FLOOR OVERHEATING STRATEGY
REF: UKO0110-OVH-00-P02

UK OVERHEATING

Notes
D = Day; N = Night. Glazing units that provide the centre-pane g-value must be procured and installed as specified. Air exchange rates must comprise air movement through the room and not simply supplied & reliant on extraction from wet rooms without consideration of air transfer. Where window areas increase or u-values significantly reduce to those used, this strategy cannot be relied upon. Noise from mechanical systems should satisfy the recommendations within the Institute of Acoustics / Association of Noise Consultants document *Acoustics, Ventilation and Overheating: Residential Design Guide*.



Notes
D = Day; N = Night. Glazing units that provide the centre-pane g-value must be procured and installed as specified. Air exchange rates must comprise air movement through the room and not simply supplied & reliant on extraction from wet rooms without consideration of air transfer. Where window areas increase or u-values significantly reduce to those used, this strategy cannot be relied upon. Noise from mechanical systems should satisfy the recommendations within the Institute of Acoustics / Association of Noise Consultants document *Acoustics, Ventilation and Overheating: Residential Design Guide*.

Glazing Solar Gain

Centre-pane G-value

0.42

All other glazing: 0.63

Ventilator Requirements

Equivalent Area, mm²

Shading

Balcony

External shutter

Mechanical Services

Air Exchange

Cooling kW

Basis of Design

Architecture
Floor plan: 20083SW-221-A
Elevations: 20079SW-230 & 20079SW-231

Air permeability
Infiltration based on 5m³/(h.m²)

Thermal parameters (u-value, W/m² K / thermal mass, kJ/m² K)

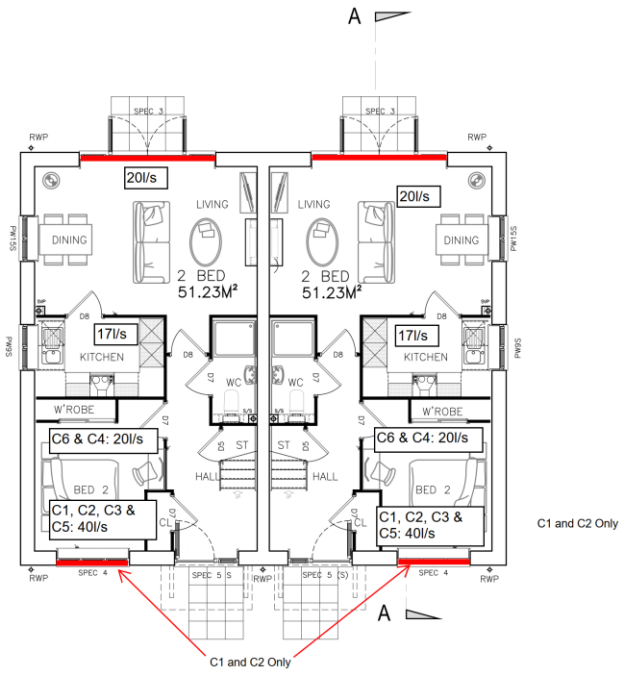
Party wall: 0.38 / 140
Party floor: 1.06 / 9
Ground floor: 0.12 / 211
Roof: 0.11 / 8
External wall: 0.17 / 111
Glazing: 0.70 / n/a

Environmental constraints
Noise: Based on Peninsular Acoustics Report PA0316-R01-P01
Air quality: unknown

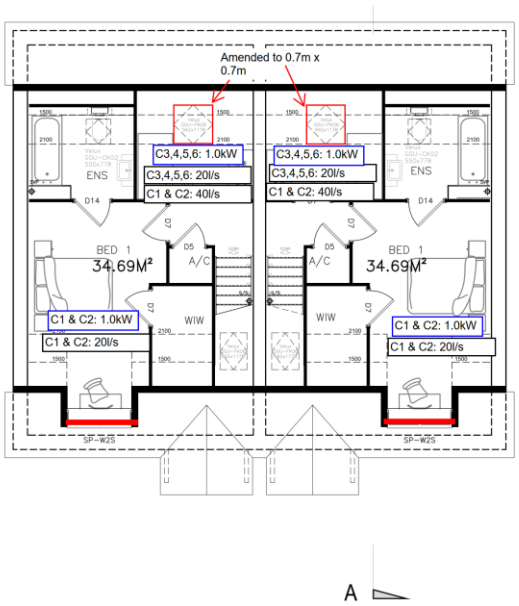
DATE	REV	DESCRIPTION	BY
19/06/24	P02	DETAILED DESIGN	JH
22/04/24	P01	DETAILED DESIGN	JH

PROJECT: CRL Southwater
FIRST FLOOR OVERHEATING STRATEGY
REF: UKO0110-OVH-01-P01

UK OVERHEATING



GROUND FLOOR LAYOUT & SERVICES



FIRST FLOOR LAYOUT & SERVICES

Glazing Solar Gain

Centre-pane G-value

0.42

All other glazing: 0.63

Ventilator Requirements

Equivalent Area, mm²

Shading

Balcony

External shutter

Mechanical Services

Air Exchange

Cooling kW

Basis of Design

Architecture
Floor plan: 20079SW-225
Elevations: 20079SW-232

Air permeability
Infiltration based on 5m³/(h.m²)

Thermal parameters (u-value, W/m² K / thermal mass, kJ/m² K)

Party wall: 0.38 / 140
Party floor: 1.06 / 9
Ground floor: 0.12 / 211
Roof: 0.11 / 8
External wall: 0.17 / 111
Glazing: 0.70 / n/a

Environmental constraints
Noise: Based on Peninsular Acoustics Report PA0316-R01-P01
Air quality: unknown

DATE	REV	DESCRIPTION	BY
19/06/24	P01	DETAILED DESIGN	JH

PROJECT: CRL Southwater
COTTAGE OVERHEATING STRATEGY
REF: UKO0110-OVH-CX-P01

UK OVERHEATING

Notes
D = Day; N = Night. Glazing units that provide the centre-pane g-value must be procured and installed as specified. Air exchange rates must comprise air movement through the room and not simply supplied & reliant on extraction from wet rooms without consideration of air transfer. Where window areas increase or u-values significantly reduce to those used, this strategy cannot be relied upon. Noise from mechanical systems should satisfy the recommendations within the Institute of Acoustics / Association of Noise Consultants document *Acoustics, Ventilation and Overheating: Residential Design Guide*.

5.3. SPECIFICATIONS

5.3.1. WINDOWS

Window openings are required to provide the opening specifications as set out in Table 5.

Window Ref.	Location	No. Panes Openable	Opening Angle per Pane (degrees)		Total Equivalent Area (m^2)		Total Night-time Outside to Inside Sound Level Difference
			Day	Night	Day	Night	
PP1, PP4 & PP8 Door	Ground floor	1	90	0	1.89	0	n/a
	Upper floors	1	90	90	1.89	1.89	n/a
PP1 & PP8 Top Window	Ground floor	2	90	0	1.11	0	n/a
	Upper floors	2	57	57	1.00	1.00	n/a
PW5	Ground floor	2	90	0	1.14	0	n/a
	Upper floors	2	45	45	0.98	0.98	TBC
PW8	Ground floor	2	90	0	0.96	0	TBC
	Upper floors	2	57	57	0.89	0.89	TBC
PW9	Ground floor	2	54	54	1.00	1.00	TBC
	Upper floors	2	TBC	TBC	TBC	TBC	TBC
PW10	Ground floor	2	TBC	TBC	TBC	TBC	TBC
	Upper floors	2	TBC	TBC	TBC	TBC	TBC
PW12	Ground floor	2	TBC	TBC	TBC	TBC	TBC
	Upper floors	2	TBC	TBC	TBC	TBC	TBC
PW13	Ground floor	2	TBC	TBC	TBC	TBC	TBC
	Upper floors	2	TBC	TBC	TBC	TBC	TBC
PW15	Ground floor	2	TBC	TBC	TBC	TBC	TBC
	Upper floors	2	TBC	TBC	TBC	TBC	TBC
Skylight	Upper floors		TBC	TBC	TBC	TBC	TBC
SPEC 4	Ground floor	2	TBC	TBC	TBC	TBC	TBC
	Upper floors	2	TBC	TBC	TBC	TBC	TBC

Window Ref.	Location	No. Panes Openable	Opening Angle per Pane (degrees)		Total Equivalent Area (m^2)		Total Night-time Outside to Inside Sound Level Difference
			Day	Night	Day	Night	
SPEC 3 Window	Ground floor	2	TBC	TBC	TBC	TBC	TBC
	Upper floors	2	TBC	TBC	TBC	TBC	TBC
SPEC 3 Door	Ground floor	2	TBC	TBC	TBC	TBC	TBC
	Upper floors	2	TBC	TBC	TBC	TBC	TBC
SPEC 2	Ground floor	3	TBC	TBC	TBC	TBC	TBC
SP-W1S	Ground floor	2	TBC	TBC	TBC	TBC	TBC
	Upper floors	2	TBC	TBC	TBC	TBC	TBC
SP-W2S	Ground floor	2	TBC	TBC	TBC	TBC	TBC
	Upper floors	2	TBC	TBC	TBC	TBC	TBC
SP-W5	Ground floor	2	TBC	TBC	TBC	TBC	TBC
	Upper floors	2	TBC	TBC	TBC	TBC	TBC

Table 5: Window Opening Specifications

5.3.2. MECHANICAL SERVICES

All air exchanges referenced relate to the movement of air out the referred space. Any ventilation system shall be designed to enable sufficient air movement without causing excessive pressure on the system and without creating turbulent noise from the movement of air between spaces.

Noise from mechanical systems should satisfy the advisory limits in Table 6.

Room	Parameter
Bedrooms	≤ $L_{Aeq,T}$ 30 (±5) dB

Table 6: Noise limits from mechanical ventilation or mechanical cooling systems

5.3.3. VENTILATORS

Where a mechanical extract system is used to remove excess heat, ventilators shall be fitted that meet the following requirements.

Ventilator Type	Outside to Inside Sound Level Difference (ref. Environmental Constraints Plan)	Equivalent Area Per Vent	No. Vents	$D_{n,e,w}$ + C_{tr} Specification Based on # Vents Per Bedroom (when open)[2]:		
				One	Two	Three
Non-acoustic	None	See plans [1]		n/a	n/a	n/a
Acoustic	25 dB	See plans[1]		33	36	38

[1] Vents shall be sized so as not to cause any undue pressure on the fan system and avoid turbulent noise contributing to an excess of the Approved Document O noise standards

[2] Based on achieving the Approved Document O noise standards assuming 0.5s reverberation time

Table 7: Ventilator Specifications

5.3.4. GUARD RAILS

Where windowsill heights are below 1000mm, a guard rail is to be fitted. Section 3.9 of Approved Document O advises that guarding should not allow children to easily climb it. Therefore, horizontal bars should generally be avoided.

Horizontal bars can be acceptable where children cannot easily climb them. In the Building Control Alliance Guidance (Technical Guidance Note 16), it suggests that horizontal bars can be used as guarding where they start a minimum of 600mm above the inside floor level. It is important that the design of horizontal bars is carefully considered in the context of the room. If the only place for furniture such as a bed is under the window children may be able to climb horizontal bars.

Any Juliet Balconies must have an opening profile of at least 70% free area.

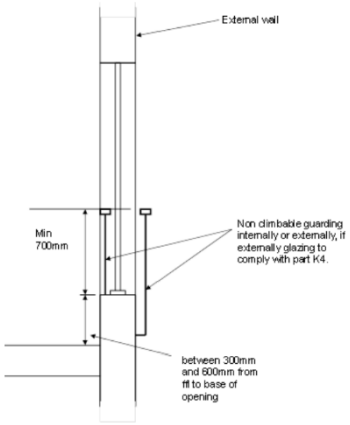


Diagram 3 – Indicates acceptable guarding arrangements where cill heights are between 600mm and 800mm above finished floor level. In this case the cill is not considered to be readily climbable by children, so compliance can be achieved by providing barrier rails to maintain an overall guard height of 800mm above floor level.

6. CONCLUSIONS

This dynamic thermal modelling report provides a full overheating strategy for proposed retirement living accommodation on Roundstone Caravan Park, Worthing Road, Southwater RH13 9JF to comply with the requirements of Approved Document O (2021 edition – England).

A site environmental noise exposure assessment has determined that there are constraints to opening a window for bedrooms at night to maintain compliance.

A passive strategy has been developed for most units comprising reduced g-value glazing, restricted window openings and mechanical ventilation.

Mechanical cooling is required for the following rooms:

- C1 Bed 1
- C2 Bed 1
- C3 Study
- C4 Study
- C5 Study
- C6 Study

Sizing of mechanical systems will need to be completed by a specialist to satisfy the air exchanges and cooling requirements to meet this strategy.

Installed building fabric will need to satisfy the u-value and g-value requirements in this strategy.

Window openings will need to satisfy the limitations in this report.

Appendix A

TECHNICAL TERMINOLOGY

Noise	Typically defined as unwanted, unpleasant or disturbing sound
Frequency (Hz)	The number of oscillations in acoustic pressure per second. It represents the 'tone' of the sound. Often determined in octave bands
Maximum sound pressure level (L_{Fmax})	The maximum or highest sound pressure level measured with a 'fast' time weighting
Equivalent continuous sound pressure level ($L_{eq,T}$)	The average of the total sound energy over a specified time period (T). L_{eq} represents the equivalent sound level that a fluctuating source would have compared to a steady source with the same total sound energy over a specific time period. Commonly used as a descriptor of human perception of sound over time.
'A' weighting	Frequency-dependent weighting based on the response of the human auditory system which has been found to correlate well with the subjective response to sound. Denoted by the use of the letter 'A'. For example, dBA denotes an 'A' weighted sound level in decibels, or L_{Amax} denotes an 'A' weighted maximum sound pressure level.
Internal Ambient Noise Level (IANL)	The noise level within a room or enclosed space. Usually determined as an equivalent continuous sound pressure level over a specific time period ($L_{Aeq,T}$, dB)
Noise Rating (NR) curve	A single figure term used to reflect the spectral frequency content of noise. Although originally proposed to assess environmental noise, NR curves are now typically used to describe noise from mechanical ventilation systems in buildings.
$L_{night,outside}$	The incident external A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all the night periods of a year, in which the night is eight hours between 23:00 and 07:00.
AVO	Acoustics, Ventilation, Overheating (e.g. AVO Guide, AVO Group).
Overheating Strategy Overheating Condition	The situation where measures are in place to mitigate overheating to meet agreed compliance criteria.
Dynamic thermal modelling	A technique that can be used to simulate internal temperatures in dwellings before they are built
Ventilative cooling	Cooling by means of introducing external ambient temperature air at a high ventilation rate. Can be either passive (no fans) or mechanical (with fans).
Purge ventilation	Ventilation to aid removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating or accidental releases such as smoke from burnt food or spillage of water.
Mechanical cooling	Cooling by means of a refrigerant cycle. This would include 'air conditioning' systems and the use of fan coil units (FCUs).
MEV	Mechanical extract ventilation.
"Free area" as used in AD-O	Approved Document O uses the term "Minimum free area" that is required to be achieved by the Equivalent area of the window openings. AD-O provides the accepted definition of Equivalent area for the description of "free area". The term "free area" is therefore avoided in this document to avoid further confusion.
Acoustic open area	The measurable, cross-sectional, geometric area of an opening. For a partially open window, this is considered to be the lesser of either the size of the hole in the window frame that is left by the opening light, or the combined cross-sectional area around the opening light through which air must pass to move from outside to inside. The area around a hinged opening light includes the triangular areas on the sides adjacent to the hinge, and the rectangular area on the side opposite the hinge. This should not be used for comparing the air-flow performance

	of elements because this will also be dependent on factors such as depth (length of air-path), surface roughness and tortuosity. Refer to reference 6 for further information.
Effective area, A_{eff}	Defined as the product of the free area and discharge coefficient, this is the preferred parameter for comparing the air-flow performance of elements.
Equivalent area, A_{eq} **a.k.a. EA**	The area of a sharp-edged, circular orifice that gives the same flow rate as the actual opening at a given pressure-difference. In other words, the free-area of a notional circular hole made in an infinitely thin, infinite extent baffle that gives the same air-flow performance as the real opening. Used to describe the area of trickle vents in Approved Document F. Not to be confused with Effective area.
Coefficient of Discharge, Cd	The ratio of the mass flow rate at the discharge end of the nozzle to that of an ideal nozzle which expands an identical working fluid from the same initial conditions to the same exit pressures.
$D_{n,e}$ / $D_{n,e,w}$	The laboratory tested sound insulation of small building elements, normalised to an equivalent absorption area of $10m^2$.
Façade level	The sound pressure level measured close to a building façade that includes contribution from both the incident sound and the sound reflected from the façade. Normally taken to be 3dB higher than the equivalent free-field level, when located at 1 metre from a façade.
Free-field level	A measured sound pressure level that is independent of any contributions due to reflections from nearby surfaces and is therefore representative of the direct path only.
R / R_w	The laboratory tested airborne sound insulation of a building element
Sound insulation	The capacity of a structure to prevent sound from reaching a receiving location. Sound energy is not necessarily absorbed; impedance mismatch, or reflection back toward the source, is often the principal mechanism

Appendix B

APPROVED DOCUMENT O CHECKLIST

TO BE PROVIDED ONCE MODELLING COMPLETE

Appendix C

MODELLING RESULTS

Room	Room Type	Occupied Summer Hours	Max. Daytime Hours	Max. Night-time Hours	Criterion 1 (≤3%) Pass/Fail	Criterion 2 (≤32) Pass/Fail
01 Bed	Bedroom	3672	110	32	1	21
01 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.2	
02 Bed	Bedroom	3672	110	32	0.9	21
02 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.5	
03 Bed 1	Bedroom	3672	110	32	2.2	17
03 Bed 2	Bedroom	3672	110	32	2.1	23
03 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.9	
04 Bed 1	Bedroom	3672	110	32	1	23
04 Bed 2	Bedroom	3672	110	32	1.4	20
04 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.8	
05 Bed	Bedroom	3672	110	32	1.5	28
05 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.8	
06 Bed 1	Bedroom	3672	110	32	1.3	16
06 Bed 2	Bedroom	3672	110	32	1.9	22
06 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2	
07 Bed	Bedroom	3672	110	32	1.1	26
07 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.4	
08 Bed	Bedroom	3672	110	32	1.5	18
08 Liv/Kit	Kitchen/Living/Dining	1989	59	N/A	2.4	
09 Bed 1	Bedroom	3672	110	32	1.3	24
09 Bed 2	Bedroom	3672	110	32	2	23
09 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.7	
10 Bed	Bedroom	3672	110	32	0.7	18
10 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.5	
11 Bed	Bedroom	3672	110	32	0.8	18
11 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.5	
12 Bed	Bedroom	3672	110	32	0.7	18
12 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.3	
12a Bed	Bedroom	3672	110	32	0.8	19
12a Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.5	

Room	Room Type	Occupied Summer Hours	Max. Daytime Hours	Max. Night-time Hours	Criterion 1 (≤3%) Pass/Fail	Criterion 2 (≤32) Pass/Fail
14 Bed	Bedroom	3672	110	32	0.8	18
14 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.5	
15 Bed 1	Bedroom	3672	110	32	1.1	20
15 Bed 2	Bedroom	3672	110	32	1.5	21
15 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.1	
16 Bed 1	Bedroom	3672	110	32	0.9	20
16 Bed 2	Bedroom	3672	110	32	1.1	20
16 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	3	
17 Bed	Bedroom	3672	110	32	1	19
17 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.9	
18 Bed	Bedroom	3672	110	32	0.8	13
18 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.4	
19 Bed 1	Bedroom	3672	110	32	2	12
19 Bed 2	Bedroom	3672	110	32	1.4	12
19 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.4	
20 Bed 1	Bedroom	3672	110	32	0.7	13
20 Bed 2	Bedroom	3672	110	32	1	12
20 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.5	
21 Bed	Bedroom	3672	110	32	1	12
21 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.1	
22 Bed	Bedroom	3672	110	32	1.2	27
22 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.1	
23 Bed 1	Bedroom	3672	110	32	1.1	17
23 Bed 2	Bedroom	3672	110	32	1.5	20
23 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.9	
24 Bed	Bedroom	3672	110	32	1.4	25
24 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.5	
25 Bed	Bedroom	3672	110	32	1.4	25
25 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.7	
26 Bed 1	Bedroom	3672	110	32	1.2	28

Room	Room Type	Occupied Summer Hours	Max. Daytime Hours	Max. Night-time Hours	Criterion 1 (≤3%) Pass/Fail	Criterion 2 (≤32) Pass/Fail
26 Bed 2	Bedroom	3672	110	32	1.6	22
26 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	1.7	
27 Bed	Bedroom	3672	110	32	0.6	8
27 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	0.8	
28 Bed	Bedroom	3672	110	32	0.8	11
28 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	0.8	
29 Bed	Bedroom	3672	110	32	0.6	11
29 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	0.8	
30 Bed	Bedroom	3672	110	32	0.8	12
30 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	0.8	
31 Bed	Bedroom	3672	110	32	0.8	12
31 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	0.8	
32 Bed 1	Bedroom	3672	110	32	0.9	13
32 Bed 2	Bedroom	3672	110	32	0.8	8
32 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.4	
33 Bed 1	Bedroom	3672	110	32	0	0
33 Bed 2	Bedroom	3672	110	32	0	0
33 Kit/Liv/Dining	Kitchen/Living/Dining	1989	59	N/A	0.3	
34 Bed	Bedroom	3672	110	32	0	0
34 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	0.2	
35 Bed	Bedroom	3672	110	32	1	9
35 Bed 1	Bedroom	3672	110	32	1.9	29
35 Bed 2	Bedroom	3672	110	32	2.7	22
35 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.5	
36 Bed	Bedroom	3672	110	32	1.1	13
36 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2.9	
37 Kit/Liv	Kitchen/Living/Dining	1989	59	N/A	2	
C1 Bed 1	Bedroom	3672	110	32	0.3	0
C1 Bed 2	Bedroom	3672	110	32	1.8	17
C1 Kitchen	Kitchen/Living/Dining	1989	59	N/A	2.5	

Room	Room Type	Occupied Summer Hours	Max. Daytime Hours	Max. Night-time Hours	Criterion 1 (≤3%) Pass/Fail	Criterion 2 (≤32) Pass/Fail
C1 Liv/Din	Kitchen/Living/Dining	1989	59	N/A	2.4	
C1 Study	Kitchen/Living/Dining	1989	59	N/A	2.6	
C2 Bed 1	Bedroom	3672	110	32	0.4	0
C2 Bed 2	Bedroom	3672	110	32	1.7	22
C2 Kitchen	Kitchen/Living/Dining	1989	59	N/A	2.3	
C2 Liv/Din	Kitchen/Living/Dining	1989	59	N/A	2.5	
C2 Study	Kitchen/Living/Dining	1989	59	N/A	2.4	
C3 Bed 1	Bedroom	3672	110	32	1	23
C3 Bed 2	Bedroom	3672	110	32	1.3	18
C3 Kitchen	Kitchen/Living/Dining	1989	59	N/A	2.2	
C3 Liv/Din	Kitchen/Living/Dining	1989	59	N/A	2.6	
C3 Study	Kitchen/Living/Dining	1989	59	N/A	0.6	
C4 Bed 1	Bedroom	3672	110	32	0.9	22
C4 Bed 2	Bedroom	3672	110	32	1.5	30
C4 Kitchen	Kitchen/Living/Dining	1989	59	N/A	2.3	
C4 Liv/Din	Kitchen/Living/Dining	1989	59	N/A	2.7	
C4 Study	Kitchen/Living/Dining	1989	59	N/A	0.6	
C5 Bed 1	Bedroom	3672	110	32	1	18
C5 Bed 2	Bedroom	3672	110	32	1.3	18
C5 Kitchen	Kitchen/Living/Dining	1989	59	N/A	2.2	
C5 Liv/Din	Kitchen/Living/Dining	1989	59	N/A	2.6	
C5 Study	Kitchen/Living/Dining	1989	59	N/A	0.6	
C6 Bed 1	Bedroom	3672	110	32	0.9	22
C6 Bed 2	Bedroom	3672	110	32	1.5	30
C6 Kitchen	Kitchen/Living/Dining	1989	59	N/A	2.3	
C6 Liv/Din	Kitchen/Living/Dining	1989	59	N/A	2.8	
C6 Study	Kitchen/Living/Dining	1989	59	N/A	0.6	
Guest Bed Room	Bedroom	3672	110	32	0.8	16

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Appendix D

AIR QUALITY LIMITS

Paragraph 3.5 of Approved Document O 2021 (England) states:

> **Buildings located near to significant local pollution sources should be designed to minimise the intake of external air pollutants. Guidance is given in Section 2 of Approved Document F, Volume 1: Dwellings.**

Section 2 of Approved Document F, Volume 1: Dwellings is titled 'Minimising the ingress of external pollutants'. Paragraph 2.1 and Table 2.1 are repeated below.

2.1 Ventilation systems should be designed to minimise the intake of external air pollutants following paragraphs 2.2 to 2.9 if either of the following applies.

a. The pollutant values in the location of the dwelling exceed any of the limits in Table 2.1. This may have been determined through an air quality assessment. Where modelling or monitoring data is required, expert advice should be sought.

b. The dwelling is located near to any of the following sources of significant local pollution.

   i. Road traffic, including traffic junctions and underground car parks.

   ii. Combustion plant (such as heating appliances) running on conventional fuels, most commonly natural gas.

   iii. Other combustion processes (for example, waste incineration, thermal oxidation abatement systems).

   iv. Discharges from industrial processes.

   v. Fugitive (i.e. not effectively controlled) discharges from industrial processes and other sources.

   vi. Exhaust discharges from building ventilation systems.

   vii. Construction and demolition sites, which are a source of particles and vaporous discharges.

   viii. Other significant sources of local air pollution which may be detrimental to health.

Table 2.1 Limit values from Schedule 2 to the Air Quality Standards Regulations 2010

Pollutant	Exposure limit	Exposure time
Carbon monoxide	10mg/m^3	8-hour average
Sulphur dioxide	350µg/m^3	1-hour average
	125µg/m^3	1-day average
Nitrogen dioxide	200µg/m^3	1-hour average
	40µg/m^3	1-year average
Benzene	5µg/m^3	1-year average
Lead	0.5µg/m^3	1-year average
$PM_{2.5}$	25µg/m^3	1-year average
PM_{10}	50µg/m^3	1-day average
	40µg/m^3	1-year average

NOTE: This section only gives guidance for typical situations. Expert advice may also be able to provide additional guidance on the suitability of other technologies to minimise the intake of external air pollutants, including filtration.

Where these limit values are exceeded outside an opening used to remove excess heat, an alternative means of removing excess heat should be used.

Appendix E

REPORT LIMITATIONS

This report has been prepared for the titled project or named part thereof and should not be used in whole or part and relied upon for any other project without the written authorisation of UK Overheating Limited. UK Overheating Limited accept no responsibility or liability for the consequences of this document if it is used for a purpose other than that for which it was commissioned. Persons wishing to use or rely upon this report for other purposes must seek written authority to do so from the owner of this report and/ or UK Overheating Limited and agree to indemnify UK Overheating Limited for any and all loss or damage resulting therefrom. UK Overheating Limited accepts no responsibility or liability for this document to any other party other than the person by whom it was commissioned.

The findings and opinions expressed are relevant to the dates of the site works and design drawings/specifications and should not be relied upon to represent conditions at substantially later dates. Opinions included therein are based on information gathered during the study and from our experience. If additional information becomes available which may affect our comments, conclusions or recommendations UK Overheating Limited reserve the right to review the information, reassess any new potential concerns and modify our opinions accordingly.



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