

Overheating Study

Wild House Court, Wild House Lane, Milnrow, ROCHDALE, OL16 3JW

CIBSE TM59:2017

AG-78035-TM59-Rev A

22nd July 2024

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1. Executive summary

All sample modelled house types comply with the requirements of Part O / TM59, assessed to the MANCHESTER Weather file DSY1, based on the following.

Predominantly naturally ventilated meeting the requirements of Criterion A and Criterion B for predominantly mechanically ventilated that occupied rooms not exceed 26°C for more than 3% of occupied hours.

Noise

An acoustic report for the site was not provided, this report has been run on the basis that there not being any acoustic issues with average internal noise levels not higher than 40dB (LAeq,T) and a maximum of 55dB (LAFmax) , all first floor bedroom windows have been modelled as being openable during sleeping hours (between 11pm and 7am).

Pollution

An air quality report was not provided, this report has been run on the basis that there not being any issues with pollution that will affect windows being opened.

Security

Ground floor bedroom windows have been modelled to be closed during sleeping hours, between 11pm and 7am.

Protection from falling

AD.O Section 3.9 relates to openings less than 1100mm from floor level (build tolerance of +0mm, -100mm for escape windows) and states that openings that can be opened wider than 100mm may form part of the overheating mitigation strategy providing windows open outwards not more than 650mm, guarding is installed that meets minimum requirements and that the guarding does not allow children to easily climb.

Key points to note

- Window openings at first floor to be above 1100mm or guarded (build tolerance for escape windows +0/-100mm).
- Window g-Value ≤ 0.33 (Window)
- Window designs, window area, window openings, Discharge Coefficient values shown in section 8.
- Ground floor bedroom windows which cannot be securely opened during sleeping hours will require an alternative ventilation as a replacement to the opening window to provide nighttime cooling.

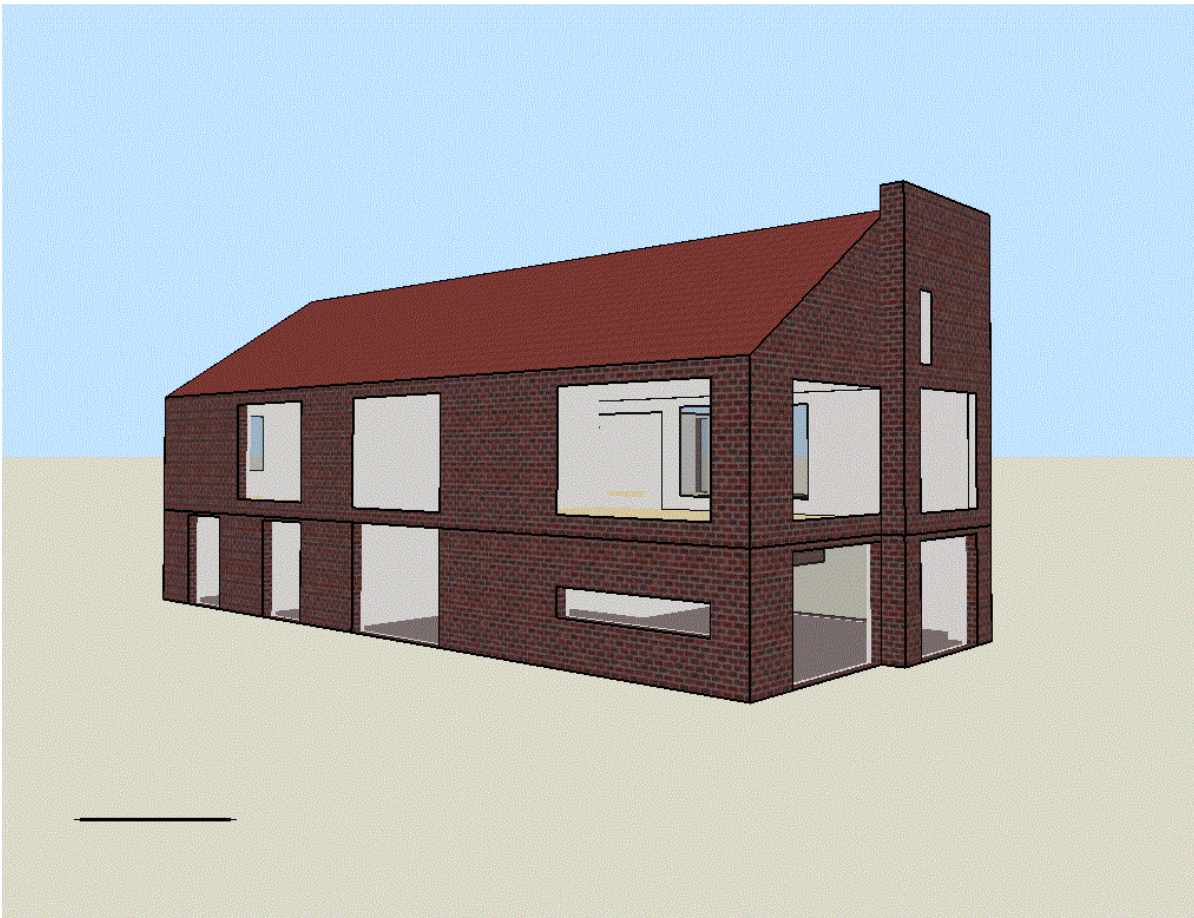
Mitigation measures

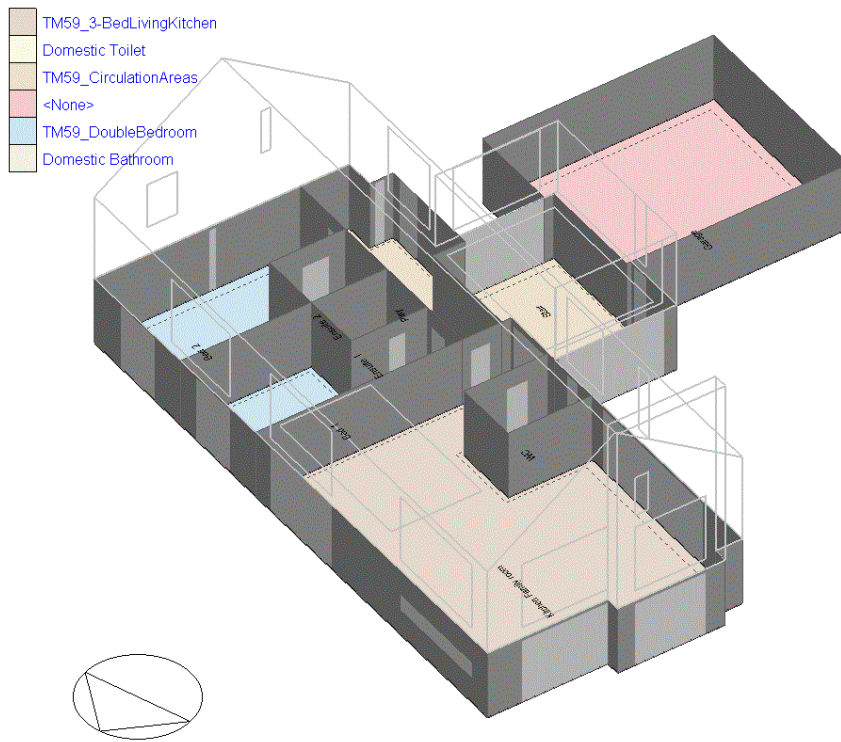
All windows form part of the overheating mitigation strategy, ground floor bedroom windows which cannot be securely opened during sleeping hours will require additional ventilation to provide the following.

- Bedroom 1 – 18litres / second
- Bedroom 2 – 18litres / second

Information on the boost operation of the Purge fan to be stated in the Home User Guide (HUG).

2. DSM Models





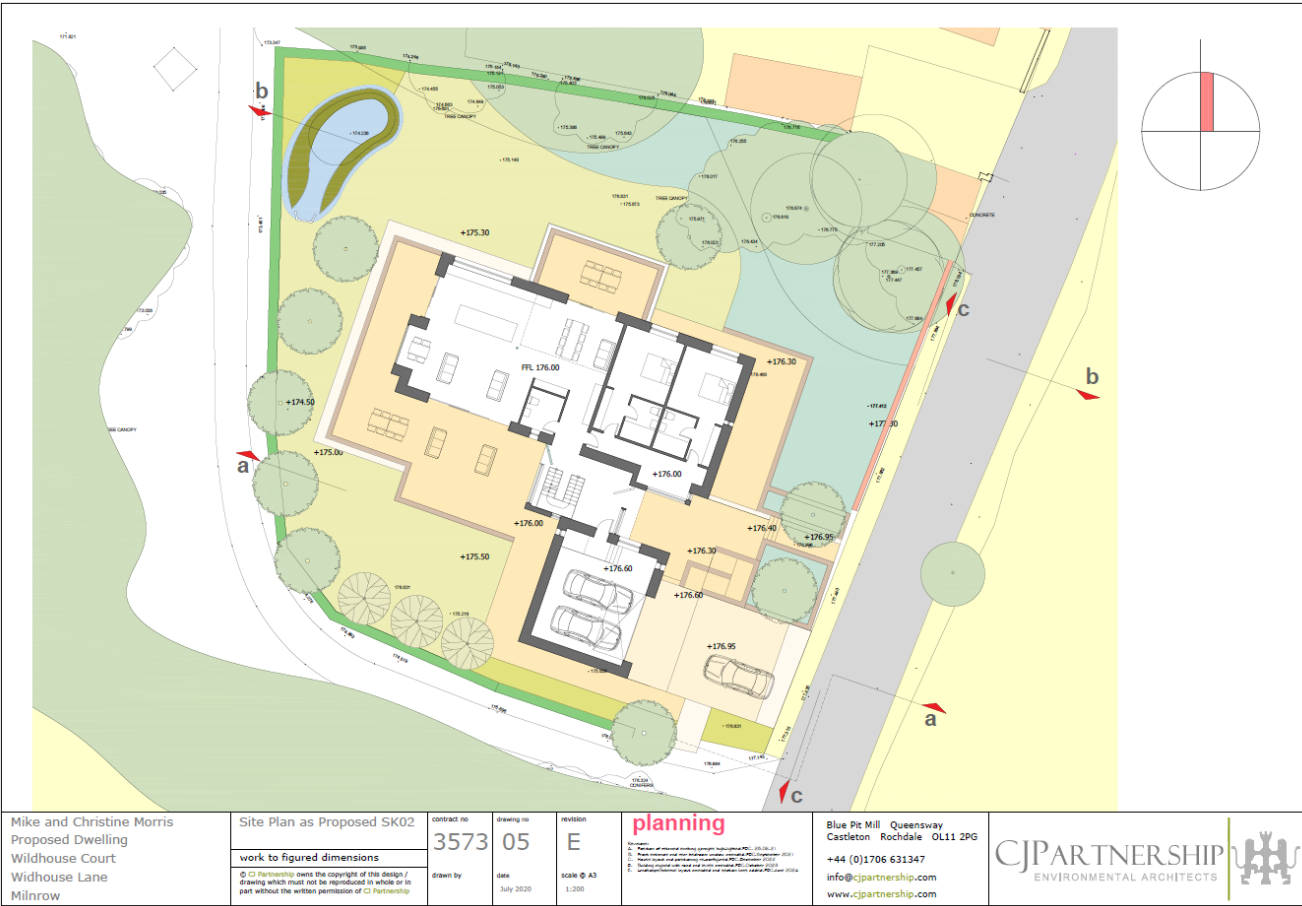
The building has been modelled using DesignBuilder Dynamic Simulation Modelling Software, using the EnergyPlus Simulation Engine version 7.1.2.006. (Part O, reference 2b.1)



The DSM model can be used to provide:

- Overheating analysis (this report)
- Energy consumption prediction
- Heating and Cooling Load prediction
- Thermal Fluid Dynamics Assessment
- Building Compliance Assessment (Building Regulations Part-L and EPC's)

3. Project details



Specification for Model

The following information has been used to produce the building model:

Construction Properties (Ref 2b.3)

U-Values:

Floor:	0.11w/m ² K
Walls:	0.18w/m ² K
Roof:	0.14w/m ² K
Windows:	U-Value 1.00w/m ² K, BFRC g-Value =< 0.33 (Window)
Door:	U-Value 1.00w/m ² K
Infiltration Rate:	4.00 ³ /h/m ² @50pa

Building Services (Ref 2b.3)

Heating:	Air Source Heat Pump
DHW:	From main system
Ventilation:	decentralised Mechanical Extract Ventilation (dMEV)
Purge Ventilation:	Predominantly Natural Ventilation
Lighting:	TM59 default lighting

Location Data

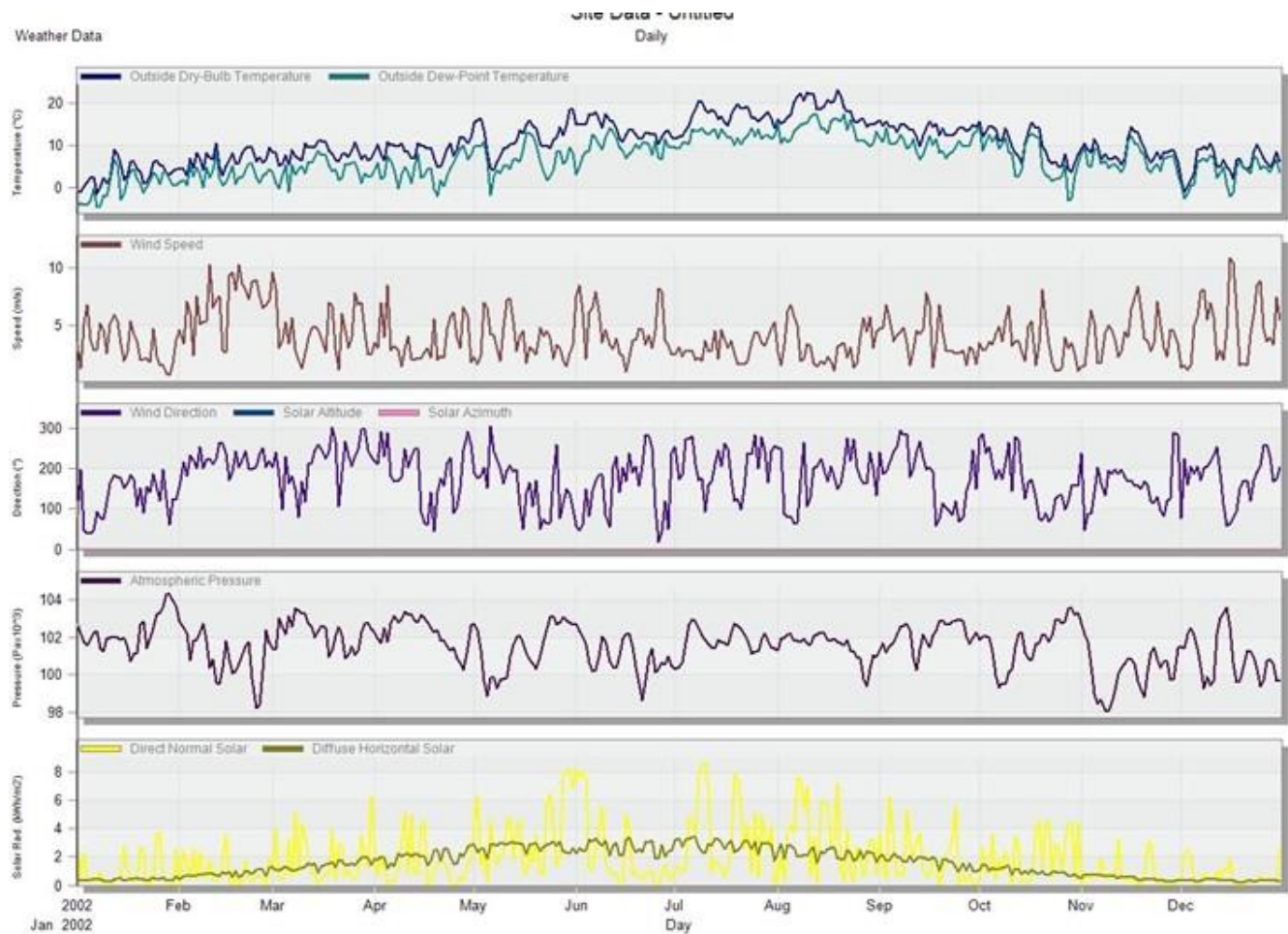
Building type:	Residential
Building Location:	ROCHDALE
Latitude:	53.35° North
Longitude:	-2.28° West

4. Weather Data (Ref 2b.1)

MANCHESTER, DSY 1 for the 2020s, high emissions, 50% percentile scenario.

Current Building Design

Weather data



5. Classification of Overheating

Predominantly naturally ventilated

Compliance is based on passing both of the following two criteria:

- a) For living rooms, kitchens and bedrooms: the number of hours during which DT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours. (CIBSE TM59 Criterion 1: Hours of exceedance).
- b) (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).

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 should assess overheating using the adaptive method based on CIBSE TM59 (2017), against criteria (a) and (b)

Predominantly mechanically ventilated

TM59 provides a single criterion for assessing comfort and overheating in predominantly mechanically ventilated buildings:

For homes with restricted window openings, the CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26 °C for more than 3% of the annual occupied annual hours (CIBSE Guide A (2015a)).

Noise

In locations where noise may be an issue windows are modelled during sleeping hours (between 11pm and 7am)

Security

When determining the free area available for ventilation during sleeping hours, only the proportion of openings that can be opened securely can be considered to provide useful ventilation, this would apply to Ground floor bedrooms and easily accessible bedrooms.

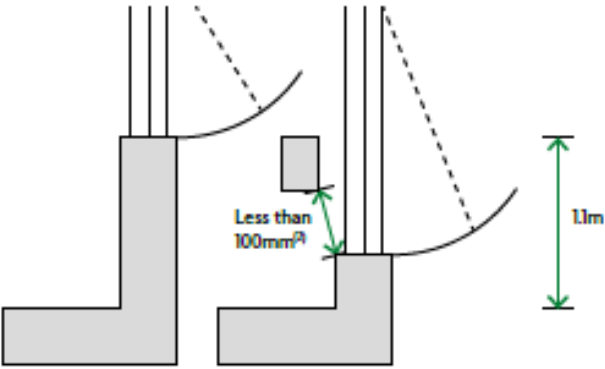
Protection from falling

Openings which are intended to be open for long periods to reduce overheating risk might pose a higher risk of falls from height. 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.

Window opening where there is greater than 600mm difference between external and internal floor levels and where the opening is less than 1100mm from internal floor level then openings that can be opened wider than 100mm may form part of the overheating mitigation strategy where they meet all of the following conditions.

- a. Window handles on windows that open outwards are not more than 650mm from the inside face of the wall when the window is at its maximum openable angle.
- b. Guarding meets the minimum standards in Table 3.1.
- c. Guarding does not allow children to easily climb it. For example, horizontal bars should generally be avoided.

Table 3.1 Guarding heights	
Change in floor level between inside and outside	Guarding height ⁽¹⁾
Less than 600mm	See Approved Document K
More than 600mm	1.1m



NOTES:

1. This approved document has increased levels of protection from falling compared to Approved Document K. Where applicable, the higher standard applies.
2. Guarding should be sized to prevent the passage of a 100mm sphere.

6. Acceptable strategies for reducing overheating risk

Limiting solar gains

Solar gains in summer should be limited by any of the following means.

- Fixed shading devices, comprising any of the following.

- Shutters.
- External blinds.
- Overhangs.
- Awnings.

- Glazing design, involving any of the following solutions.

- Size.
- Orientation.
- g-value.
- Depth of the window reveal.

- Building design – for example, the placement of balconies.

- Shading provided by adjacent permanent buildings, structures or landscaping.

Removing excess heat

Excess heat should be removed from the residential building by any of the following means.

- Opening windows (the effectiveness of this method is improved by **cross-ventilation**).
- Ventilation **louvres** in external walls.
- A mechanical ventilation system.
- A mechanical cooling system

7. Sampling (Ref 2b.1)

A sample of high-risk units has been selected for simulation, sampled units have been chosen due to the Following risk factors as they apply to the development.

- Restricted windows due to pollution
- Restricted windows at 100mm due to safety at height
- Restricted windows due to noise
- Plots with the large, glazed areas
- On the topmost floor
- Having less shading
- Having large south / southwest facing glazing
- Single aspect with no cross ventilation
- Windows having limited opening

Modelled Occupancy (Ref 2b.2)

Occupancy profiles used TM59 Occupancy profiles

Equipment profiles used TM59 Equipment profiles

Table 2 Occupancy and equipment gain descriptions

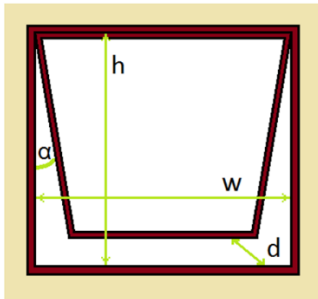
Unit/ room type	Occupancy	Equipment load
Studio	2 people at 70% gains from 11 pm to 8 am 2 people at 100% gains from 8 am to 11 pm	Peak load of 450 W from 6 pm to 8 pm*. 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and 10 pm to 12 pm Base load of 85 W for the rest of the day
1-bedroom apartment: living room/kitchen	1 person from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
1-bedroom apartment: living room	1 person at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 150 W from 6 pm to 10 pm 60 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 35 W for the rest of the day
1-bedroom apartment: kitchen	1 person at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 300 W from 6 pm to 8 pm Base load of 50 W for the rest of the day
2-bedroom apartment: living room/kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2-bedroom apartment: living room	2 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 150 W from 6 pm to 10 pm 60 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 35 W for the rest of the day
2-bedroom apartment: kitchen	2 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 300 W from 6 pm to 8 pm Base load of 50 W for the rest of the day
3-bedroom apartment: living room/kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
3-bedroom apartment: living room	3 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 150 W from 6 pm to 10 pm 60 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 35 W for the rest of the day
3-bedroom apartment: kitchen	3 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 300 W from 6 pm to 8 pm base load of 50 W for the rest of the day
Double bedroom	2 people at 70% gains from 11 pm to 8 am 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm 1 person at full gains in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single bedroom (too small to accommodate double bed)	1 person at 70% gains from 11 pm to 8 am 1 person at full gains from 8 am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
Communal corridors	Assumed to be zero	Pipework heat loss only; see section 3.1 above

8. Windows, Areas, Openings and Discharge Coefficient (Ref 2b.3)

The window areas and Discharge Coefficient values are based currently designed windows as shown in the various tables below.

ref	Room	Window area	Restrictions	Opening type	Stroke length, d (m)	Window opening %	Discharge coefficient, Cd	Equivalent area	Equivalent area %	Affective area	Affective area %
GF / Front	Kitchen / Family Room	13.20		Side		62%	0.58	7.68	58.19%	4.76	36.08%
FF / Front	Lounge	1.43		Side	0.450	50%	0.49	0.55	38.80%	0.34	24.06%
FF / Front	Sudy craft area	4.83		Top	0.450	57%	0.28	1.25	25.93%	0.78	16.08%
GF / Rear	Bed 1	4.50	Closed 11pm-7am	Side	0.450	49%	0.30	1.08	24.09%	0.67	14.94%
GF / Rear	Bed 2	4.50	Closed 11pm-7am	Side	0.450	49%	0.30	1.08	24.09%	0.67	14.94%
GF / Rear	Kitchen / Family Room	9.89		Side		45%	0.55	3.97	40.11%	2.46	24.87%
FF / Rear	Lounge	9.65		Side	0.450	25%	0.29	1.11	11.50%	0.69	7.13%
GF / Left	Kitchen / Family Room	6.82		Side		45%	0.55	2.68	39.33%	1.66	24.38%
GF / Left	Stair	12.14		Side		31%	0.53	3.22	26.50%	1.99	16.43%
FF / Left	Stair	10.15		Side	0.450	31%	0.31	1.57	15.51%	0.98	9.61%
GF / Right	Stair	9.63		Side		39%	0.53	3.22	33.40%	1.99	20.71%
FF / Right	Master	0.55		Side	0.318	65%	0.53	0.31	55.76%	0.19	34.57%
FF / Right	Ensuite	1.86		Side	0.450	85%	0.37	0.94	50.70%	0.58	31.43%
FF / Front	Master	7.85		Side	0.450	45%	0.29	1.64	20.89%	1.02	12.95%
FF / Rear	Master	5.53		Side	0.450	49%	0.26	1.15	20.82%	0.71	12.91%

Windows have been modelled based on Stroke length of 100mm for restricted windows and ≤ 450 mm (assuming 200mm from window handle to face of internal wall and maximum of 650mm), for all windows excluding patio doors.



During occupied hours between 8am to 11pm openings have been modelled to do all of the following. (Part O paragraphs 2.5 and 2.6)

- Start to open when the internal temperature exceeds 22°C.
- Be fully open when the internal temperature exceeds 26°C.
- Start to close when the internal temperature falls below 26°C.
- Be fully closed when the internal temperature falls below 22°C.

Shading strategy (Ref 2b.3)

Details for external and internal shading was not provided, the model has not taken account of any external or internal shading including curtains and blinds.

9. Ventilation Strategy (Ref 2b.3) & Overall overheating strategy (Ref 2b.4)

Natural (purge) ventilation is provided by opening windows. *The windows are simulated to be opened when a room is occupied and the operative temperature in the room is above 22 °C.*

Air infiltration through other openings, vents and cracks in the building structure is simulated and included in the natural ventilation rate, crack template set to 'good'.

Windows restriction: Ground floor bedroom windows closed during sleeping hours.

Internal doors: Door area opens 100%, door to be open 70% of the time to allow cross ventilation, TM59 occupancy.

Internal Conditions

Defined by dynamic simulation model as per TM59:2017, Section 6, Table 2:

Adjacent Buildings

Overshading from adjacent buildings has not been assessed in the model.

Ventilation rates

Simulations have been carried out based on the ventilation requirements to comply with Part F as per Table 1.2.

Table 1.2 Minimum extract ventilation rates for continuous extract systems ⁽¹⁾		
Room	High rate (l/s)	Continuous rate
Kitchen	13	The sum of all extract ventilation in the dwelling on its continuous rate should be at least the whole dwelling ventilation rate given in Table 1.3
Utility room	8	
Bathroom	8	
Sanitary accommodation	6	
NOTE:		
1. If the continuous rate of ventilation provided in a room is equal to or higher than the minimum high rate specified in the table, no extra ventilation is needed.		

Estimated ventilation rates are subject to confirmation by the mechanical designer / contractor.

10. Table of TM59 results by zone (Ref 2b.4)

2020's Simulation Results (CIBSE TM59:2017)

Criteria for predominantly naturally ventilated homes

Block	Zone	Criterion A (%)	Criterion B (hr)	Pass/Fail
LEVEL0	BED1	0.00	20.67	Pass
LEVEL0	BED2	0.00	10.00	Pass
LEVEL0	KITCHENFAMILYROOM	0.83	N/A	Pass
LEVEL1	LOUNGE	1.21	N/A	Pass
LEVEL1	MASTER	0.00	1.50	Pass

11. Conclusion

All sample modelled house types comply with the requirements of Part O / TM59 assessed to the MANCHESTER Weather file DSY1, based on the following.

Please refer to the window schedules and the calculated percentage of window, which is openable, the opening angle of the window, ventilation rates as well as the glazing specification in relation to g-Value used in this report. Actual window designs will need to meet or better the assumptions used in the TM59 overheating model for compliance with AD. Part O to be achieved.

Key points to note

- Window openings at first floor to be above 1100mm or guarded (build tolerance for escape windows +0/-100mm).
- Window g-Value ≤ 0.33 (Window)
- Window designs, window area, window openings, Discharge Coefficient values shown in section 8.
- Ground floor bedroom windows which cannot be securely opened during sleeping hours will require an alternative ventilation as a replacement to the opening window to provide nighttime cooling.

Mitigation measures

All windows form part of the overheating mitigation strategy, ground floor bedroom windows which cannot be securely opened during sleeping hours will require additional ventilation to provide the following.

- Bedroom 1 – 18litres / second
- Bedroom 2 – 18litres / second

Information on the boost operation of the Purge fan to be stated in the Home User Guide (HUG).

Example secure ventilation



Glazing g-Value guide

Double Glazing Units - g-value guide

g-value	Colour/tint	Product (6mm panes)
0.18	Clear/Neutral	Pilkington Suncool™ 30/16
0.20 - 0.28 **	Blue	Pilkington Activ SunShade™ Blue
0.21	Clear/Neutral	Pilkington Suncool™ One 30/21
0.23	Clear/Neutral	Pilkington Suncool™ 40/22
0.27	Clear/Neutral	Pilkington Suncool™ 50/25
0.28	Clear/Neutral	Pilkington Suncool™ 50/25 OW
0.28	Blue	Pilkington Suncool™ Blue 50/27
0.29 - 0.35 *	Blue	Pilkington Arctic Blue™
0.31	Silver	Pilkington Suncool™ Silver 50/30
0.31 - 0.41 *	Grey	Pilkington Optifloat™ Grey
0.32	Clear/Neutral	Pilkington Suncool™ 60/31
0.32 - 0.43 *	Bronze	Pilkington Optifloat™ Bronze
0.32 - 0.47 **	Clear/Neutral	Pilkington Activ SunShade™ Neutral
0.33 - 0.45 **	Blue	Pilkington Activ™ Blue
0.36 - 0.43 *	Green	Pilkington Optifloat™ Green
0.36 - 0.53 **	Bronze	Pilkington Activ™ Bronze
0.36	Clear/Neutral	Pilkington Suncool™ 66/33
0.37	Clear/Neutral	Pilkington Suncool™ 66/33 OW
0.37	Clear/Neutral	Pilkington Suncool™ 70/35
0.39	Clear/Neutral	Pilkington Suncool™ 70/35 OW
0.40	Clear/Neutral	Pilkington Suncool™ One 60/40
0.42	Clear/Neutral	Pilkington Suncool™ 70/40
0.45	Clear/Neutral	Pilkington Suncool™ 70/40 OW

- Colours for identification purposes only
- Figures based on IGU incorporating 6mm Pilkington **Optifloat™** Clear pane unless otherwise stated
- * g-value depends on which thermal insulation glass is selected as inner pane
- ** g-value depends on which thermal insulation glass is selected as inner pane (all based on 4 mm thickness)
- For higher g-values please refer to our Thermal Insulation glass product range
- For thicknesses other than above calculate using Pilkington Spectrum

Example purge fans

Lo-Carbon NBR Cool Unitary Fan

- Designed and manufactured in the UK
- Unitary solution to help combat overheating in dwellings
- Order made overheating extraction
- Sound levels complying with Part F building regulations
- Easy to commission with variable speed
- Local room control or automatic temperature sensor
- Passive Supply replacement air kit available when extract totals > 500/s



Lo-Carbon NBR Cool Unitary Fan
Part F ventilation rates should not meet minimum noise levels. The Vent-Axia Lo-Carbon NBR Cool Unitary Fan, in 125mm, provides adequate ventilation while minimising noise.

The fan is designed in line with the Approved Document F and G 2021 Building Regulations.

The Lo-Carbon NBR Cool Unitary Fan has been designed to extract heat as and when the occupant needs heat extraction. As standard the Lo-Carbon NBR Cool Unitary Fan is set to run at 20 1/s which is adjustable.

The Lo-Carbon NBR Cool Unitary Fan also comes with the additional option of automatic temperature control, this would be triggered when the sensor reads 24 degrees or above.

A brand new control platform also provides fully adjustable airflow, meaning Part F rates can be achieved easily.

The solution comes complete with backdraught shutter to prevent nuisance draughts in habitable rooms.

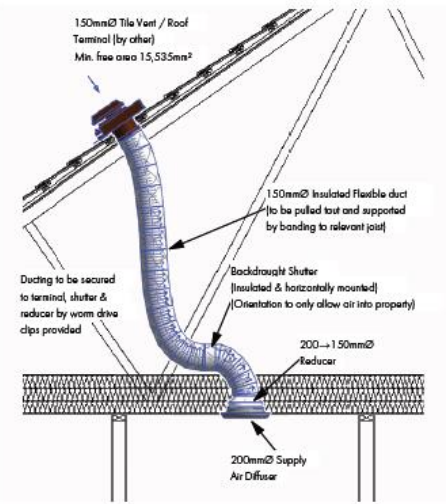
Near Silent Operation
The fan has been designed to be as discreet as possible for homeowners, with independently tested sound levels as low as 8.5dB(A).

Model
Lo-Carbon NBR Cool Unitary Fan
for habitable rooms such as bedrooms and living rooms, our new 125mm heat extraction fan is the solution for dwellings with overheating issues. With a built-in temperature sensor as standard, automation or manual control are both an option.

Variable speed setting		
Model	Lo-Carbon NBR Cool Unitary Fan	Stock Ref
		412202

Accessories

Model	Stock Ref
Wall Kit White 125mm	455226
Wall Kit Brown 125mm	497434
Wall Kit Terrace 125mm	497432
NBR Passive Duct Kit	412261



ACM 100-200

- Designed and manufactured in the UK
- Three speed motor
- Timer versions available
- Removable motor core
- Rotating motor chassis
- IP44 rated
- Aesthetically pleasing with wipe clean polymer casing
- Sound data from independent testing
- Running speed selected on installation



Ducted Ventilation
Vent-Axia has designed a complete range of energy efficient Mixed Flow In-line fans that are now quieter, offer two and half times the pressure of conventional axial fans and are dimensionally more compact making them ideal for many ducted applications.

The ACM Mixed Flow In-line fan can operate in both horizontal and vertical positions.

Motor
All motors have three speeds selectable on installation and are fitted with Standard Thermal Overload Protection (S.T.O.P.). Designed for ambient temperatures up to +50°C. All sizes with capacitor run motors. All sizes are Class II appliances. Supply voltage 220-240V/1/50Hz.

Models		Stock Ref
Model		
ACM100		17104010
ACM100T		17104020
ACM125		17105010
ACM125T		17105020
ACM150		17106010
ACM150T		17106020
ACM200		17108010
ACM200T		17108020

Dimensions (mm)				
	100	125	150	200
AØ	107	122	147	199.5
B	178	179	200	223
C	124	124	138	144
D	208	250	350	300
E	96	96	118	130
F	168	168	192	195
G (flange hole)	120	120	162	100
H (flange hole)	153.5	153.5	178	180

Installation
These units have a separate footplate for simple location mounting and detachable spigots for simple connection to ducting. The motor body chassis rotates to provide connection in acute spaces. Clearing the product is simple as all parts can be removed without removing the ducting.

Controller
For optimum variable speed performance use a Vent-Axia 1.5 Amp electronic controller. Surface mounted providing variable speed control with on/Off sensor slider with indication light. There is an adjustable minimum speed setting. The controller has electrical connections for use with suitable external sensors. Cannot be used with timer models.

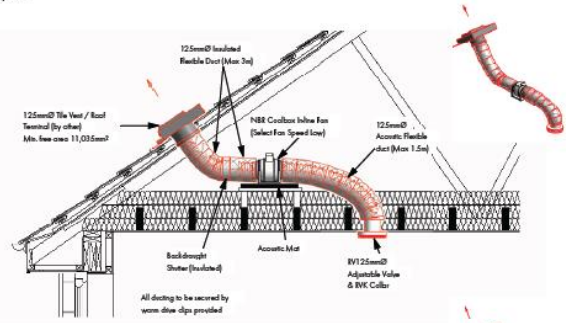
1.5 Amp Controller (Suitable for 100mm - 200mm models). Dimensions: 80 x 150 x 53mm (H x W x D).
Stock Ref
W300310

For flush fitting, a metal wall box accessory is available.
Stock Ref
400144

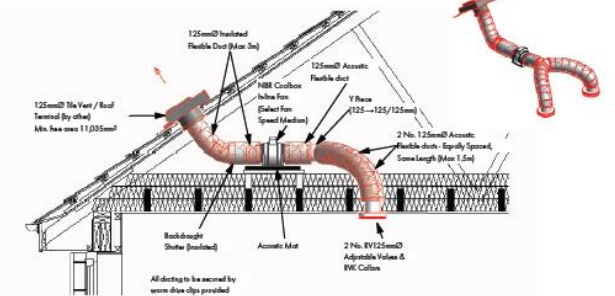
Hole for wall box: 80 x 150 x 150mm (H x W x D).

Installation Examples

NBR CoolBox 20



NBR CoolBox 30



Vent-Axia

zehnder
always the
best climate

Zehnder AID100

The Zehnder AID100 is an acoustically lined induct 100mm fan. It is ideal for residential applications where the habitable rooms are at risk of overheating, or require purge ventilation due to sealed windows on noise sensitive sites or within a AQMA (Air Quality Management Area).



SDC1

Key Features

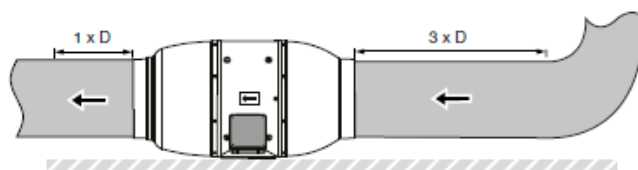
- Acoustically lined to prevent nuisance running noise when active.
- Designed to fit within a ceiling void, cupboard or loft space.
- 100% variable speed control via optional SDC1 controller.
- Two predefined speeds possible (high / low) using switching by others without the need for SDC1 controller.
- Can be installed in any orientation, horizontal, vertical, on floor, wall or ceiling.
- 4 air changes an hour for rooms up to 13m² per fan, large rooms can use multiple fans wired in parallel

Sound Data

Speed	Test area	Octave Band (Hz) Sound Power Level, dB								dB(A) @ 3m
		63	125	250	500	1000	2000	4000	8000	
Max	Inlet	19	18	29	35	39	39	31	24	
	Outlet	20	19	30	38	42	35	35	23	
	Environment	15	14	17	25	29	21	22	14	13.73

Casing tested according to ISO 3741:2010. Inlet and Outlet tested according to ISO 5136:2003 Acoustics-Determination of sound power radiated into a duct by fans and other air-moving devices – In-duct method. Environment dB(A) @ 3m given as hemispherical.

Air Direction/Connection



Arrow on the unit denotes airflow direction.

Ensure bends are 3 x Diameter away from the unit on air entering the unit and 1 x Diameter on air exiting the unit.

References are in relation to the building designer's declaration requirements from Approved Document Part O, Appendix B: Compliance checklist, Part 2b.

