



# Method Consulting

Intelligent engineering,  
sustainable buildings

Land to the west of Rodney Street, Manchester

Thermal Comfort Report

Wates Construction Ltd

June 2022

## Document History

This document has been revised and issued as below:

| Revision | Date     | Description                | Created by | Approved by |
|----------|----------|----------------------------|------------|-------------|
| P01      | 20/05/22 | Thermal Comfort Report     | JWM        | MAS         |
| P02      | 08/06/22 | Updated following comments | MLP        | DMS         |
|          |          |                            |            |             |
|          |          |                            |            |             |
|          |          |                            |            |             |

## Executive Summary

A thermal comfort analysis for RIBA stage 3 was performed for the proposed residential development located at *Land to the west of Rodney Street, Manchester*, on behalf of the client, Wates Construction Ltd.

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

- The building complies with the mandatory thermal comfort requirements as set out in CIBSE Technical Memorandum 59 (TM59) “*Design methodology for the assessment of overheating risk in homes*”.
- Each of the buildings complies with the adaptive thermal comfort requirements as set out in CIBSE Technical Memorandum 52 (TM52) “*The Limits of Thermal Comfort: Avoiding Overheating in European Buildings*”, including both the residential and communal spaces.

These results were achieved based on the following assumptions:

- Chosen u-values and g-values:

| Construction Type                                                                      | U-Value (W/m <sup>2</sup> K) | G-Value              |
|----------------------------------------------------------------------------------------|------------------------------|----------------------|
| External Wall (Blocks A & B)                                                           | 0.18                         | -                    |
| External Wall (Townhouse)                                                              | 0.09                         | -                    |
| Internal Wall                                                                          | 1.79                         | -                    |
| Roof (Blocks A & B)                                                                    | 0.18                         | -                    |
| Roof (Townhouse)                                                                       | 0.09                         | -                    |
| Ground Floor (Blocks A & B)                                                            | 0.12                         | -                    |
| Ground Floor (Townhouse)                                                               | 0.1                          | -                    |
| Glazing (Blocks A & B)                                                                 | 0.88                         | 0.49                 |
| Glazing (Blocks A & B: Lower g-Value)                                                  | 0.88                         | 0.3 (See Appendix A) |
| Glazing (Townhouse)                                                                    | 0.93                         | 0.5                  |
| Louvre                                                                                 | 1                            | -                    |
| Air Permeability (Blocks A & B/Townhouse) – 1/0.85 m <sup>3</sup> /(h.m <sup>2</sup> ) |                              |                      |

- Internal gains in residential spaces based on TM59 specifications, with communal internal gains based on expected occupancies and usage of each room type.

- The residential and communal areas within the apartment blocks and townhouses benefit from natural ventilation through operable windows, with opening angles sufficient to provide adequate ventilation to meet thermal comfort requirements.
- The residential and communal areas within the apartment blocks and townhouses are mechanically ventilated via MVHR units with high efficiency fans and heat recovery.
- Active cooling is provided in both the comms room and the larger residents amenity space in Block B.
- Design changes as specified in Section 8.3.3 for the communal spaces and Appendix J for the residential spaces.

## Contents

|           |                                                   |           |
|-----------|---------------------------------------------------|-----------|
| <b>1</b>  | Introduction.....                                 | <b>1</b>  |
| <b>2</b>  | Project Description .....                         | <b>2</b>  |
| <b>3</b>  | Planning Policy Context and Project Targets ..... | <b>2</b>  |
| <b>4</b>  | Methodology .....                                 | <b>3</b>  |
| <b>5</b>  | Assumptions .....                                 | <b>11</b> |
| <b>6</b>  | NCM Profiles.....                                 | <b>22</b> |
| <b>7</b>  | Internal Gains .....                              | <b>22</b> |
| <b>8</b>  | Overheating Risk Assessment .....                 | <b>22</b> |
| <b>9</b>  | Approved Document O .....                         | <b>25</b> |
| <b>10</b> | Conclusion .....                                  | <b>26</b> |
| <b>11</b> | Appendices .....                                  | <b>27</b> |

## 1 Introduction

Method Consulting LLP has been appointed to carry out a thermal comfort analysis and hence produce an Acoustics, Ventilation and Overheating (AVO) report for the proposed residential development, located at Land to the west of Rodney Street, Manchester on behalf of the client, Wates Construction Ltd. This report has been written to summarise the process undertaken and outline the results of the thermal comfort analysis.

A sample of various apartment types and townhouses was assessed for compliance with CIBSE TM59 “Overheating in homes”. 15 apartments and 3 townhouses were modelled. A sample of each apartment type was analysed to cover a variety of living arrangements and samples were also selected based on their potential to present the most likely risk of overheating.

3 of these apartments were included in the sample as they were identified in the noise assessment, ‘22013-M004-E 3D modelling & level 2 AVO assessment’ (Sandy Brown) as rooms subject to uncomfortable noise levels and therefore requiring constraints on window openings to meet acoustic targets

Furthermore, communal spaces within the apartment blocks have been assessed for thermal comfort using CIBSE TM52 guidance.

The following weather file has been used:

- Manchester Design Summer Year (DSY1) 2020 50% High emissions

## 2 Project Description

**Project:** This City residential development, Ancoats, Manchester

This City is a new kind of housing company, owned and run by Manchester City Council. They are a new venture that will develop high quality, low carbon housing for all Mancunians. The new homes will be a mix of market housing and homes designated for Manchester Living Rent (to be rented at or below Local Housing Allowance levels). Market housing will subsidise the provision of the Manchester Living Rent properties.

**Description of Development:** Erection of two residential apartment buildings (Use Class C3), one of 8 storeys (68 apartments) and one of 5 storeys (50 apartments), to form a total of 118 residential apartments; and erection of 10, 3 storey townhouses (Use Class C3); together with car and cycle parking provision, hard and soft landscaping including public realm, access, substation, and other associated works.

## 3 Planning Policy Context and Project Targets

### 3.1 National Planning Policy Framework (NPPF)

The National Planning Policy Framework does not make direct reference to thermal comfort. However, Section 14 (Meeting the challenge of climate change, flooding and coastal change), paragraph 153, states,

*“Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures”.*

### 3.2 Manchester Local Planning Requirements

Manchester City Council’s Core Strategy 2012 to 2017, Policy EN 8 (Adaption to Climate Change) states,

*“in achieving developments which are adaptable to climate change developers should have a regard to...: the need to control overheating of buildings through passive design.”*

Furthermore, the Council's Core Strategy states that,

*"The Council is keen to see all measures taken to reduce the negative impacts of climate change and ensure that the building stock is fully future proofed".*

In response to this, the weather file used to carry out the thermal modelling for this development is the Manchester\_DSY1\_2020High50 weather file. Compliance with this weather file is considered applicable until 2040.

### **3.3 Acoustics, Ventilation and Overheating Residential Design Guide**

As stated in the in the 'Acoustics, Ventilation and Overheating Residential Design Guide' (ANC, 2020), there is no specific requirement relating to overheating in building legislation. Both Approved Document F and Approved Document L1A of the Building Regulations briefly mention overheating but do not provide details on what constitutes overheating.

The Design Guide further points out that *CIBSE Guide: TM59* sets out a methodology for predicting temperatures inside dwellings and also provides overheating compliance criteria, and as such, it provides the basis and targets for the overheating analysis presented within this report.

The specific criteria against which the buildings will be assessed, using the IES Virtual Environment as a platform to carry out thermal modelling, are explained in Section 8 of this report.

## **4 Methodology**

Analysis was carried out using the dynamic simulation software IES VE (Integrated Environmental Solutions Virtual Environment), Version 2019.3.1.0. The analysis was conducted by a qualified and competent person.

### **4.1 Geometry**

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

1. "RODSTA-BUT-B-ZZ-M-A-0003-Block B-S2- Issued for Information-P05\_LT\_03May2022\_110432.rvt" (received from Buttress architects – 3<sup>rd</sup> May 2022)

2. "RODSTA-BUT-A-ZZ-M-A-0002-Block A-S2- Issued for Information-P05.rvt" (received from Buttress architects – 3<sup>rd</sup> May 2022)
3. "RODSTA-BUT-TA-ZZ-M-A-0004-Townhouse Block A-S2-Issued for Information-P04.rvt" (received from Buttress architects – 3<sup>rd</sup> May 2022)
4. RODSTA-BUT-ZZ-ZZ-M-A-0001-Site-S2- Issued for Information-P03.rvt (received from Buttress architects – 3<sup>rd</sup> May 2022)

The following drawings were used for the purposes of room names only:

5. "RODSTA-BUT-A-00-DP-A-02105-Residential Block A.PDF" (received from Buttress architects – 5<sup>th</sup> April 2022)
6. "RODSTA-BUT-B-00-DP-A-02114-Residential Block B - Ground Floor Area Plan. PDF" (received from Buttress architects – 5<sup>th</sup> April 2022)

Additional changes were made to the model in consultation with the architects to improve daylighting and overheating results. Details of these changes are presented in Appendix J.

## 4.2 Acoustic modelling

Opening windows to mitigate overheating through use of natural ventilation can often produce uncomfortable levels of internal noise if there are loud external sources. The northern part of the Rodney Street site has been identified as 'High Risk' due to its close proximity to a busy road, and therefore a Level 2 AVO assessment was conducted by the acoustician (Sandy Brown) as per AVO guidelines (Appendix K). This assessment predicted a risk of uncomfortable internal ambient noise levels in living rooms and bedrooms in Block A based on the sample of rooms provided by Method LLP.

### 4.2.1 AVO Assessment

It can be seen in the Level 2 assessment of noise in Appendix K, that in all instances assessed, the predicted noise levels fall below the AVO SOAEL thresholds even if the windows are open 'most of the time', except for a select few spaces listed in Section 4.3 of this report.

For the purpose of this report, the rooms that were identified as rooms of acoustic concern have been modelled with the windows closed during the problem period (daytime). Although there is some scope to open windows for different portions of time during the daytime depending on the space in question, windows are modelled as closed. This enables the ventilation required to mitigate against overheating to be sized against a conservative and future-proofed set of results.

### 4.3 Apartment selection

The proposed residential development contains varying numbers of each apartment type. For this analysis, 10% (7 of 68) of Block A apartments, 10% (5 of 50) of Block B apartments and 3 of 10 townhouses were modelled, with an additional three apartments chosen in Block A which were considered to be of greatest acoustic concern, as identified in the noise assessment, shown in Appendix K. The sample of apartments and townhouses vary in types and were chosen due to their positioning and orientation as they were felt to have the highest potential for overheating.

A list of the 15 chosen apartments and 3 chosen townhouses can be seen below:

- Block A - 00 - Flat 007 (2B4P)
- Block A - 01 - Flat 004 (2B4P)
- Block A - 01 - Flat 005 (2B4P)
- Block A - 06 - Flat 005 (2B4P)
- Block A - 06 - Flat 007 (1B2P)
- Block A - 06 - Flat 009 (2B4P)
- Block A - 07 - Flat 005 (2B4P)
- Block A - 07 - Flat 004 (2B4P)
- Block A - 07 - Flat 009 (2B4P)
- Block A - 07 - Flat 008 (1B2P)
- Block B - 02 - Flat 011 (2B4P)
- Block B - 03 - Flat 007 (2B4P)
- Block B - 04 - Flat 007 (2B4P)
- Block B - 04 - Flat 002 (2B4P)
- Block B - 04 - Flat 010 (1B2P)
- Townhouse 01 (4B7P)
- Townhouse 07 (3B5P)
- Townhouse 10 (4B7P)

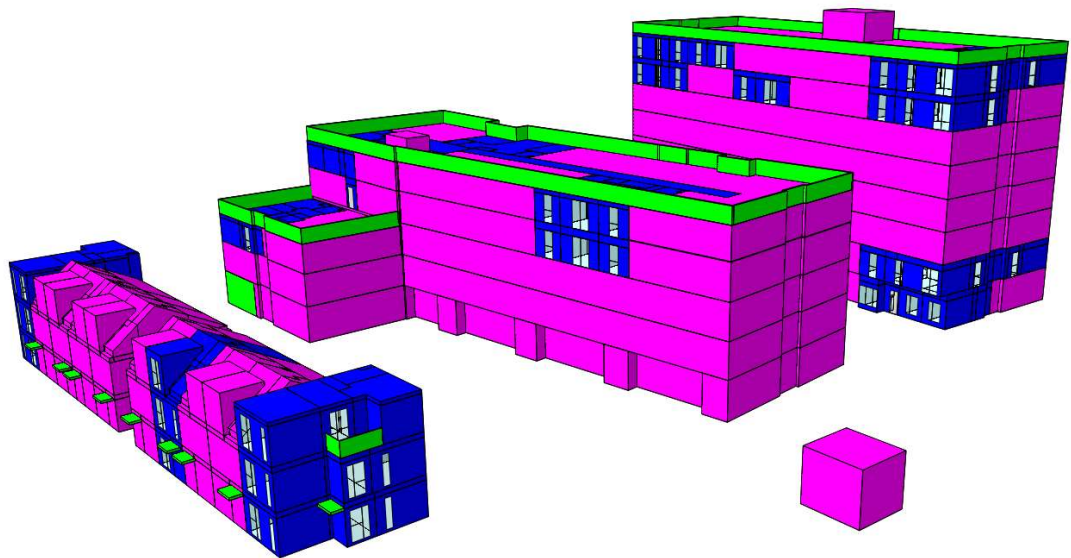
A list of the spaces within the modelled sample have been categorised in the acoustic report as “high risk”. These acoustically constrained spaces can be seen below:

- A00: Flat 007 – Bedroom 1 (Double)
- A00: Flat 007 – Bedroom 2 (Double)
- A01: Flat 004 – Bedroom 1 (Double)
- A01: Flat 004 – Bedroom 2 (Double)
- A01: Flat 004 – Living Room

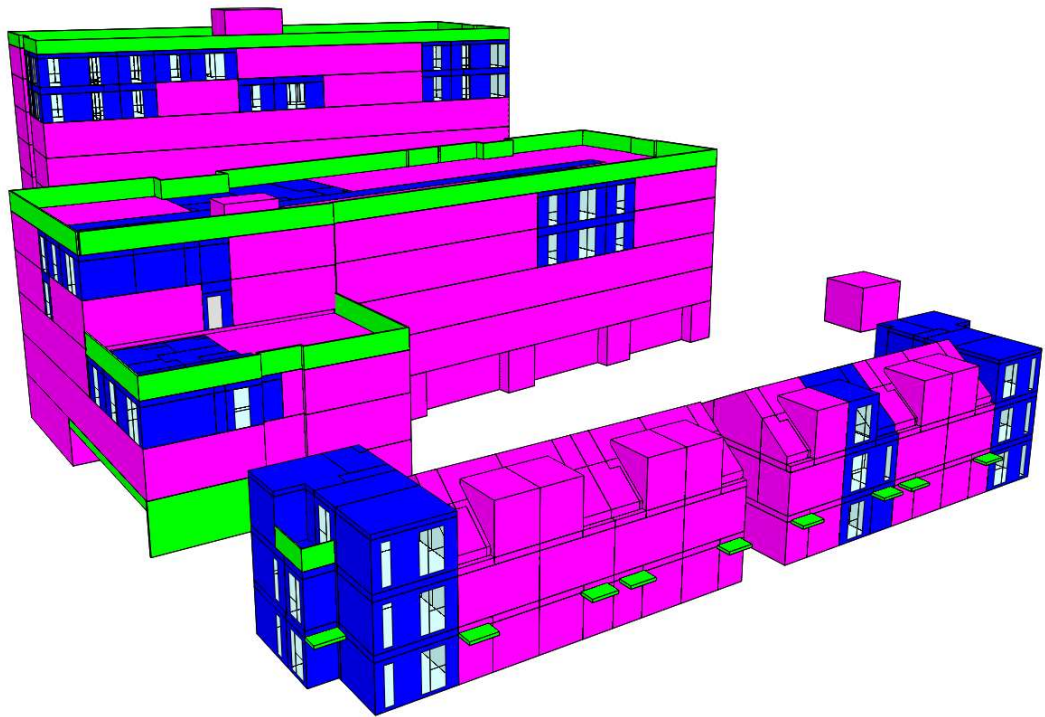
- A01: Flat 004 – Kitchen
- A01: Flat 005 – Bedroom 1 (Double)\*
- A01: Flat 005 – Bedroom 2 (Double)\*
- A01: Flat 005 – Living Room\*
- A01: Flat 005 – Kitchen\*
- A07: Flat 004 – Living Room
- A07: Flat 004 – Kitchen

\* It should be noted that A01: Flat 005 was added to the sample after the Level 2 AVO assessment was carried out and therefore has been assumed to have the same noise levels as a worst-case adjacent apartment.

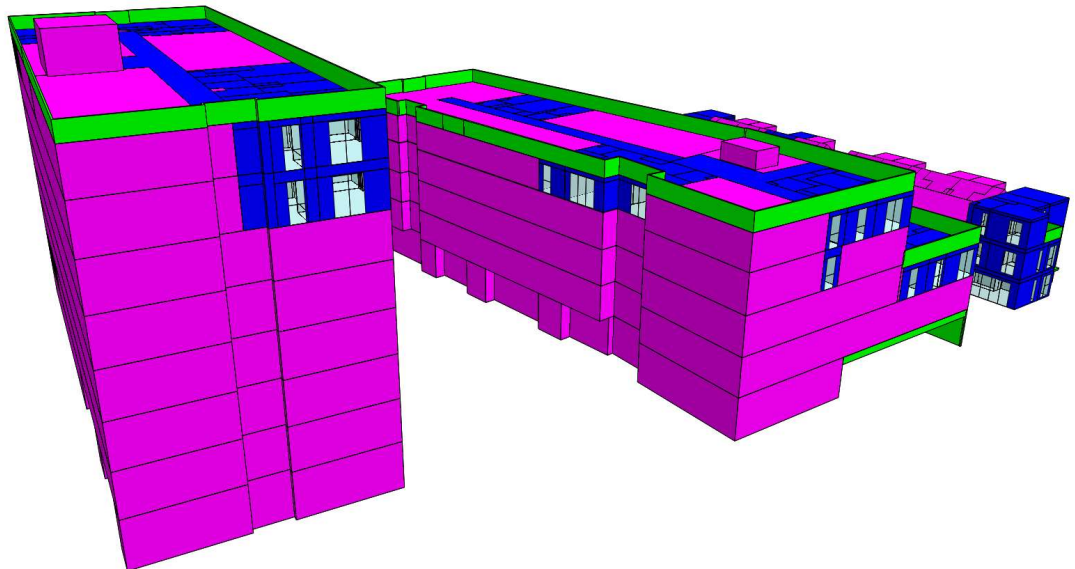
The constructed Residential Model in IES, and the 15 modelled apartments and 3 modelled townhouses in blue, can be seen in Figures 4.3.1 to 4.3.4.



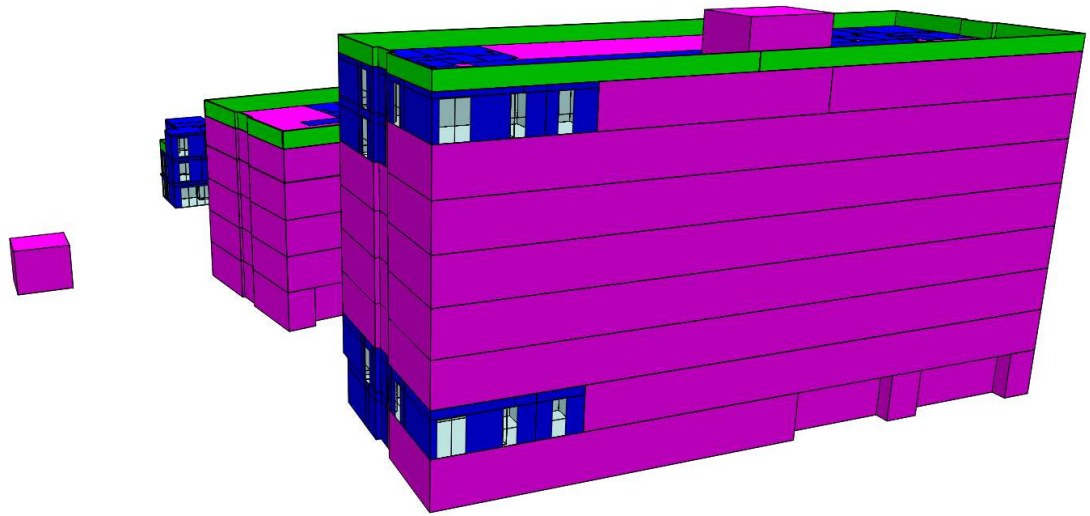
*Figure 4.3.1: IES Virtual Environment Residential Model (View from the East)*



*Figure 4.3.2: IES Virtual Environment Residential Model (View from the South)*



*Figure 4.3.3: IES Virtual Environment Residential Model (View from the West)*



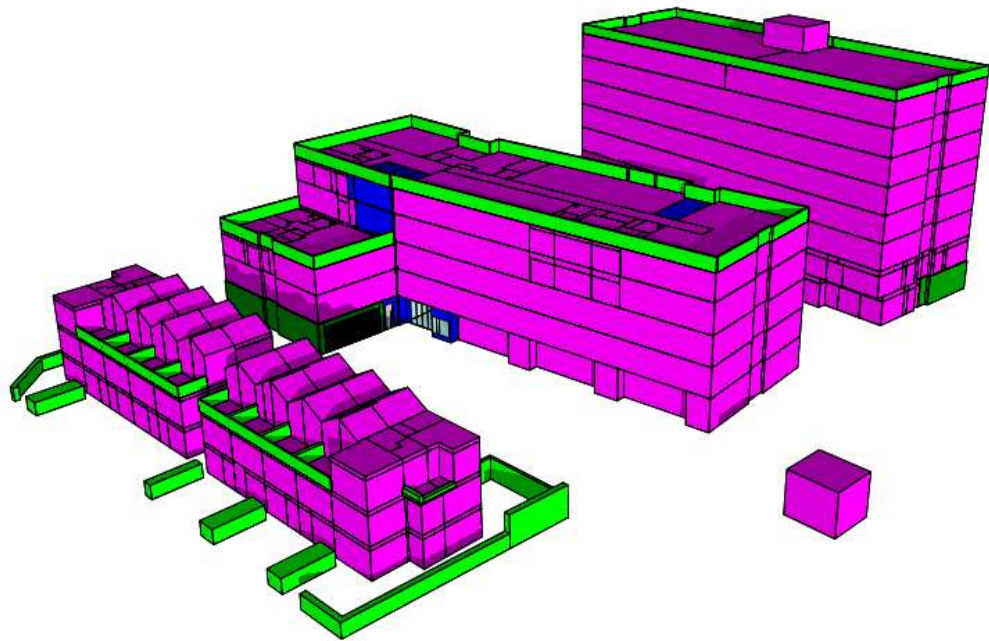
*Figure 4.3.4: IES Virtual Environment Residential Model (View from the North)*

## 4.4 Communal Spaces

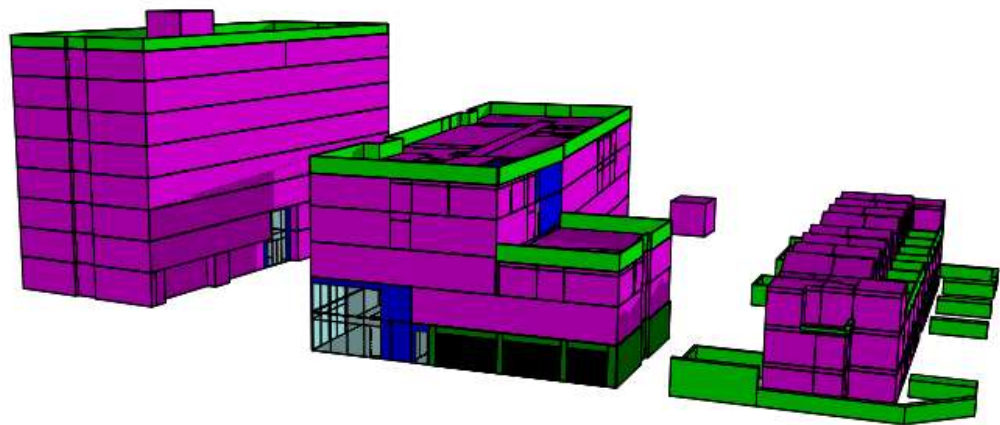
A list of the communal spaces modelled can be seen below:

- A01: Block A stairs
- A01: Lobby 1
- B01: Block B Stairs
- B00 Comms
- B00: Concierge
- B00: Lobby 1 & 2
- B00: LV Switch Room
- B00: Management Suite
- B00: Management Suite WC
- B00: Post Room
- B00: Residential Entrance
- B00: Residents Amenity 1 & 2
- B00: Riser
- B00 Secondary Entrance

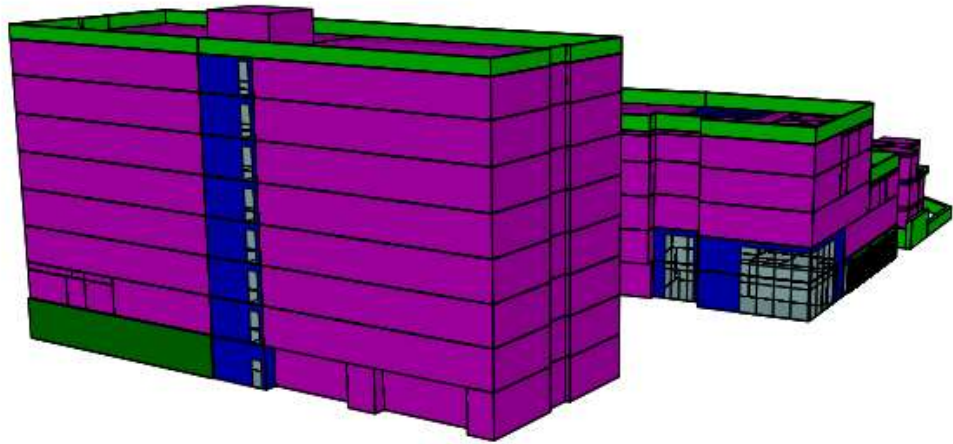
The constructed Communal model in IES, and the modelled communal spaces in blue can be seen in Figures 4.4.1 to 4.4.3.



*Figure 4.4.1: IES Virtual Environment Communal Model (View from the East)*



*Figure 4.4.2: IES Virtual Environment Communal Model (View from the Southwest)*



*Figure 4.4.3: IES Virtual Environment Communal Model (View from the Northwest)*

## 5 Assumptions

### 5.1 Building Fabric

#### 5.1.1 U-Values

The assumed u-values and g-values of the building constructions are as described below:

| Construction Type                                                                      | U-Value (W/m <sup>2</sup> K) | G-Value |
|----------------------------------------------------------------------------------------|------------------------------|---------|
| External Wall (Blocks A & B)                                                           | 0.18                         | -       |
| External Wall (Townhouse)                                                              | 0.09                         | -       |
| Internal Wall                                                                          | 1.79                         | -       |
| Roof (Blocks A & B)                                                                    | 0.18                         | -       |
| Roof (Townhouse)                                                                       | 0.09                         | -       |
| Ground Floor (Blocks A & B)                                                            | 0.12                         | -       |
| Ground Floor (Townhouse)                                                               | 0.1                          | -       |
| Glazing (Blocks A & B)                                                                 | 0.88                         | 0.49    |
| Glazing (Blocks A & B: Lower g-Value shown in Appendix A)                              | 0.88                         | 0.3     |
| Glazing (Townhouse)                                                                    | 0.93                         | 0.5     |
| Louvre                                                                                 | 1                            | -       |
| Air Permeability (Blocks A & B/Townhouse) – 1/0.85 m <sup>3</sup> /(h.m <sup>2</sup> ) |                              |         |

*Table 5.1.1.1 Construction u and g values*

#### 5.1.2 Thermal Mass

The assumed thermal mass of the building constructions are as described in the table below. These constructions are taken as the default IES constructions:

| Element                  | Construction Type               | Location | Thermal Mass |
|--------------------------|---------------------------------|----------|--------------|
| External Wall            | Cavity SFS with external brick  | All      | Lightweight  |
| Roof                     | Concrete deck with cavity       | All      | Mediumweight |
| Ground Floor             | Reinforced Concrete             | All      | Lightweight  |
| Floor/Ceiling            | Reinforced Concrete with cavity | All      | Lightweight  |
| Internal walls           | Plasterboard partition          | All      | Lightweight  |
| Lift/Core internal walls | Blockwork                       | Block B  | Mediumweight |

*Table 5.1.2.1 Detailed constructions used in IES VE model*

## 5.2 Ventilation Strategy

The buildings utilise a mixed mode ventilation strategy, being both naturally ventilated via operable windows and mechanically ventilated via MVHR units with high efficiency fans and heat recovery.

### 5.2.1 Natural Ventilation (Residential)

The dimensions and opening angles of operable windows and glazed doors for the residential areas are provided in the table below. These opening angles are the minimum angle required to supply sufficient natural ventilation to achieve overheating requirements for all occupied spaces.

Internal doors are included in the model and assumed open during the daytime.

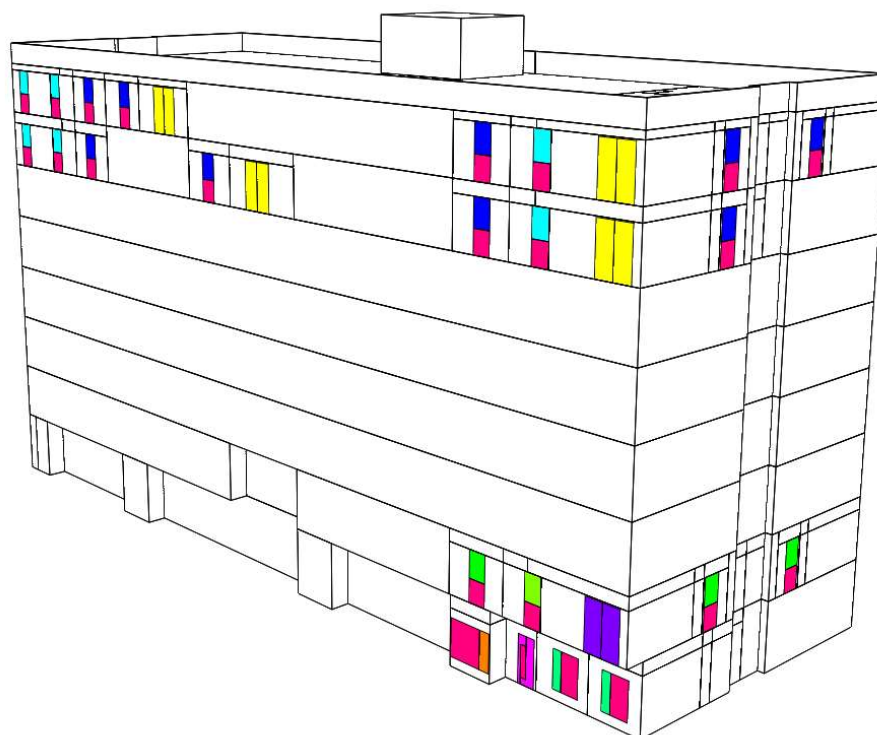
The opening types, opening angles, opening dimensions, and opening locations for Apartment Blocks A and B are as below:

| Residential Opening Types - Apartments |                                      |                  |               |                                |        |
|----------------------------------------|--------------------------------------|------------------|---------------|--------------------------------|--------|
| Ref                                    | Blocks A & B Opening Types           | Dimensions (WxH) | Opening Angle | Location (Modelled)            | Colour |
| A                                      | Internal Door                        | (Variable)       | 90°           | All Bedrooms                   |        |
| B                                      | External Door                        | (Variable)       | N/A           | Floors A00, B03                |        |
| C                                      | Fixed Glazing                        | (Variable)       | N/A           | All modelled                   |        |
| D                                      | Glazed Juliet Balcony Door (Living)  | 880x2350mm       | 90°           | Floors A06, A07, B02, B03, B04 |        |
| E                                      | Glazed Juliet Balcony Door (Bedroom) | 880x2350mm       | 90°           | Floor B04                      |        |
| F                                      | Bedroom Window Bottom-hung           | 900x1300mm       | 15°           | Floors A06, A07, B02, B03, B04 |        |
| G                                      | Living Room Window Bottom-hung       | 900x1300mm       | 15°           | Floors A06, A07, B02           |        |
| H                                      | *GF Living Room Window Side-hung     | 550x1810mm       | 15°           | Floor A00                      |        |
| I                                      | *GF Bedroom Window Side-hung         | 450x1810mm       | 20°           | Floor A00                      |        |
| J                                      | *Bedroom Window Bottom-hung          | 900x1300mm       | 15°           | Floor A01                      |        |

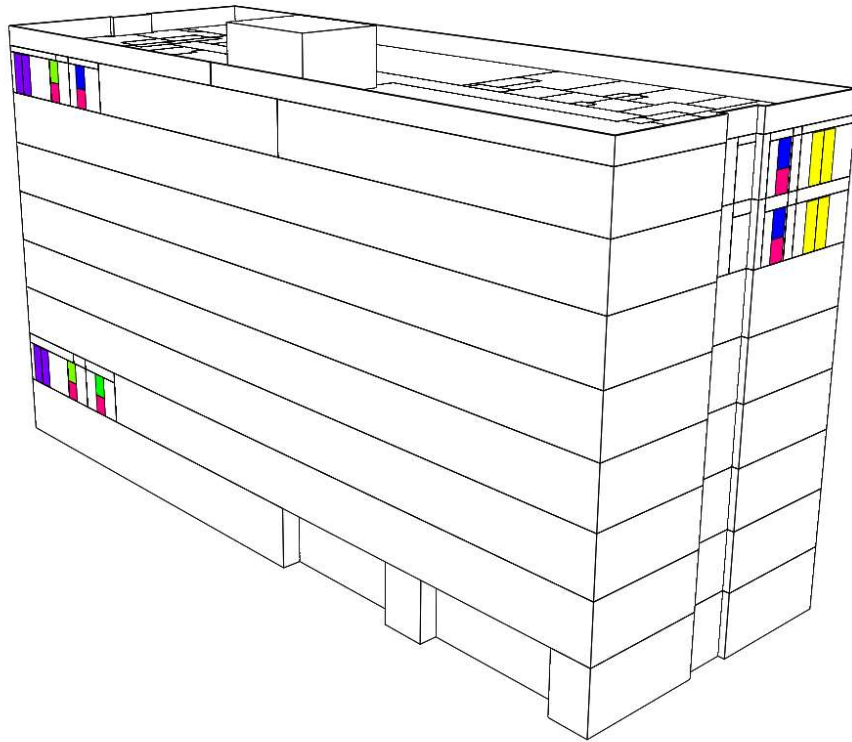
| Residential Opening Types - Apartments |                                         |                     |                  |                     |        |
|----------------------------------------|-----------------------------------------|---------------------|------------------|---------------------|--------|
| Ref                                    | Blocks A & B<br>Opening Types           | Dimensions<br>(WxH) | Opening<br>Angle | Location (Modelled) | Colour |
| K                                      | *Glazed Juliet<br>Balcony Door (Living) | 880x2350mm          | 90°              | Floors A01, A07     | Orange |
| L                                      | *Living/Kitchen<br>Window Bottom-       | 900x1300mm          | 15°              | Floors A01, A07     | Yellow |
| M                                      | Corridor Window<br>Bottom-hung          | 900x1300mm          | 15°              | Floor B03, B04      | Blue   |

*Table 5.2.1.1 Opening information for apartment block windows*

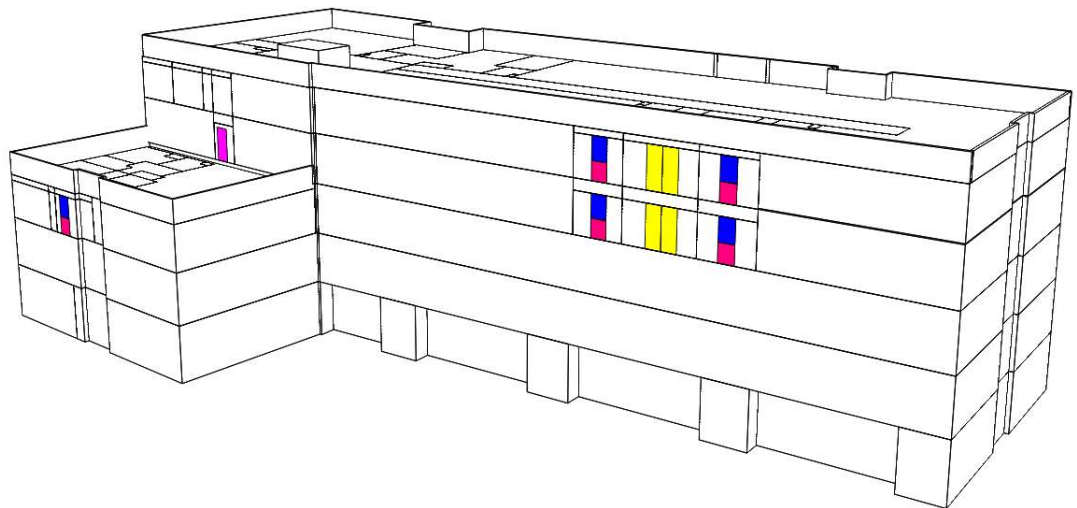
\*Acoustically constrained (night open/day closed) window opening types



*Figure 5.2.1.1: Block A Opening Types (East View)*



*Figure 5.2.1.2: Block A Opening Types (West View)*



*Figure 5.2.1.3: Block B Opening Types (East View)*

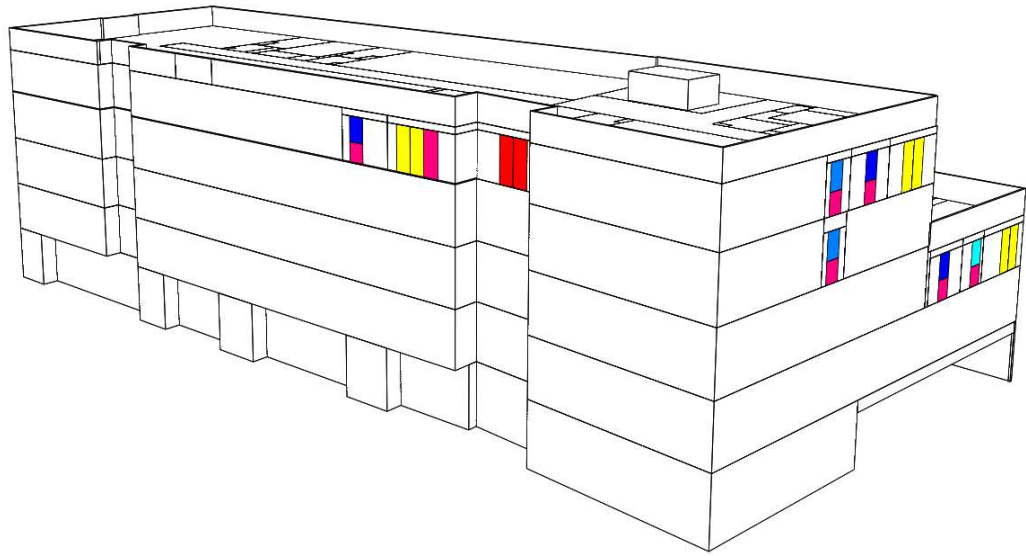


Figure 5.2.1.4: Block B Opening Types (West View)

The opening types, opening angles, opening dimensions, and opening locations for the Townhouses are as below:

| Residential Opening Types - Townhouses |                                |                  |               |                          |        |
|----------------------------------------|--------------------------------|------------------|---------------|--------------------------|--------|
| Ref                                    | Townhouse Opening Types        | Dimensions (WxH) | Opening Angle | Location (Modelled)      | Colour |
| C                                      | Fixed Glazing                  | (Variable)       | N/A           | All modelled             |        |
| D                                      | Glazed Door (Living/Kitchen)   | 700x2260mm       | 90°           | T07: Floor 00            |        |
| F                                      | Bedroom Window Top-hung        | 800x1000mm       | 15°           | Floors 01, 02            |        |
| G                                      | Living/Kitchen Window Top-hung | 900x1300mm       | 15°           | T07: Floor 00            |        |
| L                                      | Circulation Window Top-hung    | 800x1000mm       | 15°           | T01 & T10: Floor 00      |        |
| M                                      | Bedroom Window Side-hung       | 550x1810mm       | 15°           | Floors 01, 02            |        |
| N                                      | Circulation Window Side-hung   | 450x1810mm       | 15°           | T01 & T10: Floors 01, 02 |        |

| Residential Opening Types - Townhouses |                             |                  |               |                     |        |
|----------------------------------------|-----------------------------|------------------|---------------|---------------------|--------|
| Ref                                    | Townhouse Opening Types     | Dimensions (WxH) | Opening Angle | Location (Modelled) | Colour |
| O                                      | Glazed Door (Living)        | 880x2260mm       | 90°           | T01 & T10: Floor 00 | Blue   |
| P                                      | Living Room Window Top-hung | 800x1000mm       | 35°           | T01 & T10: Floor 00 | Red    |

Table 5.2.1.2 Opening information for townhouse block windows

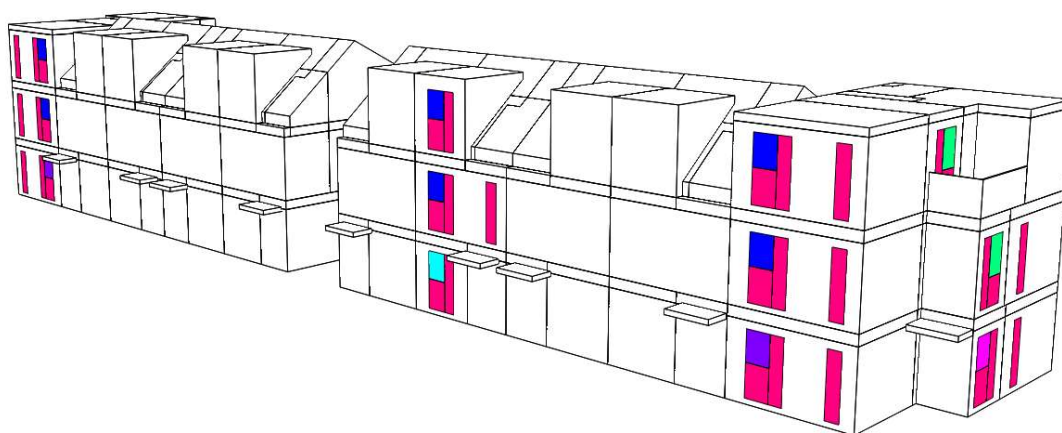


Figure 5.2.1.1 Townhouse Opening Types (West View)

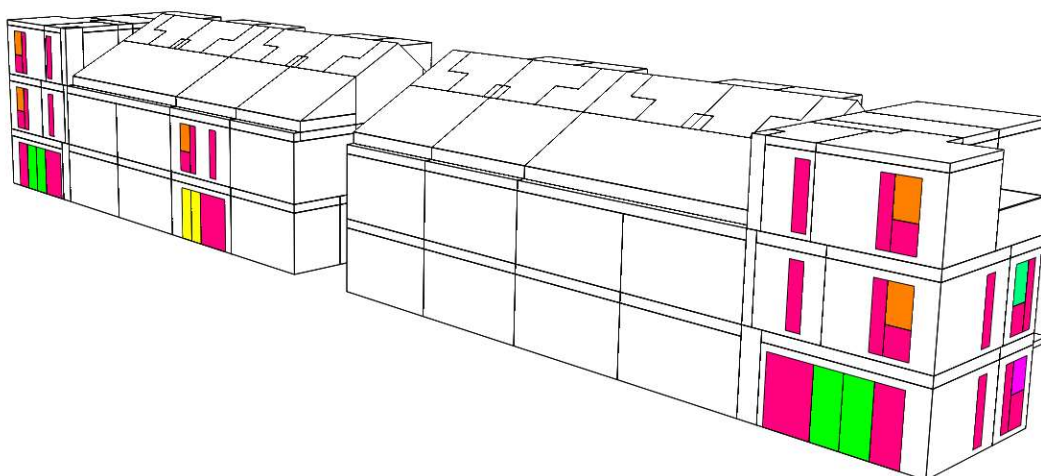


Figure 5.2.1.2 Townhouse Opening Types (East View)

All openings are manually controlled, and it has been assumed in the model that they are opened when the rooms are occupied, and when the internal operative temperature exceeds 22°C AND the internal operative temperature exceeds the external temperature, OR the CO<sub>2</sub> concentration exceeds 1000ppm.

All operable glazing in residential spaces is assumed closed when the room is not occupied, except for windows in acoustically constrained living rooms/kitchens which are open at night-time to provide night ventilation.

The opening profiles for each room type are explained below:

**Acoustically constrained spaces:**

- Living/kitchen space glazed doors are not modelled as operable as opening is restricted during the day, and rooms are unoccupied at night.
- Living/kitchen space windows are modelled as operable during night-time to provide night ventilation (23:00 to 07:00).
- Bedroom windows are operable during night-time only, 23:00 to 07:00 when  $T(\text{indoor}) > T(\text{outdoor})$  AND  $T(\text{indoor}) > 22^{\circ}\text{C}$  OR CO<sub>2</sub> concentration exceeds 1000ppm.

**Non-acoustically constrained spaces:**

- Living/kitchen space windows/glazed doors are operable between 09:00 and 22:00 when  $T(\text{indoor}) > T(\text{outdoor})$  AND  $T(\text{indoor}) > 22^{\circ}\text{C}$  OR CO<sub>2</sub> concentration exceeds 1000ppm.
- Bedroom windows are operable throughout the day, 00:00 to 24:00 when  $T(\text{indoor}) > T(\text{outdoor})$  AND  $T(\text{indoor}) > 22^{\circ}\text{C}$  OR CO<sub>2</sub> concentration exceeds 1000ppm.
- Bedroom windows are operable during night-time only, 23:00 to 07:00 when  $T(\text{indoor}) > T(\text{outdoor})$  AND  $T(\text{indoor}) > 22^{\circ}\text{C}$  OR CO<sub>2</sub> concentration exceeds 1000ppm.
- The corridor windows are operable 00:00 to 24:00 when  $T(\text{indoor}) > T(\text{outdoor})$  AND  $T(\text{indoor}) > 22^{\circ}\text{C}$  OR CO<sub>2</sub> concentration exceeds 1000ppm.

### **5.2.2 Mechanical Ventilation (Residential)**

The buildings are mechanically ventilated via MVHR units with high efficiency fans and heat recovery.

Open plan kitchen/living rooms will be served with both supply and extract ventilation, whilst bedrooms have supply ventilation only.

WCs/en-suites/bathrooms and utility cupboards will be served with extract only on the same system.

Acoustically constrained bedrooms are provided with the option of mechanical purge ventilation to control occupant comfort at a set-point of 22°C as well as standard continuous mech vent otherwise.

The ground floor living rooms in townhouse T01 and T10 are also provided with the option of mechanical purge ventilation at a set-point of 21°C as well as standard continuous mech vent otherwise.

The ventilation rates for each space can be seen in Appendix B. Active cooling is not provided.

### 5.2.3 *Natural Ventilation (Communal)*

The dimensions and opening angles of the communal operable windows are provided in the table below. These opening angles are the minimum angle required to supply sufficient natural ventilation to achieve overheating requirements for all occupied spaces.

The opening types, opening angles, opening dimensions, and opening locations for Blocks A and B are as below:

| Communal Opening Types |                                             |                  |               |                          |        |
|------------------------|---------------------------------------------|------------------|---------------|--------------------------|--------|
| Ref                    | Communal Space Opening Types                | Dimensions (WxH) | Opening Angle | Location (Modelled)      | Colour |
| A                      | Fixed Glazing                               | (Variable)       | N/A           | All modelled             |        |
| B                      | Stairwell Window (Top-hung)                 | 910x1375mm       | 15°           | Floors B01-B04 & A01-A07 |        |
| C                      | Smaller Residents Amenity Window (Top-hung) | 575x1805mm       | 15°           | Floor B00                |        |
| D                      | (2) Residential Entrance Window (Top-hung)  | 580x600mm        | 15°           | Floor B00                |        |

| Communal Opening Types |                                            |                  |               |                     |        |
|------------------------|--------------------------------------------|------------------|---------------|---------------------|--------|
| Ref                    | Communal Space Opening Types               | Dimensions (WxH) | Opening Angle | Location (Modelled) | Colour |
| E                      | (1) Residential Entrance Window (Top-hung) | 620x600mm        | 15°           | Floor B00           |        |
| F                      | Lobby Window (Top-hung)                    | 870x730mm        | 15°           | Floor A00           |        |

Table 5.2.3.1 Opening information for windows to communal areas

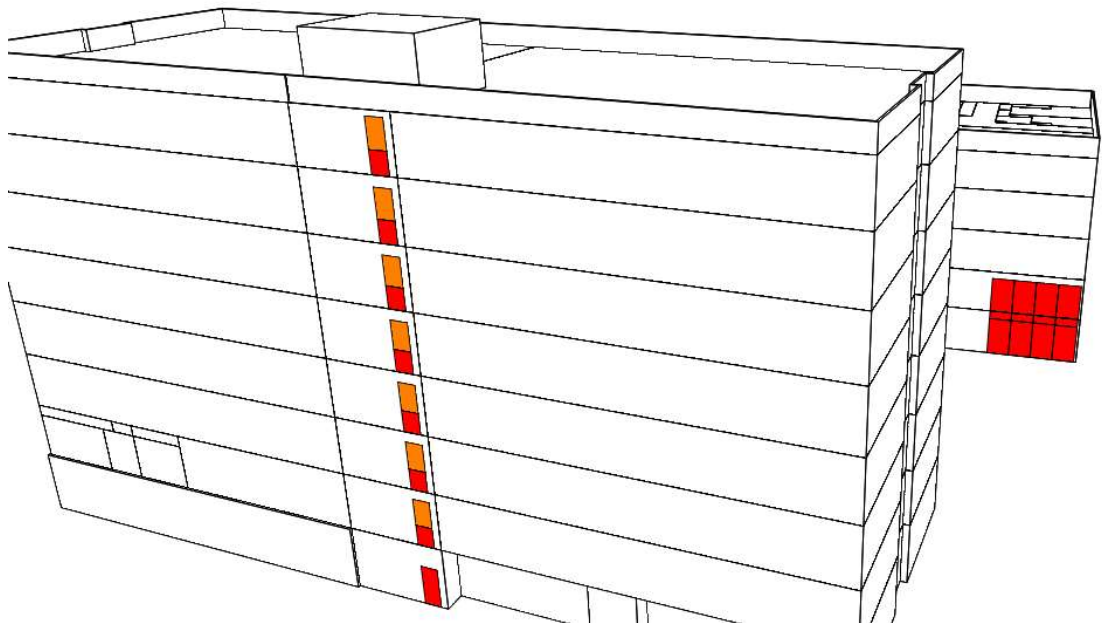


Figure 5.2.3.1: Block A communal area opening types: A00- Stairs (Northwest View)



Figure 5.2.3.2: Block B communal area opening types: B00 - Stairs & B00 – Residents Entrance (North View)

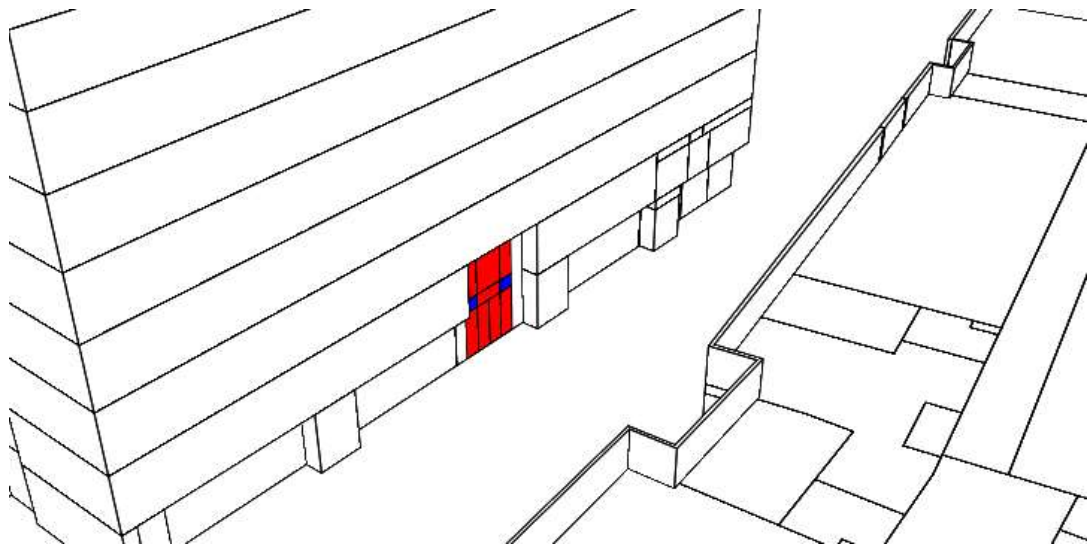


Figure 5.2.3.3: Block A communal area opening types: A00 - Lobby (Southwest View)

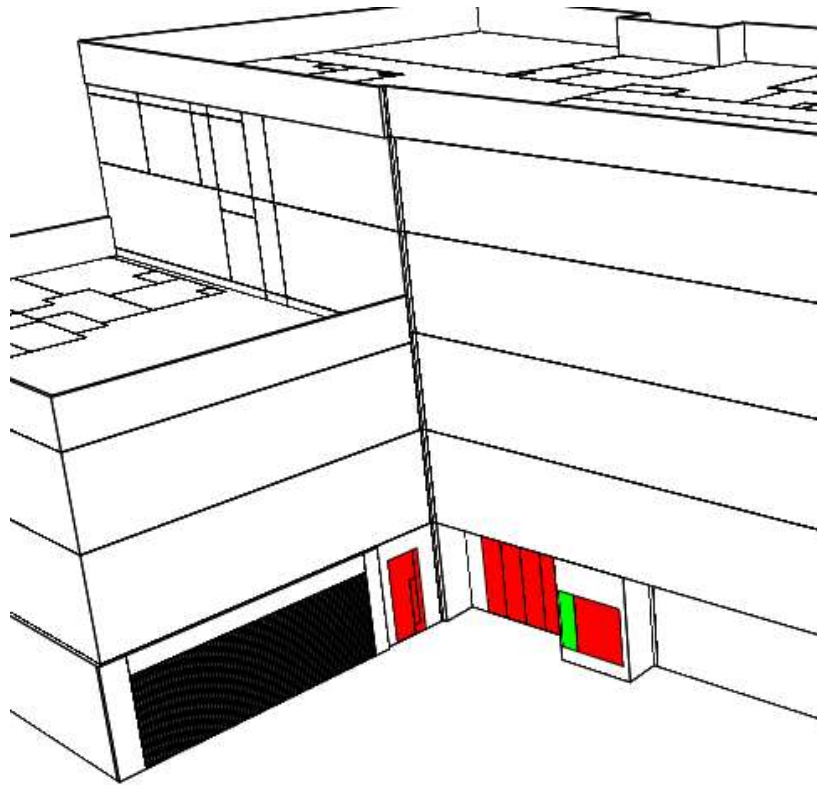


Figure 5.2.3.4: Block B communal area opening types: B00 – Smaller Residents Amenity (Southeast View)

All openings are manually controlled, and it has been assumed in the model that they are openable throughout the day (00:00-24:00), and when the internal operative temperature exceeds 22°C AND the internal operative temperature exceeds the external temperature, OR the CO<sub>2</sub> concentration exceeds 1000ppm.

#### 5.2.4 Mechanical Ventilation (Communal)

The communal spaces are mechanically ventilated via MVHR units with high efficiency fans and heat recovery.

The management suite and WC, residents' amenities and concierge will be served with both supply and extract ventilation.

The ventilation rates for each space can be seen in Appendix B.

Active cooling is provided in both the comms room and the larger residents amenity space in Block B, at a setpoint of 22°C.

## 6 NCM Profiles

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

## 7 Internal Gains

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

## 8 Overheating Risk Assessment

### 8.1 Overheating Risk in Homes (CIBSE TM59)

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

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

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

1. *For living rooms, kitchens and bedrooms:* They must meet 'criterion 1: hours of exceedance' as set out in CIBSE TM52. (The number of hours where  $\Delta T > 1^\circ\text{C}$  should not exceed 3% of the occupied hours.)

2. *For bedrooms only:* During sleeping hours (22:00 to 07:00) the temperature should not exceed 26°C for more than 1% of annual hours (33 hours).

In addition to the above, communal corridors should be tested for overheating if community heating pipework runs through them, ensuring the temperature does not exceed 28°C. While this is not mandatory, if the temperature exceeds 28°C for more than 3% of the hours, it should be reported as a risk. However, for this particular overheating analysis there are no internal pipework gains to be modelled and therefore this test has been excluded from the report.

While it is not required to pass Criteria 2 and 3 of TM52 for TM59 compliance, the buildings were still assessed for adaptive thermal comfort in order to additionally comply with TM52 requirements in the occupied spaces.

## 8.2 Adaptive Thermal Comfort (CIBSE TM52)

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

The TM52 assessment is based on comparison of room temperature with a maximum acceptable room temperature, which is calculated from the running mean of the outdoor temperature. The running mean used places greater weight on the temperature for days closer to the present as these have more influence on a person's comfort temperature. The criteria are all defined in terms of  $\Delta T$ , which is the difference between the actual operative temperature in the room at any time and the maximum acceptable temperature and can be summarised as follows:

**Criterion 1:** "Hours of Exceedance" The number of hours where  $\Delta T > 1^\circ\text{C}$  should not exceed 3% of the occupied hours.

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

**Criterion 3:** “Upper Limit Temperature”  $\Delta T \leq 4^\circ\text{C}$  at all times.

## 8.3 Results

### 8.3.1 *TM59 – Overheating Risk in Homes (Residential)*

All of the proposed apartments and townhouses meet the mandatory TM59 criteria stated above.

The full results contained within Appendices E (apartments) & G (townhouses), indicate how each space complies with the requirements of TM59.

### 8.3.2 *TM52 – Adaptive Thermal Comfort (Residential)*

In addition to complying with the requirements of TM59, all occupied residential spaces comply with the adaptive thermal comfort requirements of TM52. These results can be seen in Appendix F (apartments) & Appendix H (townhouses).

### 8.3.3 *TM52 – Adaptive Thermal Comfort (Communal Spaces)*

All communal spaces comply with the requirements of TM52. These results can be seen in Appendix I.

In order to achieve compliance with the adaptive thermal comfort requirements of TM52, the following design parameters were required:

- Window openings as per Section 5.2.3.
- Removal of  $1\text{m}^2$  of glazing in the Block B larger residential amenity’s south-west façade.
- Mechanical cooling included in the larger residential amenity space and the comms room in Block B.
- Auxiliary ventilation rate of 15 l/s/person in the Block B smaller residential amenity, assisted by night purge.
- All other spaces with mechanical ventilation have a vent rate of 12 l/s/person and are assisted by night purge.
- Reduced g-value of 0.3 for all glazing in the Block A Lobby, Block B smaller residents amenity space, Block B larger residents amenity space, and Block B secondary entrance as shown in Appendix A.

## 9 Approved Document O

The aim of approved Document Part O is to protect the health and welfare of occupants by limiting unwanted solar gains in the summer and providing an adequate means of removing excess heat from the indoor environment, hence reducing the occurrence of high indoor temperatures.

In order to demonstrate compliance with Part O Requirement O1 using dynamic thermal modelling, acceptable strategies to mitigate overheating risk are provided. In addition to this, CIBSE's TM59 methodology must be adopted, with the introduction of further limitations to the choices made that must be adopted by the modeller to comply with the TM59 methodology.

Approved Document O is not expected to be applicable for the proposed development due to the proposed date when the site is to be registered with Building Control and the date that site works are proposed to commence.

In any event, the proposed development targets and achieves compliance with CIBSE's TM59 and TM52 criteria for the prevention of overheating.

## 10 Conclusion

A thermal comfort analysis for RIBA stage 3 was performed for the proposed residential development located at *Land to the west of Rodney Street, Manchester*, on behalf of the client, Wates Construction Ltd.

15 apartments and 3 townhouses were modelled. A sample of each apartment type was analysed to cover a variety of living arrangements and samples were also selected based on their potential to present the most likely risk of overheating. 3 of these apartments were included in the sample as they were identified in the noise assessment, '*22013-M004-E 3D modelling & level 2 AVO assessment*' (Sandy Brown) as rooms subject to uncomfortable noise levels and therefore requiring constraints on window openings to meet acoustic targets.

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

- The building complies with the mandatory thermal comfort requirements as set out in CIBSE Technical Memorandum 59 (TM59) "*Design methodology for the assessment of overheating risk in homes*".
- Each of the buildings complies with the adaptive thermal comfort requirements as set out in CIBSE Technical Memorandum 52 (TM52) "*The Limits of Thermal Comfort: Avoiding Overheating in European Buildings*".
- All communal spaces comply with the CIBSE Technical Memorandum (TM52) overheating requirements, subject to the assumptions detailed in this report.

This was based on the following key assumptions:

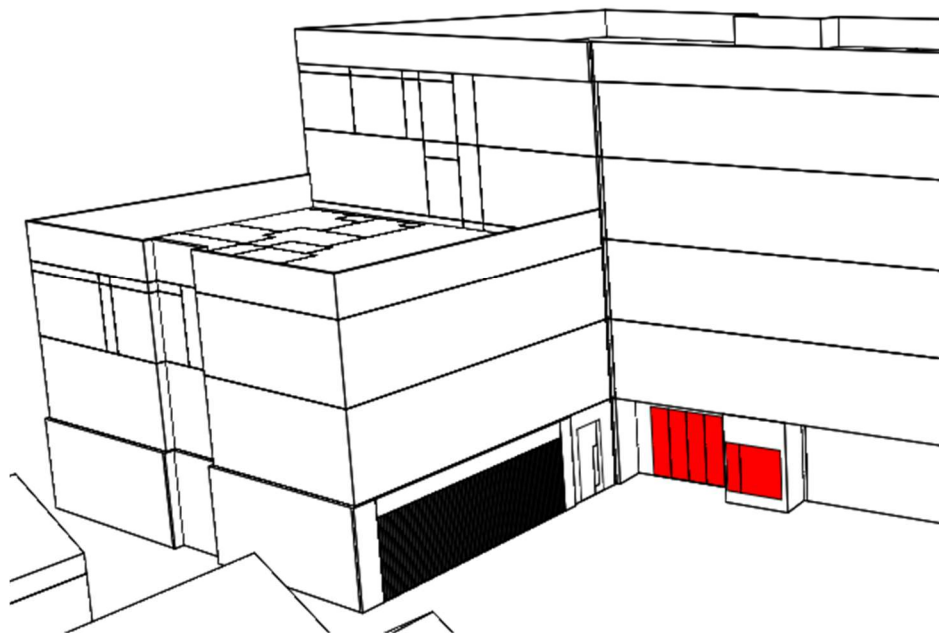
- Internal gains based on TM59 specifications for residential spaces.
- The residential and communal areas within the apartment blocks and townhouses benefit from natural ventilation through operable windows, with opening angles sufficient to provide adequate ventilation to meet thermal comfort requirements.
- The residential and communal areas within the apartment blocks and townhouses are mechanically ventilated via MVHR units with high efficiency fans and heat recovery.
- Active cooling is provided in both the comms room and the larger residents amenity space in Block B.
- Design changes as specified in Section 8.3.3 for the communal spaces and Appendix J for the residential spaces.

## 11 Appendices

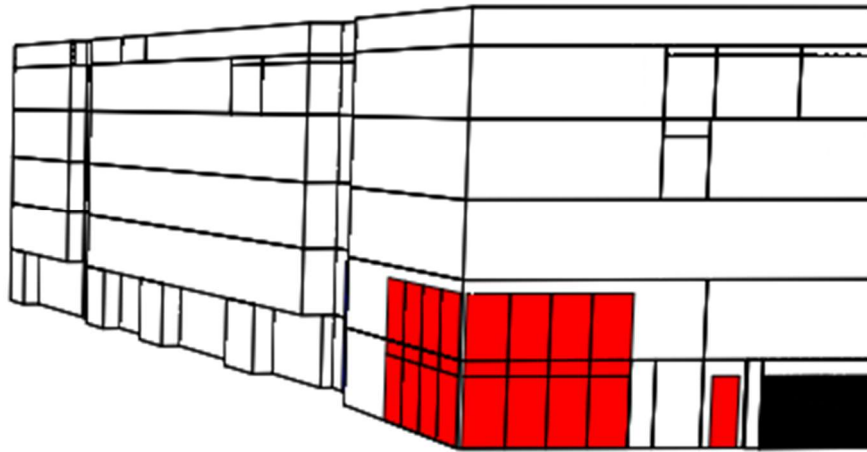
### 11.1 Appendix A – IES Virtual Environment views showing the reduced g-value glazing (0.3) in Block B

All spaces have been assigned a g-value of 0.49, except the following communal spaces which required a g-value of 0.3, as shown in Figure 11.1.1 to Figure 11.1.3. The spaces are also listed below:

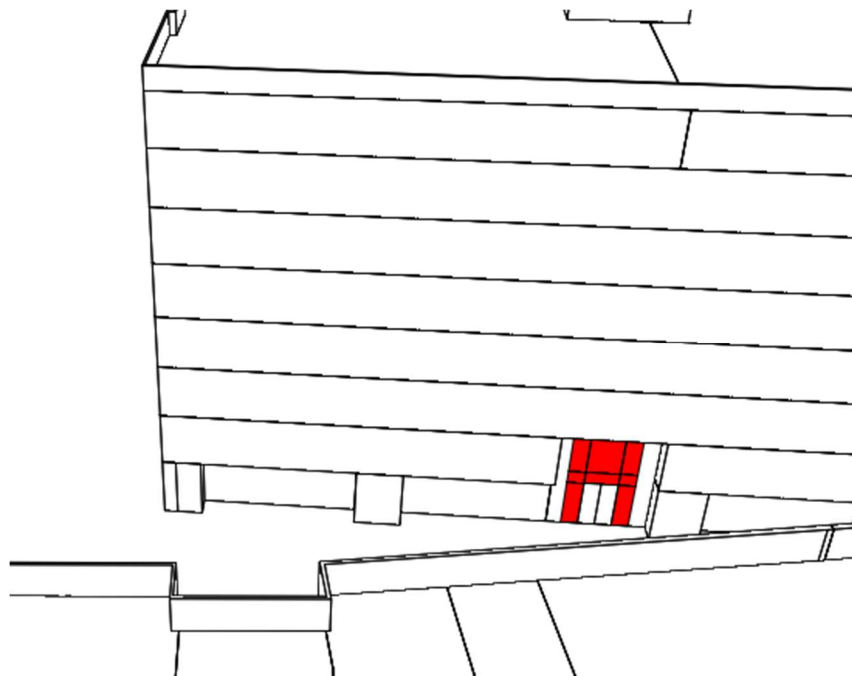
- Block A – 00: Lobby
- Block B – 00: Smaller Residents Amenity
- Block B – 00: Larger Residents Amenity
- Block B – 00: Secondary Entrance



*Figure 11.1.1 IES VE Image showing the reduced glazing g-value of 0.3 (in red) in Block B: 00 – Smaller Residents Amenity.*



*Figure 11.1.2 IES VE Image showing the reduced glazing g-value of 0.3 (in red) in Block B: 00 – Larger Residents Amenity and Block B: 00 – Secondary Entrance.*



*Figure 11.1.3 IES VE Image showing the reduced glazing g-value of 0.3 (in red) in Block A: 00 – Lobby.*

## 11.2 Appendix B – Mechanical Ventilation Flow Rates

| Space                            | Flow Rate (l/s) |
|----------------------------------|-----------------|
| Living Room*                     | 15              |
| Kitchen*                         | 15              |
| Bedroom*                         | 14              |
| Bathroom/WC/Ensuite*             | 10              |
| Utility Cupboard*                | 8               |
| A00: Flat 007 - Bedrooms**       | 25              |
| A00: Flat 007 - Living Room**    | 30              |
| A01: Flat 004 - Bedrooms**       | 25              |
| A01: Flat 004 - Living/Kitchen** | 25              |
| A01: Flat 005 - Bedrooms**       | 20              |
| A01: Flat 005 - Living/Kitchen** | 30              |
| A07: Flat 004 - Living/Kitchen** | 25              |
| T01 00: Living Room***           | 38              |
| T10 00: Living Room***           | 35              |
| B00: Concierge****               | 12              |
| B00: Management Suite****        | 24              |
| B00: Management Suite WC****     | 15              |
| B00: Residents Amenity 1****     | 144             |
| B00: Residents Amenity 2****     | 180             |

\* Standard ventilation rates modelled as on continuously when mechanical purge ventilation is not in effect.

\*\* Purge ventilation rate (standard rates apply when internal temperature < 22°C)

\*\*\* Purge ventilation rate (standard rates apply when internal temperature < 21°C)

\*\*\*\* Communal Space ventilation rates modelled as on continuously for night-time cooling

## 11.3 Appendix C – Assigned NCM Templates

| Space                               | NCM template                    |
|-------------------------------------|---------------------------------|
| Bathrooms (Residential)             | Dwell: Bathroom                 |
| Ensuites (Residential)              | Dwell: Bathroom                 |
| WC (Residential)                    | Dwell: Toilet                   |
| Residential Amenities (Communal)    | C2Schools: Communal area        |
| Stairs/Lobbies/Entrances (Communal) | Dwell: Common circulation areas |
| Post Room/LV Switchroom (Communal)  | Office: Cupboard                |

| Space                                 | NCM template                    |
|---------------------------------------|---------------------------------|
| Management Suite WC (Communal)        | Office: Toilet                  |
| Management Suite/Concierge (Communal) | Office: Office (Office: Common) |
| Comms (Communal)                      | Office: Light plant room        |

## 11.4 Appendix D – Internal Gains

### 11.4.1 Residential Occupancy

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

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

| Space                         | Max Occupancy (People) | Occupancy Variation                                                                         |
|-------------------------------|------------------------|---------------------------------------------------------------------------------------------|
| Bedrooms (Double)             | 2                      | 08:00-09:00 (100%**)<br>09:00-22:00 (50%**)<br>22:00 -23:00 (100%**)<br>23:00-08:00 (70%**) |
| Bedrooms (Single)             | 1                      | 08:00-23:00 (100%**)<br>23:00-08:00 (70%**)                                                 |
| Living Room (1-bed apartment) | 1                      | 09:00-22:00 (75%**)                                                                         |
| Living Room (2-bed apartment) | 2                      |                                                                                             |
| Living Room (4-bed apartment) | 4                      |                                                                                             |
| Kitchen/Dining Room (1-bed)   | 1                      | 09:00-22:00 (25%**)                                                                         |
| Kitchen/Dining Room (2-bed)   | 2                      |                                                                                             |
| Kitchen/Dining Room (4-bed)   | 4                      |                                                                                             |
| Living/Dining/Kitchen (2-bed) | 2                      | 09:00-22:00 (100%**)                                                                        |
| Living/Dining/Kitchen (3-bed) | 3                      |                                                                                             |
| Bathrooms                     | 0.06 - 0.09*           | From NCM Template                                                                           |
| Utility Cupboard              | -                      | -                                                                                           |
| Toilets                       | 0.03 - 0.05*           | From NCM Template                                                                           |

\* From NCM Templates

\*\* Percentage of occupation during time period

The occupancy profiles for the TM59 spaces can also be seen in the figures below.

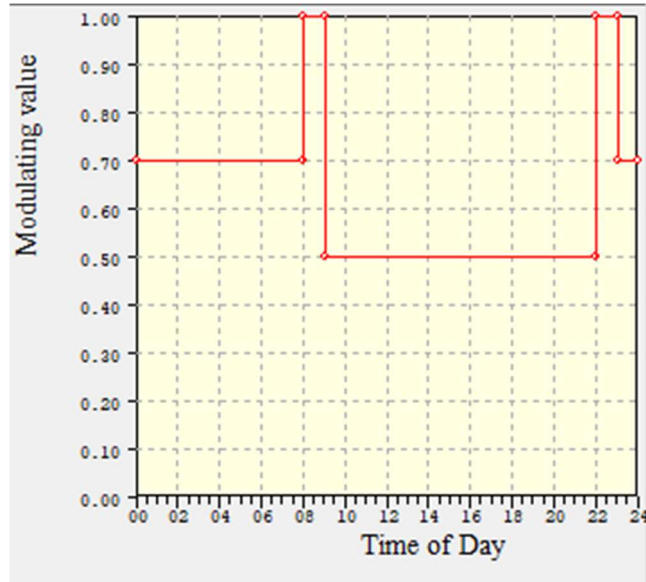


Figure 11.4.1.1 TM59 Bedroom (Double) Occupancy Variation Profile

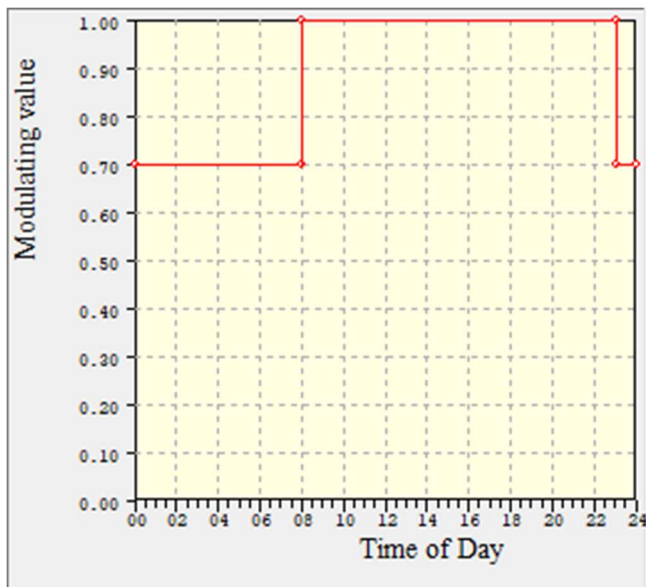


Figure 11.4.1.2 TM59 Bedroom (Single) Occupancy Variation Profile

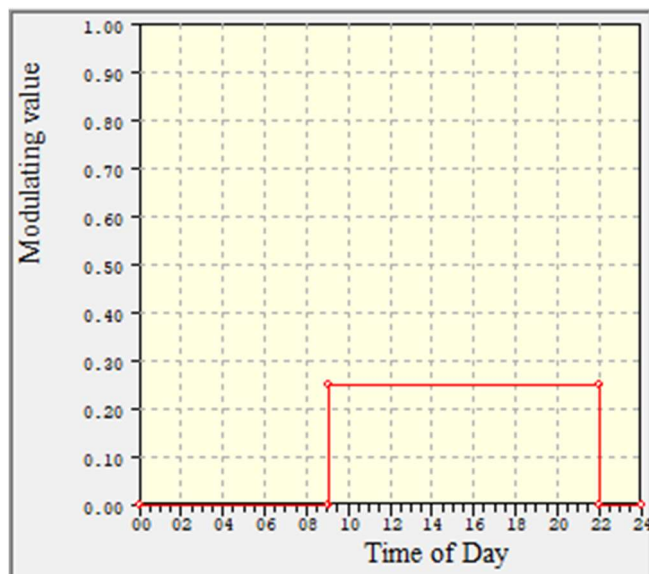


Figure 11.4.1.3 TM59 Kitchen Occupancy Variation Profile

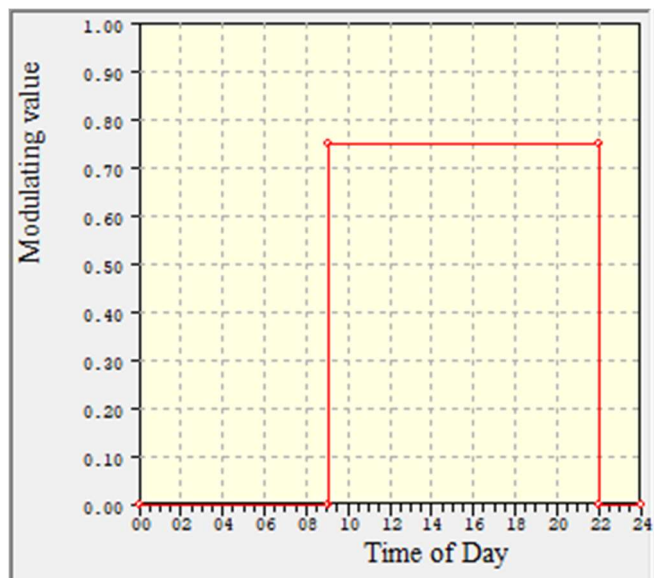


Figure 11.4.1.4 TM59 Living Room Occupancy Variation Profile

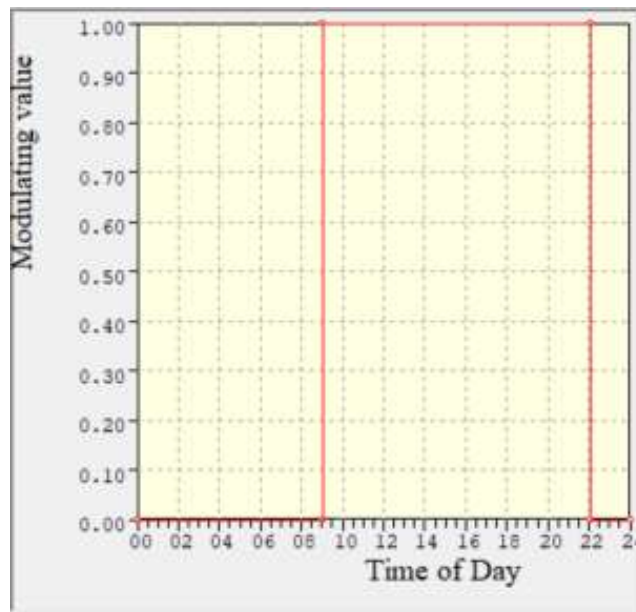


Figure 11.4.1.5 TM59 Living/Dining/Kitchen Occupancy Variation Profile

#### 11.4.2 Lighting

The gains from lighting for each space in the residential model were provided by TM59, as shown in the table below, and Figure 11.4.2.1.

| Space                | Lighting Gain (W/m <sup>2</sup> ) | Lighting Variation |
|----------------------|-----------------------------------|--------------------|
| Bedrooms             | 2                                 | 18:00-23:00        |
| Living Rooms         | 2                                 |                    |
| Kitchen/Dining Room  | 2                                 |                    |
| Bathrooms            | 2                                 |                    |
| Drying/Utility Space | 2                                 |                    |
| Corridors/Halls      | 2                                 |                    |
| Toilets              | 2                                 |                    |

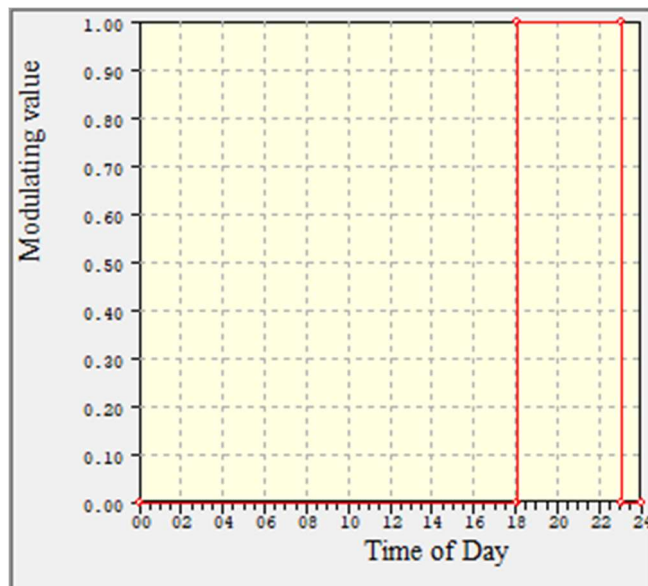


Figure 11.4.2.1 TM59 Lighting Variation Profile

### 11.4.3 Equipment

The equipment gains included in the residential model are provided in the table below. The gains and variation profiles for the bedrooms, living rooms and kitchens are provided by TM59, with the remaining rooms based on the NCM template.

| Space                         | Equipment Gains (W)     | Equipment Variation                                                                                              |
|-------------------------------|-------------------------|------------------------------------------------------------------------------------------------------------------|
| Bedrooms (Double)             | 80                      | 08:00-23:00 (100%**)<br>23:00-08:00 (12.5%**)                                                                    |
| Bedrooms (Single)             |                         |                                                                                                                  |
| Living Room (1-bed apartment) | 150                     | 00:00-09:00 (23%**)<br>09:00-18:00 (40%**)<br>18:00-22:00 (100%**)<br>22:00-24:00 (40%**)                        |
| Living Room (2-bed apartment) |                         |                                                                                                                  |
| Living Room (4-bed apartment) |                         |                                                                                                                  |
| Kitchen/Dining Room (1-bed)   | 300                     | 18:00-20:00 (100%**)<br>20:00-18:00 (16%**)                                                                      |
| Kitchen/Dining Room (2-bed)   |                         |                                                                                                                  |
| Kitchen/Dining Room (4-bed)   |                         |                                                                                                                  |
| Living/Dining/Kitchen (2-bed) | 450                     | 00:00-09:00 (19%**)<br>09:00-18:00 (24%**)<br>18:00-20:00 (100%**)<br>20:00-22:00 (44%**)<br>22:00-24:00 (24%**) |
| Living/Dining/Kitchen (3-bed) |                         |                                                                                                                  |
|                               |                         |                                                                                                                  |
|                               |                         |                                                                                                                  |
| Bathrooms                     | 1.67 W/m <sup>2</sup> * | From NCM Template                                                                                                |
| Utility Cupboard              | 78                      | 00:00-24:00 (100%**)                                                                                             |
| Toilets                       | 1.61 W/m <sup>2</sup> * | From NCM Template                                                                                                |

\* From NCM Templates

\*\* Percentage of equipment gain during time period

The variation profiles for the TM59 spaces can also be seen in the figures below.

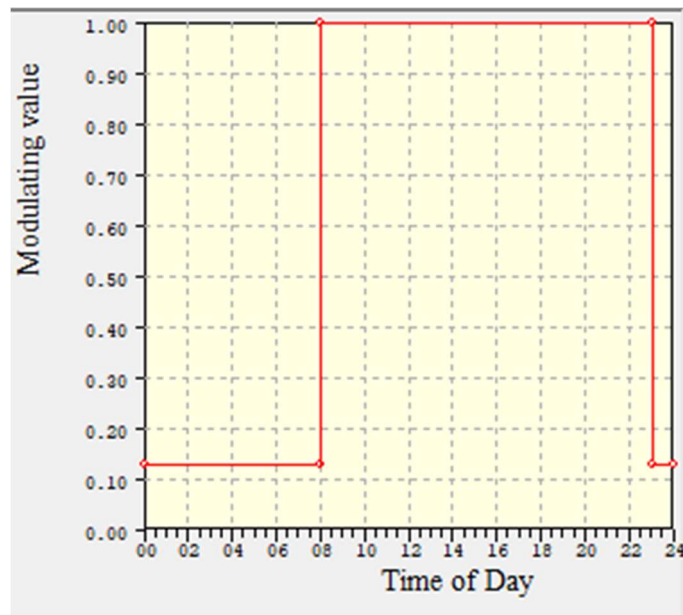


Figure 11.4.3.1 TM59 Bedroom Equipment Variation Profile

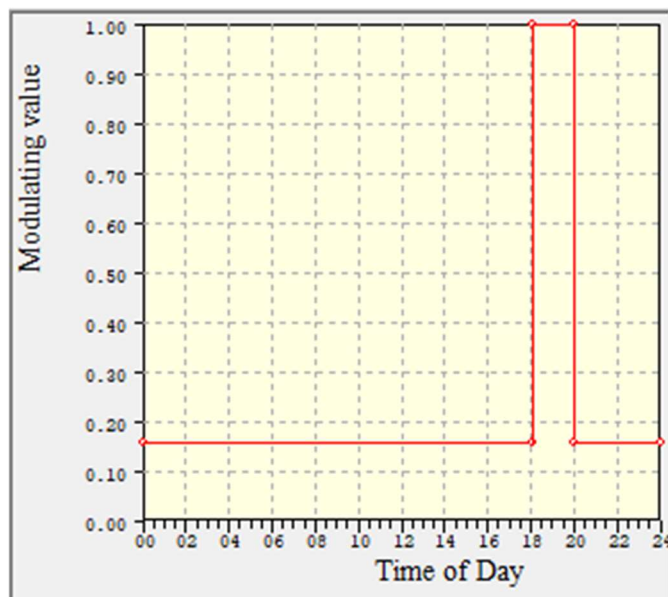


Figure 11.4.3.2 TM59 Kitchen Equipment Variation Profile

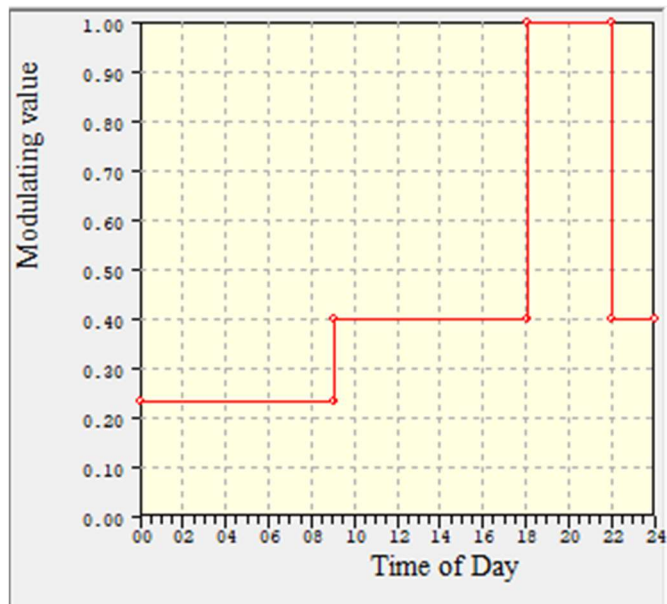


Figure 11.4.3.3 TM59 Living Room Equipment Variation Profile

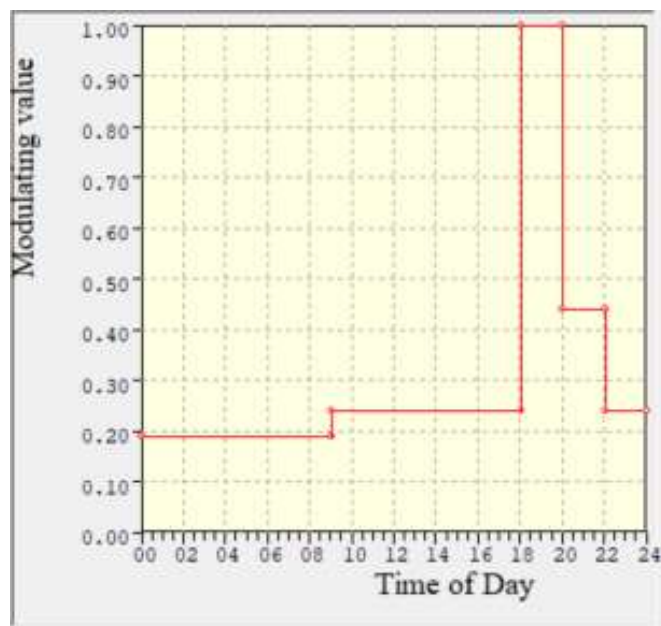


Figure 11.4.3.4 TM59 Living/Dining/Kitchen Equipment Variation Profile

#### 11.4.4 Communal Space Internal Gains

Occupancy numbers, lighting gains and equipment gains have been included in the communal model as per the table below.

| Location                  | Lighting Gain<br>(W/m <sup>2</sup> ) | Max Occupancy<br>(People) | Equipment Gain      |         |
|---------------------------|--------------------------------------|---------------------------|---------------------|---------|
|                           |                                      |                           | (W/m <sup>2</sup> ) | (W)     |
| A00 - Stairs              | 5.00                                 | 0.31*                     | 0                   | 0       |
| A01 - Stairs              | 5.00                                 | 0.16*                     | 0                   | 0       |
| A01: Lobby 1              | 5.00                                 | 1.05*                     | 0                   | 0       |
| A02 - Stairs              | 5.00                                 | 0.16*                     | 0                   | 0       |
| A03 - Stairs              | 5.00                                 | 0.16*                     | 0                   | 0       |
| A04 - Stairs              | 5.00                                 | 0.16*                     | 0                   | 0       |
| A05 - Stairs              | 5.00                                 | 0.16*                     | 0                   | 0       |
| A06 - Stairs              | 5.00                                 | 0.16*                     | 0                   | 0       |
| A07 - Stairs              | 5.00                                 | 0.16*                     | 0                   | 0       |
| B00: Comms                | 5.00                                 | 0.50                      | 52.50               | 962.10* |
| B00: Concierge            | 5.00                                 | 1.00                      | 10.00               | 101.32  |
| B00: Lobby 1              | 5.00                                 | 0.46*                     | 0                   | 0       |
| B00: Lobby 2              | 5.00                                 | 0.26*                     | 0                   | 0       |
| B00: LV Switchroom        | 5.00                                 | 0.17*                     | 5.00                | 34.68   |
| B00: Management Suite     | 5.00                                 | 2.00                      | 10.00               | 177.86  |
| B00: Management Suite WC  | 5.00                                 | 0.31*                     | 0                   | 0       |
| B00: Post Room            | 5.00                                 | 0.19*                     | 0                   | 0       |
| B00: Residential Entrance | 5.00                                 | 0.59*                     | 0                   | 0       |
| B00: Residents Amenity 1  | 5.00                                 | 12.00                     | 5.00                | 533.26  |
| B00: Residents Amenity 2  | 5.00                                 | 12.00                     | 5.00                | 274.50  |
| B00: Secondary Entrance   | 5.00                                 | 0.23*                     | 0                   | 0       |
| B00: Stairs 1             | 5.00                                 | 0.41*                     | 0                   | 0       |
| B00: Stairs 2             | 5.00                                 | 0.39*                     | 0                   | 0       |
| B01: Stairs 1             | 5.00                                 | 0.29*                     | 0                   | 0       |
| B01: Stairs 2             | 5.00                                 | 0.21*                     | 0                   | 0       |
| B01: Stairs 2             | 5.00                                 | 0.21*                     | 0                   | 0       |
| B02: Stairs 1             | 5.00                                 | 0.29*                     | 0                   | 0       |
| B03: Stairs 1             | 5.00                                 | 0.29*                     | 0                   | 0       |
| B03: Stairs 2             | 5.00                                 | 0.21*                     | 0                   | 0       |
| B04: Stairs 1             | 5.00                                 | 0.29*                     | 0                   | 0       |
| B04: Stairs 2             | 5.00                                 | 0.21*                     | 0                   | 0       |

\*NCM Template Value

## 11.5 Appendix E – Block A & B TM59 Results – Weather File: Manchester DSY1 2020 High 50%

### 11.5.1 Living Rooms, Kitchens, and Bedrooms – Criterion 1 of TM52

Rooms are compliant with Criterion 1 if the percentage of hours is less than 3%.

| Room Name                          | Percentage of occupied hours $\Delta T \geq 1K$<br>(Criterion 1 – TM52) (%) |
|------------------------------------|-----------------------------------------------------------------------------|
|                                    | DSY1 2020                                                                   |
| A00: Flat 007 - Bedroom 1 (Double) | 0.7                                                                         |
| A00: Flat 007 - Bedroom 2 (Double) | 1.1                                                                         |
| A00: Flat 007 - Kitchen            | 1.5                                                                         |
| A00: Flat 007 - Living Room        | 1.4                                                                         |
| A01: Flat 004 - Bedroom 1 (Double) | 0.3                                                                         |
| A01: Flat 004 - Bedroom 2 (Double) | 0.1                                                                         |
| A01: Flat 004 - Kitchen            | 1.8                                                                         |
| A01: Flat 004 - Living Room        | 1.9                                                                         |
| A01: Flat 005 - Bedroom 1 (Double) | 0.4                                                                         |
| A01: Flat 005 - Bedroom 2 (Double) | 1                                                                           |
| A01: Flat 005 - Kitchen            | 2.9                                                                         |
| A01: Flat 005 - Living Room        | 3                                                                           |
| A06: Flat 005 - Bedroom 1 (Double) | 0                                                                           |
| A06: Flat 005 - Bedroom 2 (Double) | 0                                                                           |
| A06: Flat 005 - Kitchen            | 0.3                                                                         |
| A06: Flat 005 - Living Room        | 0.2                                                                         |
| A06: Flat 007 - Bedroom 1 (Double) | 0                                                                           |
| A06: Flat 007 - Kitchen            | 0.1                                                                         |
| A06: Flat 007 - Living Room        | 0                                                                           |
| A06: Flat 009 - Bedroom 1 (Double) | 0.2                                                                         |
| A06: Flat 009 - Bedroom 2 (Double) | 0                                                                           |
| A06: Flat 009 - Kitchen            | 0.7                                                                         |
| A06: Flat 009 - Living Room        | 0.7                                                                         |
| A07: Flat 004 - Bedroom 1 (Double) | 0                                                                           |
| A07: Flat 004 - Bedroom 2 (Double) | 0                                                                           |
| A07: Flat 004 - Kitchen            | 0.7                                                                         |
| A07: Flat 004 - Living Room        | 0.6                                                                         |
| A07: Flat 005 - Bedroom 1 (Double) | 0                                                                           |

| Room Name                          | Percentage of occupied hours $\Delta T \geq 1K$<br>(Criterion 1 – TM52) (%) |
|------------------------------------|-----------------------------------------------------------------------------|
|                                    | DSY1 2020                                                                   |
| A07: Flat 005 - Bedroom 2 (Double) | 0.1                                                                         |
| A07: Flat 005 - Kitchen            | 0.5                                                                         |
| A07: Flat 005 - Living Room        | 0.3                                                                         |
| A07: Flat 008 - Bedroom 1 (Double) | 0                                                                           |
| A07: Flat 008 - Kitchen            | 0.1                                                                         |
| A07: Flat 008 - Living Room        | 0                                                                           |
| A07: Flat 009 - Bedroom 1 (Double) | 0.5                                                                         |
| A07: Flat 009 - Bedroom 2 (Double) | 0                                                                           |
| A07: Flat 009 - Kitchen            | 0.8                                                                         |
| A07: Flat 009 - Living Room        | 1                                                                           |
| B02: Flat 011 - Bedroom 1 (Double) | 0                                                                           |
| B02: Flat 011 - Bedroom 2 (Double) | 0.4                                                                         |
| B02: Flat 011 - Living Room        | 0.8                                                                         |
| B02: Flat 011 -Kitchen             | 0.8                                                                         |
| B03: Flat 007 - Bedroom 1 (Double) | 0                                                                           |
| B03: Flat 007 - Bedroom 2 (Double) | 0                                                                           |
| B03: Flat 007 - Kitchen            | 0.2                                                                         |
| B03: Flat 007 - Living Room        | 0                                                                           |
| B04: Flat 002 - Bedroom 1 (Double) | 0                                                                           |
| B04: Flat 002 - Bedroom 2 (Double) | 0                                                                           |
| B04: Flat 002 - Living/Kitchen     | 0                                                                           |
| B04: Flat 007 - Bedroom 1 (Double) | 0                                                                           |
| B04: Flat 007 - Bedroom 2 (Double) | 0                                                                           |
| B04: Flat 007 - Ensuite            | 0                                                                           |
| B04: Flat 007 - Kitchen            | 0.2                                                                         |
| B04: Flat 007 - Living Room        | 0                                                                           |
| B04: Flat 010 - Bedroom 1 (Double) | 0.1                                                                         |
| B04: Flat 010 - Kitchen            | 0.5                                                                         |
| B04: Flat 010 - Living Room        | 0.3                                                                         |

### 11.5.2 Bedrooms Overheating

Bedrooms comply with TM59 if the number of hours exceeding 26°C is less than 33.

| Room Name                          | Number of hours exceeding 26°C between<br>22:00 and 07:00 |
|------------------------------------|-----------------------------------------------------------|
|                                    | DSY1 2020                                                 |
| A00: Flat 007 - Bedroom 1 (Double) | 30                                                        |
| A00: Flat 007 - Bedroom 2 (Double) | 31                                                        |
| A01: Flat 004 - Bedroom 1 (Double) | 25                                                        |
| A01: Flat 004 - Bedroom 2 (Double) | 28                                                        |
| A01: Flat 005 - Bedroom 1 (Double) | 31                                                        |
| A01: Flat 005 - Bedroom 2 (Double) | 31                                                        |
| A06: Flat 005 - Bedroom 1 (Double) | 4                                                         |
| A06: Flat 005 - Bedroom 2 (Double) | 4                                                         |
| A06: Flat 007 - Bedroom 1 (Double) | 4                                                         |
| A06: Flat 009 - Bedroom 1 (Double) | 4                                                         |
| A06: Flat 009 - Bedroom 2 (Double) | 4                                                         |
| A07: Flat 004 - Bedroom 1 (Double) | 5                                                         |
| A07: Flat 004 - Bedroom 2 (Double) | 4                                                         |
| A07: Flat 005 - Bedroom 1 (Double) | 4                                                         |
| A07: Flat 005 - Bedroom 2 (Double) | 4                                                         |
| A07: Flat 008 - Bedroom 1 (Double) | 4                                                         |
| A07: Flat 009 - Bedroom 1 (Double) | 4                                                         |
| A07: Flat 009 - Bedroom 2 (Double) | 4                                                         |
| B02: Flat 011 - Bedroom 1 (Double) | 4                                                         |
| B02: Flat 011 - Bedroom 2 (Double) | 5                                                         |
| B03: Flat 007 - Bedroom 1 (Double) | 5                                                         |
| B03: Flat 007 - Bedroom 2 (Double) | 5                                                         |
| B04: Flat 002 - Bedroom 1 (Double) | 0                                                         |
| B04: Flat 002 - Bedroom 2 (Double) | 4                                                         |
| B04: Flat 007 - Bedroom 1 (Double) | 5                                                         |
| B04: Flat 007 - Bedroom 2 (Double) | 5                                                         |
| B04: Flat 010 - Bedroom 1 (Double) | 4                                                         |

### 11.5.3 Corridor Overheating

Corridors comply with TM59 requirements if the percentage of hours exceeding 28°C remains below 3%.

However as there are no internal pipework gains to be modelled for blocks A, B and the townhouses, according to TM59, corridors do not have to be included in the overheating analysis and therefore they have been excluded from this report.

## 11.6 Appendix F – Block A and B Residential, TM52 Results – Weather File: Manchester DSY1 2020 High 50%

| DSY1 2020 High 50% Weather File    |                                   |                                    |                             |                  |
|------------------------------------|-----------------------------------|------------------------------------|-----------------------------|------------------|
| Room Name                          | Criteria 1<br>(%Hrs Top-Tmax>=1K) | Criteria 2<br>(Max. Daily Deg.Hrs) | Criteria 3<br>(Max. DeltaT) | Criteria failing |
| A00: Flat 007 - Bedroom 1 (Double) | 0.7                               | 12                                 | 2                           | 2                |
| A00: Flat 007 - Bedroom 2 (Double) | 1.1                               | 16                                 | 2                           | 2                |
| A00: Flat 007 - Kitchen            | 1.5                               | 12                                 | 2                           | 2                |
| A00: Flat 007 - Living Room        | 1.4                               | 12                                 | 2                           | 2                |
| A01: Flat 004 - Bedroom 1 (Double) | 0.3                               | 3                                  | 1                           | -                |
| A01: Flat 004 - Bedroom 2 (Double) | 0.1                               | 1                                  | 1                           | -                |
| A01: Flat 004 - Kitchen            | 1.8                               | 6                                  | 2                           | -                |
| A01: Flat 004 - Living Room        | 1.9                               | 6                                  | 2                           | -                |
| A01: Flat 005 - Bedroom 1 (Double) | 0.4                               | 8                                  | 1                           | 2                |
| A01: Flat 005 - Bedroom 2 (Double) | 1                                 | 13                                 | 2                           | 2                |
| A01: Flat 005 - Kitchen            | 2.9                               | 19                                 | 3                           | 2                |
| A01: Flat 005 - Living Room        | 3                                 | 20                                 | 3                           | 2                |
| A06: Flat 005 - Bedroom 1 (Double) | 0                                 | 0                                  | 0                           | -                |
| A06: Flat 005 - Bedroom 2 (Double) | 0                                 | 0                                  | 0                           | -                |
| A06: Flat 005 - Kitchen            | 0.3                               | 2                                  | 1                           | -                |
| A06: Flat 005 - Living Room        | 0.2                               | 2                                  | 1                           | -                |
| A06: Flat 007 - Bedroom 1 (Double) | 0                                 | 0                                  | 0                           | -                |
| A06: Flat 007 - Kitchen            | 0.1                               | 1                                  | 1                           | -                |
| A06: Flat 007 - Living Room        | 0                                 | 0                                  | 0                           | -                |
| A06: Flat 009 - Bedroom 1 (Double) | 0.2                               | 3                                  | 1                           | -                |
| A06: Flat 009 - Bedroom 2 (Double) | 0                                 | 0                                  | 0                           | -                |

| DSY1 2020 High 50% Weather File    |                                   |                                    |                             |                  |
|------------------------------------|-----------------------------------|------------------------------------|-----------------------------|------------------|
| Room Name                          | Criteria 1<br>(%Hrs Top-Tmax>=1K) | Criteria 2<br>(Max. Daily Deg.Hrs) | Criteria 3<br>(Max. DeltaT) | Criteria failing |
| A06: Flat 009 - Kitchen            | 0.7                               | 4                                  | 1                           | -                |
| A06: Flat 009 - Living Room        | 0.7                               | 5                                  | 1                           | -                |
| A07: Flat 004 - Bedroom 1 (Double) | 0                                 | 0                                  | 0                           | -                |
| A07: Flat 004 - Bedroom 2 (Double) | 0                                 | 0                                  | 0                           | -                |
| A07: Flat 004 - Kitchen            | 0.7                               | 2                                  | 1                           | -                |
| A07: Flat 004 - Living Room        | 0.6                               | 2                                  | 1                           | -                |
| A07: Flat 005 - Bedroom 1 (Double) | 0                                 | 0                                  | 0                           | -                |
| A07: Flat 005 - Bedroom 2 (Double) | 0.1                               | 3                                  | 1                           | -                |
| A07: Flat 005 - Kitchen            | 0.5                               | 5                                  | 1                           | -                |
| A07: Flat 005 - Living Room        | 0.3                               | 4                                  | 1                           | -                |
| A07: Flat 008 - Bedroom 1 (Double) | 0                                 | 0                                  | 0                           | -                |
| A07: Flat 008 - Kitchen            | 0.1                               | 1                                  | 1                           | -                |
| A07: Flat 008 - Living Room        | 0                                 | 0                                  | 0                           | -                |
| A07: Flat 009 - Bedroom 1 (Double) | 0.5                               | 5                                  | 2                           | -                |
| A07: Flat 009 - Bedroom 2 (Double) | 0                                 | 1                                  | 1                           | -                |
| A07: Flat 009 - Kitchen            | 0.8                               | 5                                  | 2                           | -                |
| A07: Flat 009 - Living Room        | 1                                 | 6                                  | 2                           | -                |
| B02: Flat 011 - Bedroom 1 (Double) | 0                                 | 0                                  | 0                           | -                |
| B02: Flat 011 - Bedroom 2 (Double) | 0.4                               | 4                                  | 1                           | -                |
| B02: Flat 011 - Living Room        | 0.8                               | 6                                  | 2                           | -                |
| B02: Flat 011 -Kitchen             | 0.8                               | 6                                  | 2                           | -                |
| B03: Flat 007 - Bedroom 1 (Double) | 0                                 | 0                                  | 0                           | -                |
| B03: Flat 007 - Bedroom 2 (Double) | 0                                 | 0                                  | 0                           | -                |
| B03: Flat 007 - Kitchen            | 0.2                               | 2                                  | 1                           | -                |
| B03: Flat 007 - Living Room        | 0                                 | 0                                  | 0                           | -                |
| B04: Flat 002 - Bedroom 1 (Double) | 0                                 | 0                                  | 0                           | -                |
| B04: Flat 002 - Bedroom 2 (Double) | 0                                 | 0                                  | 0                           | -                |
| B04: Flat 002 - Living/Kitchen     | 0                                 | 0                                  | 0                           | -                |
| B04: Flat 007 - Bedroom 1 (Double) | 0                                 | 1                                  | 1                           | -                |
| B04: Flat 007 - Bedroom 2 (Double) | 0                                 | 0                                  | 0                           | -                |
| B04: Flat 007 - Ensuite            | 0                                 | 0                                  | 0                           | -                |
| B04: Flat 007 - Kitchen            | 0.2                               | 2                                  | 1                           | -                |
| B04: Flat 007 - Living Room        | 0                                 | 0                                  | 0                           | -                |
| B04: Flat 010 - Bedroom 1 (Double) | 0.1                               | 2                                  | 1                           | -                |

| DSY1 2020 High 50% Weather File |                                       |                                       |                                |                     |
|---------------------------------|---------------------------------------|---------------------------------------|--------------------------------|---------------------|
| Room Name                       | Criteria 1<br>(%Hrs Top-<br>Tmax>=1K) | Criteria 2<br>(Max. Daily<br>Deg.Hrs) | Criteria 3<br>(Max.<br>DeltaT) | Criteria<br>failing |
| B04: Flat 010 - Kitchen         | 0.5                                   | 3                                     | 2                              | -                   |
| B04: Flat 010 - Living Room     | 0.3                                   | 2                                     | 1                              | -                   |

## 11.7 Appendix G – Townhouses TM59 Results – Weather File: Manchester DSY1 2020 High 50%

### 11.7.1 Living Rooms, Kitchens and Bedrooms – Criterion 1 of TM52

Rooms are compliant with Criterion 1 if the percentage of hours is less than 3%.

| Room Name                  | Percentage of occupied hours $\Delta T \geq 1K$<br>(Criterion 1 – TM52) (%) |
|----------------------------|-----------------------------------------------------------------------------|
|                            | DSY1 2020                                                                   |
| 00: T01 Dining Kitchen     | 1.2                                                                         |
| 00: T01 Living             | 2.9                                                                         |
| 00: T07 Living/Kitchen     | 0.6                                                                         |
| 00: T10 Dining Kitchen     | 0.6                                                                         |
| 00: T10 Living             | 2.6                                                                         |
| 01: T01 Bedroom 1 (Single) | 0.6                                                                         |
| 01: T01 Bedroom 2 (Double) | 1.7                                                                         |
| 01: T07 Bedroom 1 (Double) | 0                                                                           |
| 01: T07 Bedroom 2 (Single) | 2.4                                                                         |
| 01: T10 Bedroom 1 (Single) | 0                                                                           |
| 01: T10 Bedroom 2 (Double) | 1.4                                                                         |
| 02: T01 Bedroom 1 (Double) | 0.1                                                                         |
| 02: T01 Bedroom 2 (Double) | 1.6                                                                         |
| 02: T07 Bedroom 1 (Double) | 0.1                                                                         |
| 02: T10 Bedroom 1 (Double) | 0                                                                           |
| 02: T10 Bedroom 2 (Double) | 1.3                                                                         |

### 11.7.2 Bedrooms Overheating

Bedrooms comply with TM59 if the number of hours exceeding 26°C is less than 33.

| Room Name                  | Number of hours exceeding 26°C between 22:00 and 07:00 |
|----------------------------|--------------------------------------------------------|
|                            | DSY1 2020                                              |
| 01: T01 Bedroom 1 (Single) | 4                                                      |
| 01: T01 Bedroom 2 (Double) | 20                                                     |
| 01: T07 Bedroom 1 (Double) | 4                                                      |
| 01: T07 Bedroom 2 (Single) | 15                                                     |
| 01: T10 Bedroom 1 (Single) | 1                                                      |
| 01: T10 Bedroom 2 (Double) | 19                                                     |
| 02: T01 Bedroom 1 (Double) | 4                                                      |
| 02: T01 Bedroom 2 (Double) | 21                                                     |
| 02: T07 Bedroom 1 (Double) | 16                                                     |
| 02: T10 Bedroom 1 (Double) | 4                                                      |
| 02: T10 Bedroom 2 (Double) | 18                                                     |

### 11.7.3 Corridor Overheating

Corridors comply with TM59 requirements if the percentage of hours exceeding 28°C remains below 3%.

However as there are no internal pipework gains to be modelled for blocks A, B and the townhouses, according to TM59, corridors do not have to be included in the overheating analysis and therefore they have been excluded from this report.

## 11.8 Appendix H – Townhouses TM52 Results – Weather File: Manchester DSY1 2020 High 50%

| DSY1 2020 High 50% Weather File |                                |                                 |                          |                  |
|---------------------------------|--------------------------------|---------------------------------|--------------------------|------------------|
| Room Name                       | Criteria 1 (%Hrs Top-Tmax>=1K) | Criteria 2 (Max. Daily Deg.Hrs) | Criteria 3 (Max. DeltaT) | Criteria failing |
| 00: T01 Dining Kitchen          | 1.2                            | 6                               | 2                        | -                |
| 00: T01 Living                  | 2.9                            | 18                              | 2                        | 2                |

| DSY1 2020 High 50% Weather File |                                       |                                       |                                |                     |
|---------------------------------|---------------------------------------|---------------------------------------|--------------------------------|---------------------|
| Room Name                       | Criteria 1<br>(%Hrs Top-<br>Tmax>=1K) | Criteria 2<br>(Max. Daily<br>Deg.Hrs) | Criteria<br>3 (Max.<br>DeltaT) | Criteria<br>failing |
| 00: T01 WC                      | 0                                     | 0                                     | 0                              | -                   |
| 00: T07 Living/Kitchen          | 0.6                                   | 4                                     | 1                              | -                   |
| 00: T07 WC                      | 0                                     | 0                                     | 0                              | -                   |
| 00: T10 Dining Kitchen          | 0.6                                   | 4                                     | 2                              | -                   |
| 00: T10 Living                  | 2.6                                   | 17                                    | 2                              | 2                   |
| 00: T10 WC                      | 0                                     | 0                                     | 0                              | -                   |
| 01: T01 Bathroom                | 0                                     | 0                                     | 0                              | -                   |
| 01: T01 Bedroom 1 (Single)      | 0.6                                   | 7                                     | 2                              | 2                   |
| 01: T01 Bedroom 2 (Double)      | 1.7                                   | 17                                    | 3                              | 2                   |
| 01: T07 Bathroom                | 0                                     | 0                                     | 0                              | -                   |
| 01: T07 Bedroom 1 (Double)      | 0                                     | 0                                     | 0                              | -                   |
| 01: T07 Bedroom 2 (Single)      | 2.4                                   | 22                                    | 4                              | 2                   |
| 01: T10 Bathroom                | 0                                     | 0                                     | 0                              | -                   |
| 01: T10 Bedroom 1 (Single)      | 0                                     | 0                                     | 0                              | -                   |
| 01: T10 Bedroom 2 (Double)      | 1.4                                   | 16                                    | 3                              | 2                   |
| 02: T01 Bathroom                | 0                                     | 0                                     | 0                              | -                   |
| 02: T01 Bedroom 1 (Double)      | 0.1                                   | 1                                     | 1                              | -                   |
| 02: T01 Bedroom 2 (Double)      | 1.6                                   | 17                                    | 2                              | 2                   |
| 02: T07 Bedroom 1 (Double)      | 0.1                                   | 2                                     | 1                              | -                   |
| 02: T10 Bathroom                | 0                                     | 0                                     | 0                              | -                   |
| 02: T10 Bedroom 1 (Double)      | 0                                     | 0                                     | 0                              | -                   |
| 02: T10 Bedroom 2 (Double)      | 1.3                                   | 16                                    | 3                              | 2                   |

### 11.9 Appendix I – Block A & B Communal Spaces, TM52 Results – Weather File: Manchester DSY1 2020 High 50%

| DSY1 2020 High 50% Weather File |                                       |                                       |                                |                     |
|---------------------------------|---------------------------------------|---------------------------------------|--------------------------------|---------------------|
| Room Name                       | Criteria 1<br>(%Hrs Top-<br>Tmax>=1K) | Criteria 2<br>(Max. Daily<br>Deg.Hrs) | Criteria<br>3 (Max.<br>DeltaT) | Criteria<br>failing |
| A00 - Stairs                    | 0                                     | 0                                     | 0                              | -                   |
| A01 - Stairs                    | 0                                     | 0                                     | 0                              | -                   |
| A01: Lobby 1                    | 0                                     | 0                                     | 0                              | -                   |
| A02 - Stairs                    | 0                                     | 0                                     | 0                              | -                   |

| DSY1 2020 High 50% Weather File    |                                   |                                    |                          |                  |
|------------------------------------|-----------------------------------|------------------------------------|--------------------------|------------------|
| Room Name                          | Criteria 1<br>(%Hrs Top-Tmax>=1K) | Criteria 2<br>(Max. Daily Deg.Hrs) | Criteria 3 (Max. DeltaT) | Criteria failing |
| A03 - Stairs                       | 0                                 | 0                                  | 0                        | -                |
| A04 - Stairs                       | 0                                 | 0                                  | 0                        | -                |
| A05 - Stairs                       | 0                                 | 0                                  | 0                        | -                |
| A06 - Stairs                       | 0                                 | 0                                  | 0                        | -                |
| A07 - Stairs                       | 0                                 | 0                                  | 0                        | -                |
| B00: Comms                         | 0                                 | 0                                  | 0                        | -                |
| B00: Concierge                     | 0.2                               | 3.0                                | 1.0                      | -                |
| B00: Lobby 1                       | 0                                 | 0                                  | 0                        | -                |
| B00: Lobby 2                       | 0                                 | 0                                  | 0                        | -                |
| B00: LV Switch Room                | 0                                 | 0                                  | 0                        | -                |
| B00: Management Suite              | 0.2                               | 1.0                                | 1.0                      | -                |
| B00: Management Suite WC           | 0                                 | 0                                  | 0                        | -                |
| B00: Post Room                     | 0                                 | 0                                  | 0                        | -                |
| B00: Residential Entrance          | 0.7                               | 3.0                                | 1.0                      | -                |
| B00: Residents Amenity 1 (Larger)  | 0                                 | 0                                  | 0                        | -                |
| B00: Residents Amenity 2 (Smaller) | 2.4                               | 17.0                               | 2.0                      | 2                |
| B00: Secondary Entrance            | 0.9                               | 4.0                                | 1.0                      | -                |
| B00: Stairs 1                      | 0                                 | 0                                  | 0                        | -                |
| B00: Stairs 2                      | 0                                 | 0                                  | 0                        | -                |
| B01: Stairs 1                      | 0                                 | 0                                  | 0                        | -                |
| B01: Stairs 2                      | 0                                 | 0                                  | 0                        | -                |
| B01: Stairs 2                      | 0                                 | 0                                  | 0                        | -                |
| B02: Stairs 1                      | 0                                 | 0                                  | 0                        | -                |
| B03: Stairs 1                      | 0                                 | 0                                  | 0                        | -                |
| B03: Stairs 2                      | 0                                 | 0                                  | 0                        | -                |
| B04: Stairs 1                      | 0                                 | 0                                  | 0                        | -                |
| B04: Stairs 2                      | 0                                 | 0                                  | 0                        | -                |

## 11.10 Appendix J – Additional design modifications

Additional changes were made to the model in consultation with the architects to improve daylighting and overheating results. Details of these changes are presented below.

### 11.10.1 BLOCKS A & B:

- I. Extend vision panels to 300mm x 1800mm

This change has been modelled for the following room within the sample:

1. A00: Flat 007 - Living/Kitchen

The room was found to achieve the thermal comfort requirements.

### 11.10.2 BLOCK A:

- I. Rearrangement of FLAT 007 (1B2P) from Level 02 upwards

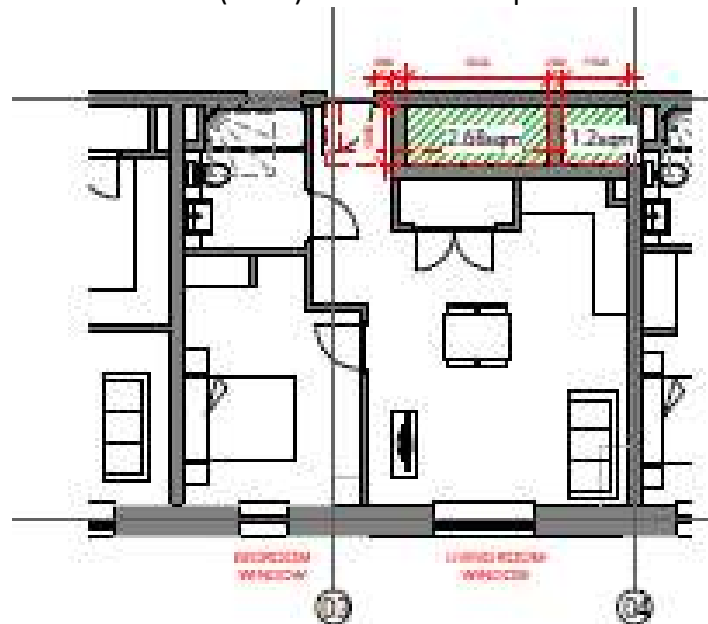


Figure 11.10.2.1 A02-A07 Flat 007 plan

### 11.10.3 BLOCK B:

- II. TYPE-A1-1B2P can have the coat cupboard reinstated at the front door – Flats 01 and 03.

- III. TYPE-C1/2-2B4P needs a minor change to the wall position in front of the entrance door as dimensioned in Figure 11.4.3.1Figure 11.10.3.1Error! Reference source not found. (where the storage cupboard was removed, the wall should be pushed approximately 250mm towards entrance door wall).

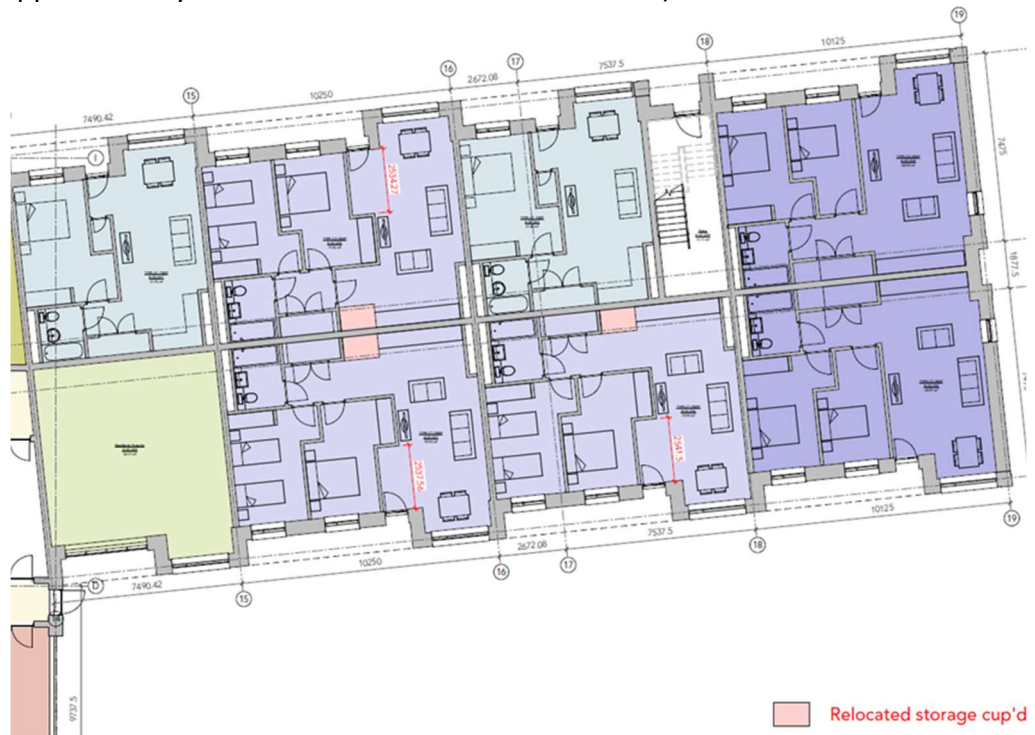


Figure 11.10.3.1 Block B ground floor changes

- IV. B02-B04 Flat 002 Bedroom 01 Window Panel changed to 1810x2350 mm as shown in Figure 11.10.3.2 and Figure 11.10.3.3.

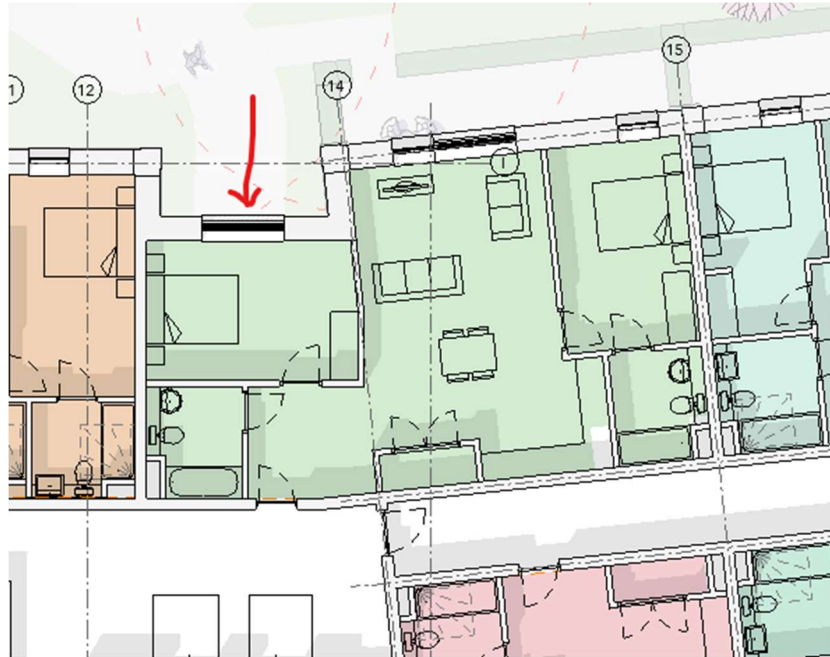


Figure 11.10.3.2 Plan of Block B Flat 002 Bedroom window position



Figure 11.10.3.3 Elevation changes to windows from Level 2 to Level 4 Flat 002  
Bedroom 01, Block B north façade

## **11.11 Appendix K – 3D Modelling & Level 2 AVO Assessment (Sandy Brown)**



**Swindon Office**  
Berkeley House  
Hunts Rise  
Swindon SN3 4TG

**Bristol Office**  
1st Floor, Queens Quay  
33-35 Queen Square  
Bristol, BS1 4LU

**Plymouth Office**  
4 Oakland Mews  
Liskeard  
PL14 3UX